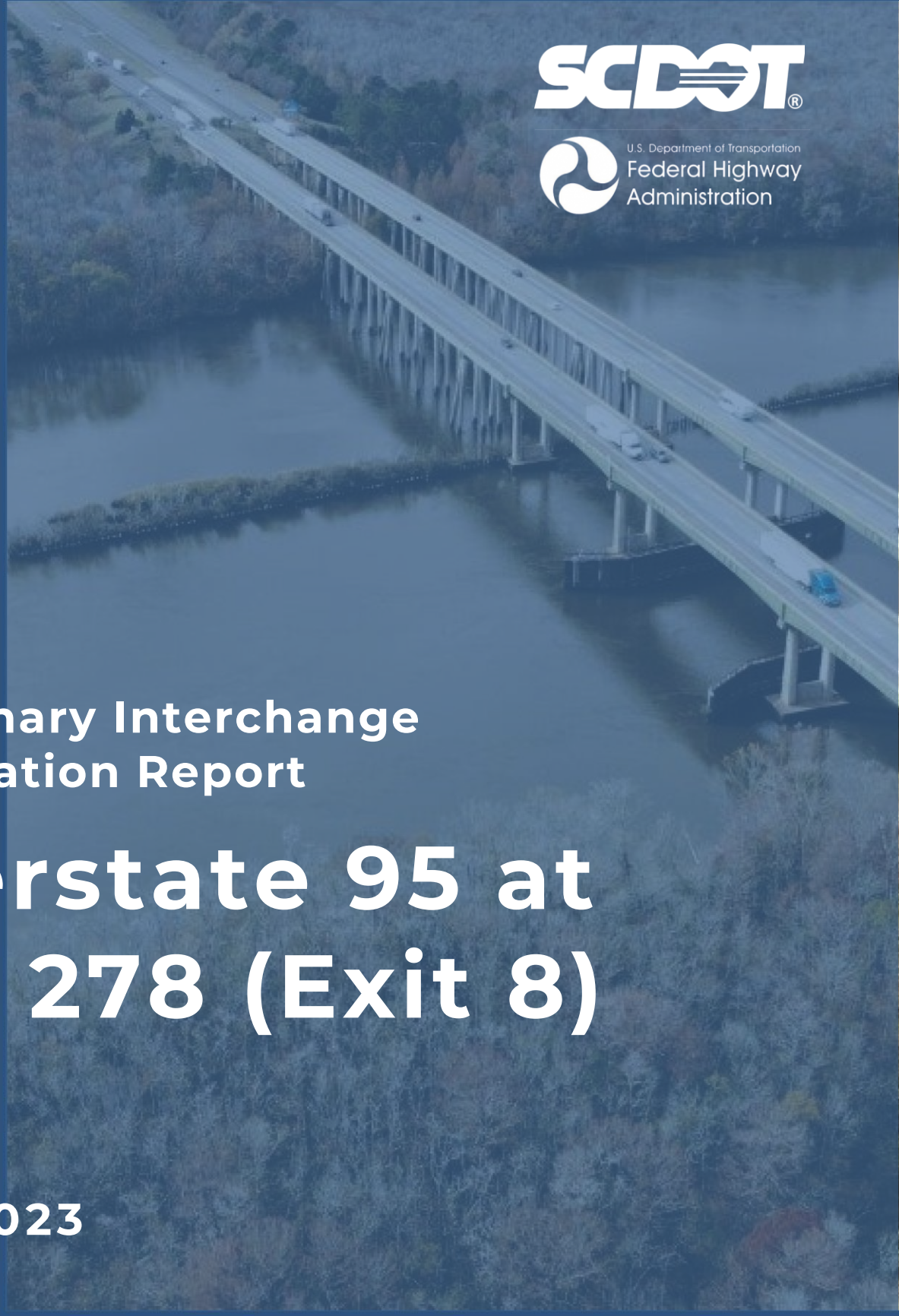


SCDOT IMR Report
I-95 Bagshaw Swamp Final Seimic Summary Report
I-95 Bagshaw Swamp Final Bridge Hydraulic Report Signed
BGER I-95 BRO Bagshaw Swamp Rev1 10/14/2021



SCDOT

U.S. Department of Transportation
Federal Highway Administration

Preliminary Interchange Modification Report

Interstate 95 at U.S. 278 (Exit 8)

April 2023

I-95 WIDENING
Savannah River to US 278

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EXECUTIVE SUMMARY

The South Carolina Department of Transportation (SCDOT) proposes to widen I-95 from the state line at MM 0 to approximately MM 9, north of Exit 8 (U.S. 278) in Jasper County, South Carolina. The purpose of the project is to improve capacity, mobility, and operations in the corridor and address operational deficiencies at interchanges. This Preliminary Interchange Modification Report (PIMR) presents the traffic operations and safety analyses performed for the proposed modification of the I-95 at U.S. 278 diamond interchange (Exit 8). This modification will also affect adjacent surface street intersections, so recommendations for improvements to those intersections is included.

Crash analysis of the study area shows that the crash rate and rate of fatalities in the interstate corridor for the most recent three years is lower than the statewide average. Crashes for the surface street segment and intersections appear high at some locations, but the study segments are relatively short. Single-vehicle collisions and rear-end collisions were the major crash types in the I-95 corridor. Angle crashes were the primary manner of collision on U.S. 278. The number of crashes on the interchange ramps was low. Recommendations for safety improvements include pavement, geometric, and control modifications to keep vehicles on the roadway, provide space for safe recovery, and reduce crash severity.

Capacity analysis of Exit 8 indicates that existing interchange intersection conditions will degrade to unacceptable levels by 2030 under projected volumes, potentially impacting the operation of I-95 by 2050. The adjacent intersections are also expected to deteriorate. Six alternatives were evaluated, including improvements to the adjacent surface street intersections to support interchange operations. It is recommended that the 6-lane DDI alternative be pursued as the preferred alternative at Exit 8. The following improvements are also recommended:

- Signalization of the U.S. 17 intersection, coordinated with the interchange
- Widen U.S. 278 to six lanes east of the northbound ramps intersection
- Relocate the Henry Moss Boulevard/Medical Center Drive intersection east of its existing location and include
  - a dual left-turn lane and single right-turn storage lane for the eastbound U.S. 278 approach
  - single right-turn storage lane for the westbound approach
  - a left, through, and right-turn lane for each side street approach, with storage
  - a roundabout intersection connecting the existing Brickyard Road north of the relocated Henry Moss Boulevard/Medical Center Drive intersection with the southbound approach to U.S. 278
  - signal coordination with the interchange
- Relocate driveway openings on U.S. 278 west of the southbound intersection to new connections on U.S. 17

- Consolidate and relocate driveway openings on U.S. 278 between the northbound intersection and Henry Moss Boulevard/Medical Center Drive to the new Henry Moss Boulevard/Medical Center Drive intersection

1. INTRODUCTION

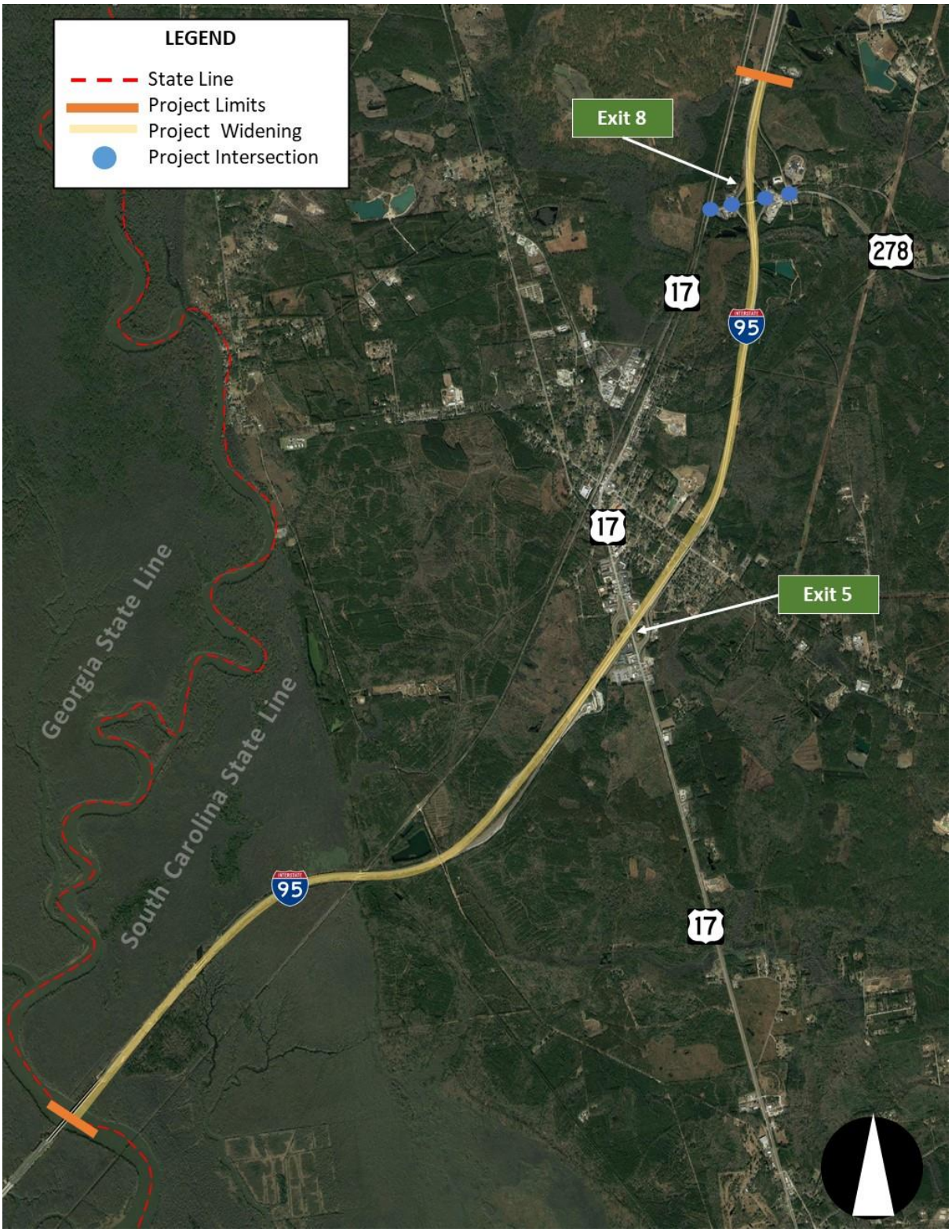
1.0 Project Background

The South Carolina Department of Transportation (SCDOT) proposes improvements to the I-95 corridor from mile marker 0 at the Georgia-South Carolina border to mile marker 9, just north of Exit 8. The primary improvement is to widen the interstate to a total of 6 lanes to increase capacity and improve operations. Estimated future traffic volumes are expected to degrade the service conditions at Exit 8. Alternative interchange designs were analyzed at Exit 8 to mitigate these effects, in conjunction with analysis of the adjacent U.S. 278 intersections.

1.1 Study Area

The project is located in Jasper County, South Carolina, around the City of Hardeeville. The study area stretches 9 miles from the Georgia-South Carolina border to just north of Exit 8 on I-95, encompassing intersections in, and adjacent to, Exit 8. I-95 is a north-south Interstate on the east coast that extends from the United States – Canada border in the north to Miami, Florida in the south. In the study area, I-95 is classified as a rural principal arterial interstate that provides connectivity for local surface street traffic, regional traffic for Georgia and South Carolina, and interstate traffic along the east coast. The extents of the study area are shown in **Figure 1**.

Figure 1: Study Area Location Map



Source: Google Earth Pro Image, 03/2022, Project Study Area

1.2 Purpose and Need

The purpose of the proposed transportation project is to improve capacity, mobility, and operations along the 9-mile corridor of I-95 and to address operational deficiencies for interchanges and bridges within the study corridor. An alternative would successfully reduce congestion if it would decrease travel delays within the corridor compared to the 2050 No Build condition during peak traffic hours.

1.3 Existing Roadway Conditions

1.3.1 Study Corridors

I-95

Within the study area, I-95 is a 4-lane divided rural interstate with a speed limit of 70 mph. The approximately 9-mile segment has 12 ft. lanes in each direction. The vertical grade can reach up to 3%, but these grades do not exceed a half-mile in length in any segment. The following interchanges are present within the study area limits:

- Exit 5 – U.S. 17
- Exit 8 – U.S. 278

U.S. 278

U.S. 278 is classified as a rural principal arterial with a posted speed of 45 mph. The four-lane divided roadway extends from U.S. 17 to east of I-95 at Henry Moss Boulevard/Medical Center Drive within the project area. It has a two way left turn lane median that provides access to both sides of the road. There are multiple accesses for gas, food, and lodging. U.S. 278 has a signalized intersection at the I-95 south ramps and at Henry Moss Boulevard/Medical Center Drive.

U.S. 17

Classified as a rural principal arterial with a posted speed limit of 55 mph, U.S. 17 is located west of I-95 and intersects with the interstate at Exit 5. Within the project area U.S. 17 is a two-lane undivided highway from north of Garr Lane to U.S. 278, and a four-lane highway at the interchange at Exit 5. There is storage capacity for the left turn on-ramp lanes at Exit 5. At the U.S. 278 and U.S. 17 intersection, traffic is controlled by a stop sign on U.S. 278 while the north and south approaches remain free. The southbound U.S. 17 approach has a dedicated left turn lane that yields to oncoming northbound traffic. U.S. 17 provides access to food, gas, and lodging areas at the Exit 5 interchange.

1.3.2 Study Interchanges

Exit 5

The Exit 5 interchange is a partial cloverleaf interchange with a single-lane loop off-ramp in the southeast quadrant carrying traffic from I-95 northbound to U.S. 17 and a

single-lane loop off-ramp in the northwest quadrant carrying traffic from I-95 Southbound to U.S. 17. Each intersection is unsignalized. While this interchange is not expected to be modified as part of this project, it is included in this analysis as it is the next full access interchange along I-95 adjacent to Exit 8. The Exit 5 Interchange is shown in **Figure 2**.

Figure 2: Exit 5 Interchange

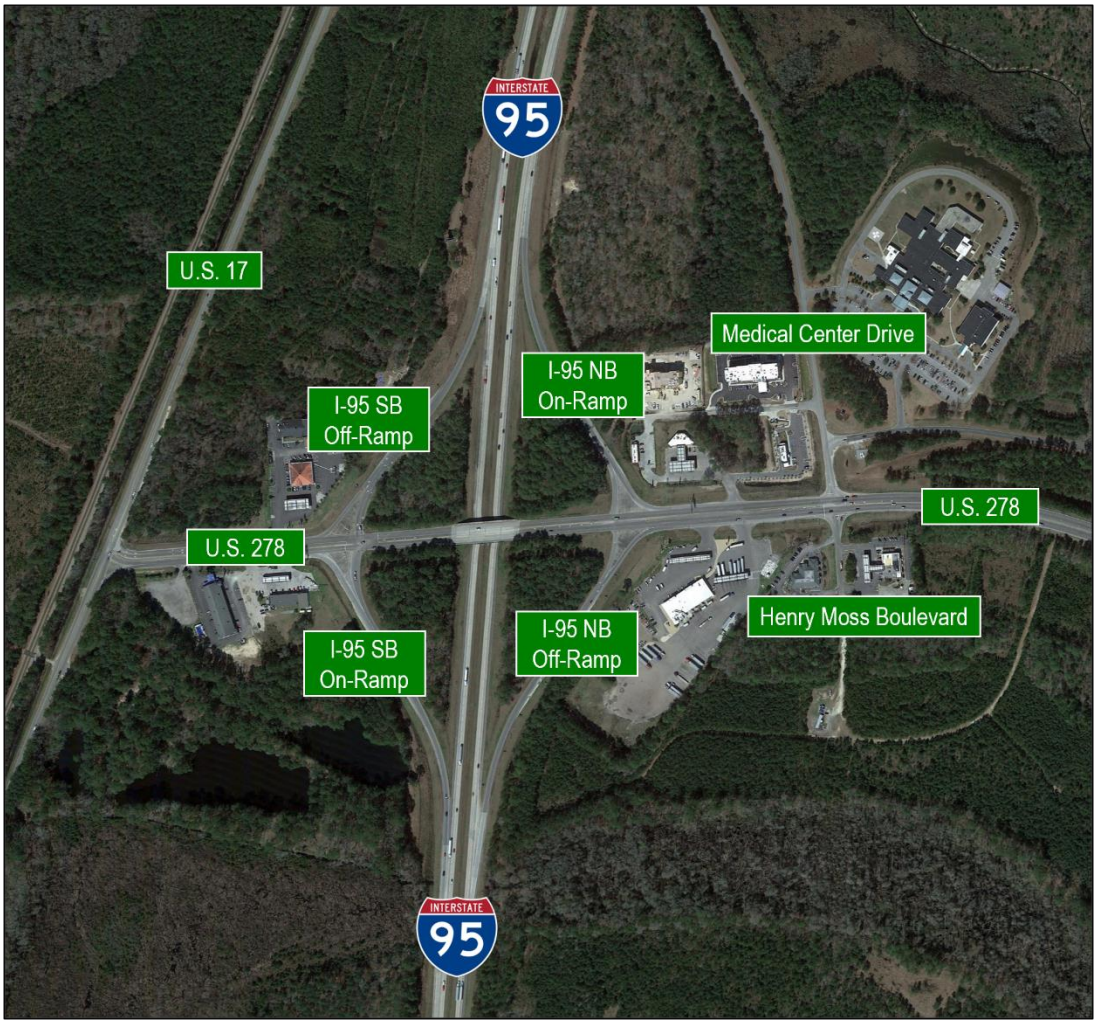


Exit 8

The Exit 8 interchange is a diamond interchange providing access to U.S. 278 with a bridge over I-95. The southbound off-ramp is a signalized intersection with a dual left turn lane and a yield controlled, channelized right turn. The westbound U.S. 278 approach has a left turn lane, and the eastbound approach has a yield controlled right turn lane that merges in the on-ramp. The northbound ramps intersection is unsignalized. Separate entrance lanes merge into the single-lane on-ramp, and the single-lane off-ramp splits into separate right and thru-left movements at the intersection. The northbound off-ramp right turn lane is yield controlled, but it continues to the downstream intersection, becoming a right turn only lane. Storage is provided for the U.S. 278 eastbound left and westbound right turn movements. There are lodging

areas, fast food and gas stations located east and west of the interchange. U.S. 278 at U.S. 17 is the nearest intersection to the west and U.S. 278 at Henry Moss Boulevard/Medical Center Drive is the nearest intersection to the east. The Exit 8 Interchange is shown in **Figure 3**.

Figure 3: Exit 8 Interchange



1.3.3 Adjacent Interchanges

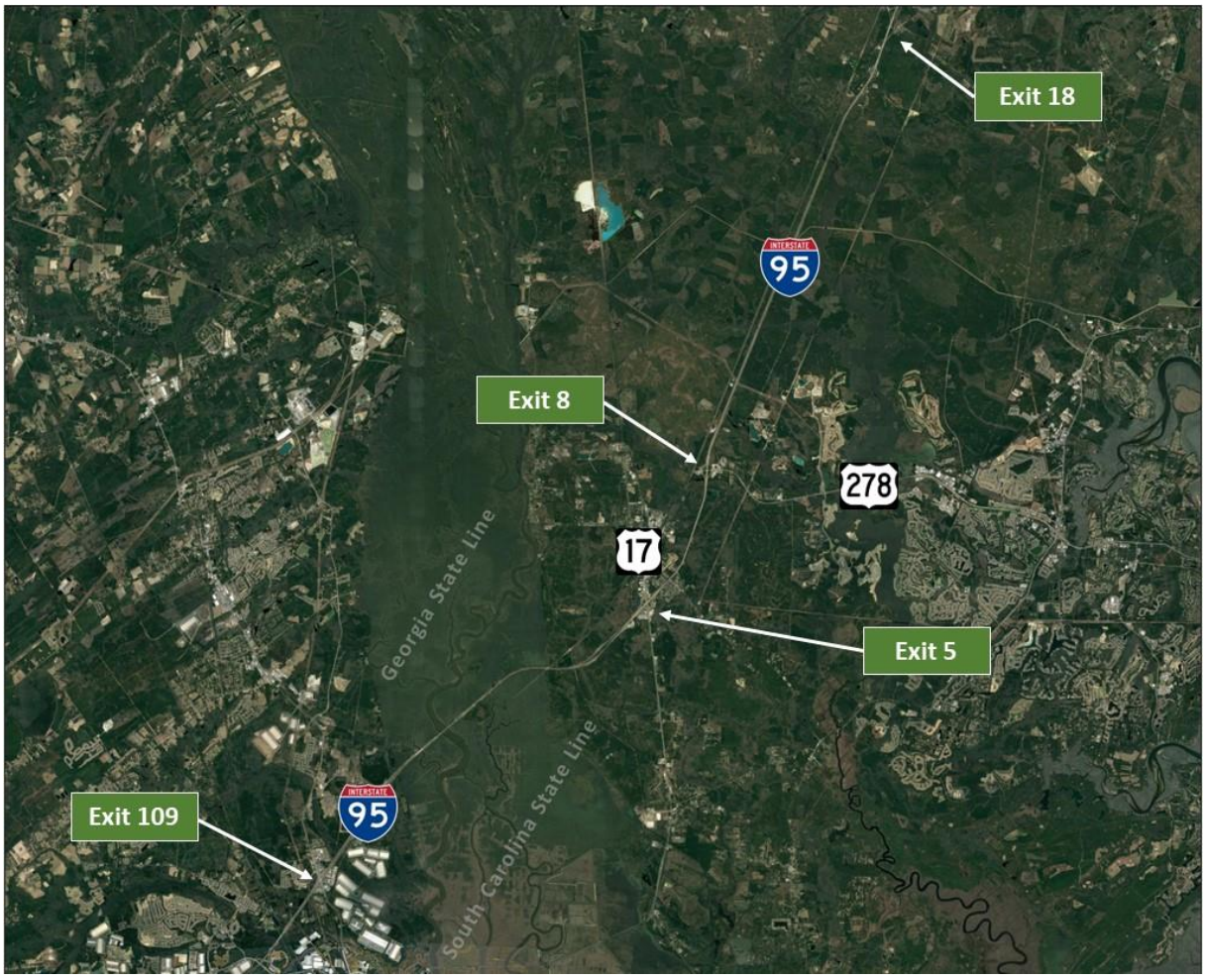
Exit 18

Exit 18 is located approximately ten miles north of the Exit 8 interchange. Exit 18 is a flyover interchange with a partial cloverleaf in the southeast quadrant, carrying vehicles on and off I-95 to and from U.S. 17 and Bees Creek Road. Due to the distance separating the Exit 18 interchange from the study area, it was determined that this interchange does not have the ability to reasonably serve U.S. 278, removing it from consideration as a viable alternative**.** Hence, it was excluded from further capacity and level of service analysis. **Figure 4** shows the location of the Exit 18 interchange relative to the study area.

Georgia Exit 109

Georgia Exit 109 is located approximately 12 miles south of Exit 8 in Georgia. Due to the distance separating Exit 109 from the study area as well as the lack of alternative river crossings, it was determined that this interchange does not have the ability to reasonably serve U.S. 278 volumes, removing it from consideration as a viable alternative. **Figure 4** shows the location of the Exit 109 interchange relative to the study area.

Figure 4: Adjacent Interchange Location Map



1.4 Proposed Design Years

The I-95 widening project study's analysis years were developed using the South Carolina Roadway Design Manual (SCRDM) guidelines. The SCRDM recommends a design year 20 years after the date of the completion of the project's plans, specifications and estimates package. The final plans for the I-95 widening project are anticipated to be completed in February of 2024, with a construction letting in December of 2024 and projected completion in 2028. For this project, the anticipated

opening year was shifted to 2030 to be conservative, which results in a design year of 2050. These years were also used for interchange analysis.

2. CRASH ANALYSIS

A safety analysis of crashes from January 2017 to December 2019 was conducted for the project study area from the Georgia State Line to Exit 8 with crash data provided by the South Carolina Department of Public Safety (SCDPS). Crashes were identified by geographic coordinates and by mile point; some of the latitude and longitude for the crashes with I-95 mile points were mapped in GIS outside of the corridor. These points were removed from the crash maps due to lack of reliable location identifiers but were included in the crash tallies with the assumption that the corridor was correct. The following sections discuss segment and intersection crashes by location, type, and severity.

2.1 Statewide Crash and Fatality Rates

In South Carolina, the statewide crash average for rural principal arterials/interstates is 0.66 crashes per million vehicle miles traveled. The five-year statewide average crash fatality rate in South Carolina is 1.84 deaths per 100 million vehicle miles traveled.

Crash rates for this study were calculated using the following equations:

Segment Crash Rate Calculations

$$MVM = \frac{AADT \times segment\ length \times 365 \times number\ of\ years}{1{,}000{,}000}$$

$$\text{Segment Crash Rate} = \frac{\text{Number of Crashes in the } n \text{ Year Period}}{\text{MVM for the } n \text{ Year Period}}$$

Source: FHWA

Intersection Crash Rate Calculations

$$MEV = \frac{TEV\ per\ day \times 365 \times number\ of\ years}{1{,}000{,}000}$$

$$\text{Intersection Crash Rate} = \frac{\text{Number of Crashes in the } n \text{ Year Period}}{\text{MEV for the } n \text{ Year Period}}$$

Source: FHWA

The 3-year fatality rate for this study area was calculated to be 0.4 deaths per 100 million vehicle miles traveled. No fatalities occurred at or in the vicinity of Exit 8. The crash rate for the interstate study segment was found to be lower than the statewide average (0.4 versus 1.84). Crash rates for local road segments appear high but were for

short segments. Calculations are provided in **Appendix A**. Recommendations for safety improvements are provided at the end of this section. The calculated rates are provided below in **Table 1**.

Table 1: Calculated Study Crash Rates

Study Segment	Crashes/MVM
I-95 from MM 0-9	0.35
U.S. 278 from Milepoint 32.25 to 32.6	3.56
Study Intersection	**Crashes/MEV**
U.S. 278 at I-95 SB Ramps	1.25

2.2 I-95 Crashes

Table 2 summarizes I-95 crash severity types by year. Of the 388 crashes, 79% were property damage only crashes. The four fatal crashes are detailed at the end of this section. The data shows that most crashes occurred in 2018. In 2017, there were 28 injury collisions resulting in 43 injuries. In 2018, there were 27 injury collisions resulting in 41 injuries. In 2019, there were 23 injury collisions resulting in 51 injuries.

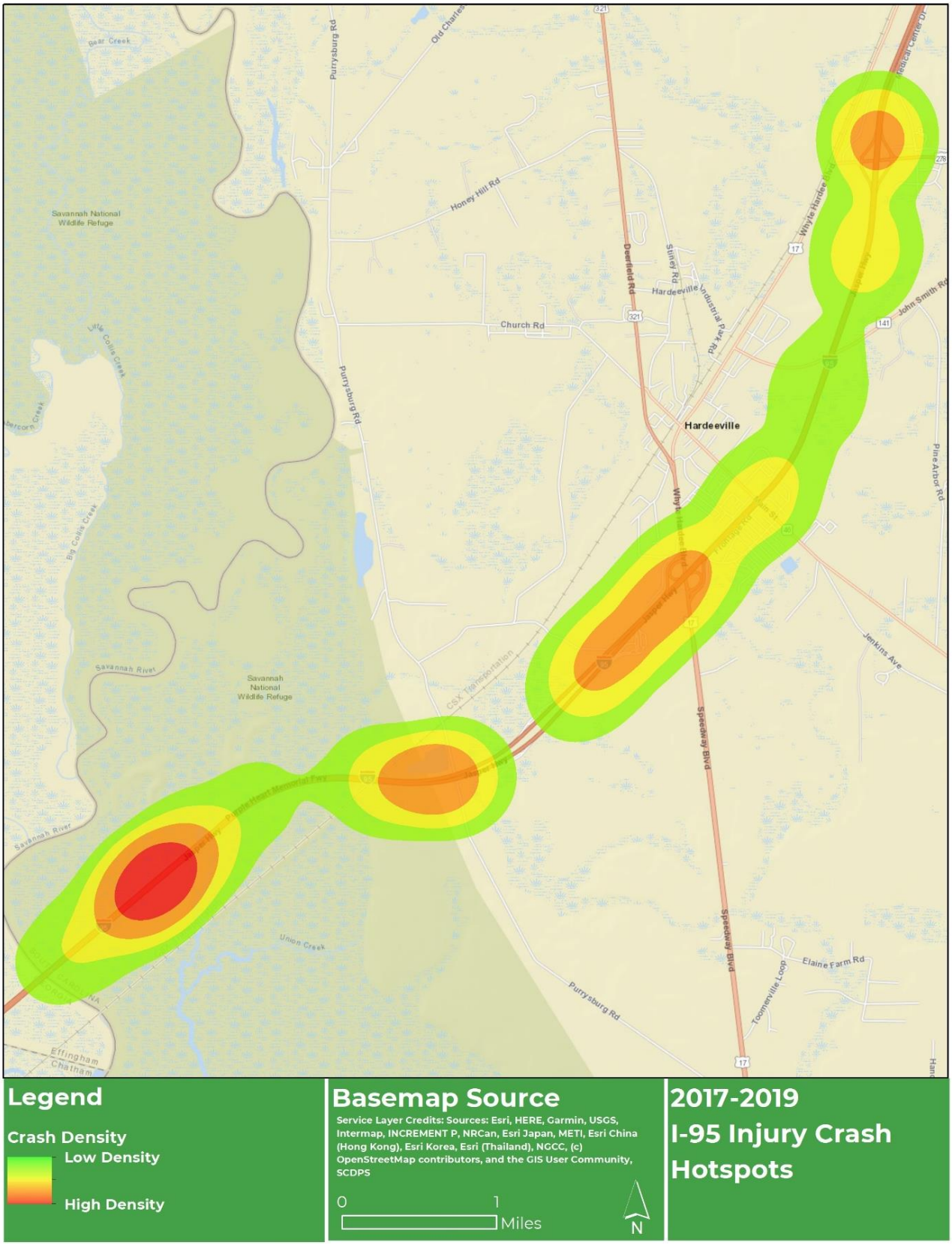
Table 2. I-95 Crash Severity by Year

Year	Fatal	Injury	PDO	Total
2017	1	28	106	134
2018	3	27	112	141
2019	0	23	90	113
Total	**4**	**78**	**308**	**388**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Figure 5 shows the geographic hotspots of injury crashes on I-95. The densest concentration of injury crashes occurred near the Georgia-South Carolina border. Other dense concentrations of injury crashes occurred near Purrysburg Road, south of Exit 5, and north of Exit 8.

Figure 5: Injury Crash Hotspots Within I-95 Study Segment



The table below summarizes the crash data by manner of collision from 2017 to 2019. Of the 388 crashes, 49% were rear-end collisions, with not collisions with motor vehicles being the second highest type of collision (114).

Of the 191 rear-end collisions, 40% had a probable cause of driving too fast for conditions, the probable cause of 19 were distracted/inattentive, and 73 were followed too closely. The other 21 rear-end collisions had miscellaneous probable causes such as aggressive operation of vehicle, brakes, failure to yield right of way, improper lane usage/change, etc.

The probable causes of the 114 not collisions with motor vehicles were due to a variety of circumstances including 36 of which were driving too fast for conditions, 13 were ran off the road, 8 were due to debris, 8 were due to tires/wheel, 7 were due to fatigued/asleep, and 6 were due to animal in the road. The other 36 not collisions with motor vehicles were due to miscellaneous probable causes such as brakes, cargo, cell phone, distracted/inattentive, followed too closely, etc.

Table 3. I-95 Manner of Collision by Year

Year	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
2017	5	1	1	40	73	14	134
2018	17	2	0	41	63	18	141
2019	16	0	0	33	55	9	113
Total	**38**	**3**	**1**	**114**	**191**	**41**	**388**

Source: SC Department of Public Safety Crash Reports, 2017-2019

The table below summarizes manner of collision by severity. Rear-end property damage only crashes were the most common type of crashes (146) on I-95. Property damage only crashes classified as "Not Collision with Motor Vehicle" were the second most common type of crash (86). Forty-five of the injury crashes on I-95 were rear-end crashes. Two of the four fatal crashes on I-95 were not collisions with motor vehicles.

Of the 45 rear-end injury crashes, the probable cause of 22 were driving too fast for conditions, 16 were followed too closely, 3 were distracted/inattentive, 2 were made an improper turn, 1 was improper lane usage/change, and 1 was under the influence.

Of the 26 "Not Collision with Motor Vehicle" injury crashes, 30% had a probable cause of driving too fast for conditions. Driver behavior was the largest contributing factor in the injury crashes including ran off the road, fatigued/asleep, distracted/inattentive, improper lane usage/change, under the influence, and over-correcting/over-steering. Mechanical failures such as tires/wheels also contributed to injury crashes.

Table 4. I-95 Manner of Collision by Severity

Severity	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
PDO	35	3	0	86	146	37	307
Injury	2	0	0	26	45	4	77
Fatal	1	0	1	2	0	0	4
Total	**38**	**3**	**1**	**114**	**191**	**41**	**388**

Source: SC Department of Public Safety Crash Reports, 2017-2019

The table below summarizes severity by road surface condition. Of the 388 crashes, 237 were property damage only crashes in dry conditions. Sixty-six injury crashes occurred in dry conditions. Four fatal crashes also occurred in dry conditions.

Table 5. I-95 Severity Road Surface Condition

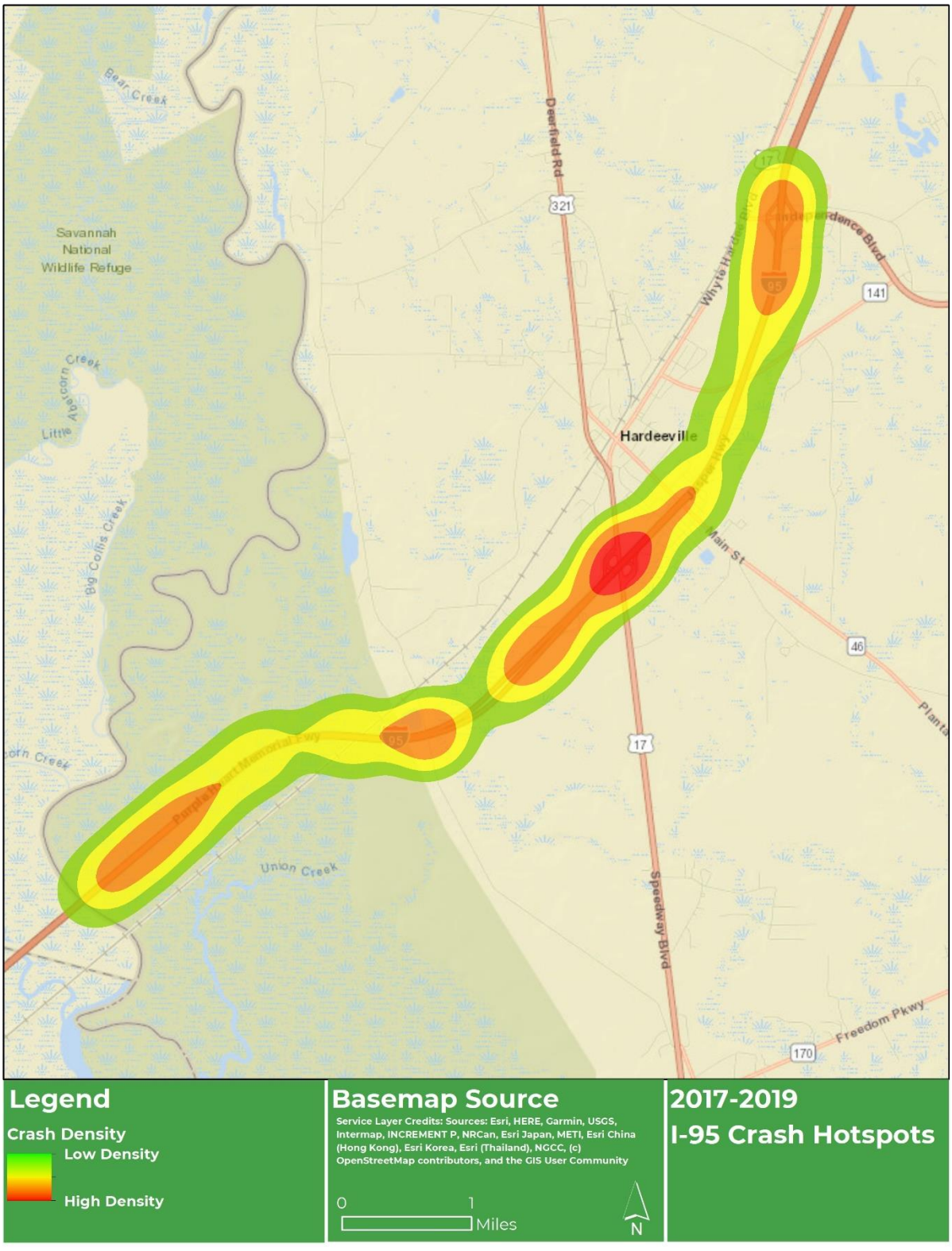
Road Surface Condition	Fatal	Injury	PDO	Total
Dry	4	66	237	307
Wet	0	12	61	73
Other (Standing Water; Ice)	0	0	8	8
Total	**4**	**78**	**306**	**388**

Source: SC Department of Public Safety Crash Reports, 2017-2019

2.2.1 Crash Hotspots on I-95

Of the 550 collisions occurring in the project area from 2017 to 2019, 354 (64%) occurred on I-95. The largest crash hotspot in that period was near the Exit 5 interchange. The second largest crash hotspot was on a 0.75 mile stretch south of the Exit 8 interchange. Smaller hotspots appear approximately 1 mile south of the Exit 5 interchange, near the Georgia-South Carolina border, and near Purrysburg Road. Figure 6 shows the crash hotspots from 2017 to 2019.

Figure 6. 2017-2019 Crash Hotspots



2.2.2 I-95 Fatal Crashes

In 2017, there was one fatal crash on I-95 resulting in two fatalities and one injury. The crash occurred on Saturday, August 19th heading south near the South Carolina visitors center and was a head-on collision with the probable cause being wrong side or wrong way. The first harmful event was motor vehicle in transport. The road surface condition was dry, and the lighting was daylight.

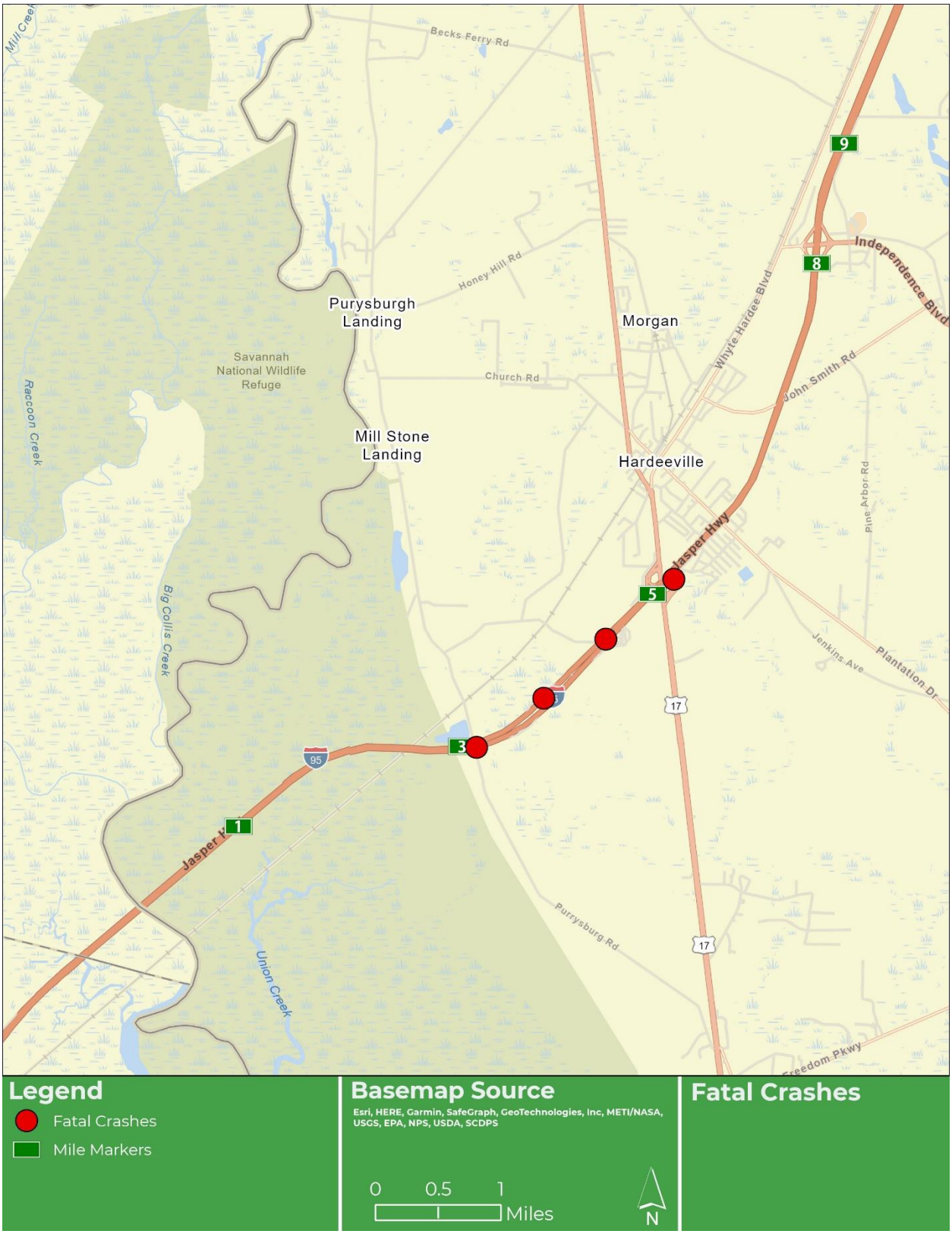
In 2018, there were three separate fatal crashes on I-95 resulting in a total of three fatalities. One crash occurred on Sunday, June 3rd and occurred headed southbound near the I-95 southbound truck stop near Mile Marker 4 and was not a collision with a motor vehicle with the probable cause being under the influence. The first harmful event was a fixed object such as post, pole, support, etc. The road surface condition was dry, and the lighting was dark with no lights. This crash resulted in one fatality and no injuries.

The second crash occurred on Wednesday, August 8th, headed north near Mile Marker 3, and was an angle crash with the probable cause being failure to yield right-of-way. More information regarding the details of this angle crash were unavailable to explain a crash type that typically does not occur on interstates. The first harmful event was motor vehicle in transport. The road surface condition was dry, and the lighting was dark with no lights. This crash resulted in one fatality and no injuries.

The third crash occurred on Tuesday, December 18th, headed north near the Exit 5 interchange, and was not a collision with a motor vehicle with the probable cause being distracted/inattentive. The first harmful event was a tree. The road surface condition was dry, and the lighting was daylight. and This crash resulted in one fatality and two injuries.

Figure 7 shows the location of the four fatal crashes on I-95.

Figure 7: Fatal Crashes Within I-95 Study Segment



2.3 Ramp Crashes

Between 2017 and 2019, there were five crashes that occurred on the Exit 8 ramps. None of these crashes resulted in a fatality. One Exit 8 ramp resulted in an injury.

The tables below summarize the crash severity types by year. All crashes listed as occurring on the Exit 8 ramps are tallied in these tables except for four crashes that occurred within the U.S. 278 intersection area at Exit 8.

Of the five crashes at the Exit 8 ramps from 2017 to 2019, four were property damage only crashes. One crash on the I-95 northbound on-ramp in 2019 resulted in one injury. The probable cause of the crash was distracted/inattentive. The table below summarizes the crash severity at the Exit 8 ramps.

Table 6. Exit 8 Ramps Crash Severity by Year

Year	Fatal	Injury	PDO	Total
2017	0	0	1	1
2018	0	0	2	2
2019	0	1	1	2
Total	**0**	**1**	**4**	**5**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Table 7 summarizes the crash data by manner of collision from 2017 to 2019 for Exit 8. Three of the five collisions were rear-end collisions.

Table 7. Exit 8 Ramps Manner of Collision by Year

Year	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
2017	0	0	0	0	1	0	1
2018	1	0	0	1	0	0	2
2019	0	0	0	0	2	0	2
Total	**1**	**0**	**0**	**1**	**3**	**0**	**5**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Table 8 summarizes manner of collision by severity for the Exit 8 ramps. The majority were rear-end crashes.

Table 8. Exit 8 Ramps Manner of Collision by Severity

Severity	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
PDO	1	0	0	1	2	0	4
Injury	0	0	0	0	1	0	1

Severity	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
Fatal	0	0	0	0	0	0	0
Total	**1**	**0**	**0**	**1**	**3**	**0**	**5**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Table 9 summarizes severity by road surface condition on the Exit 8 ramps. Four of the five crashes were property damage only crashes in dry conditions. The single injury crash on the I-95 northbound on-ramp occurred in dry conditions.

Table 9. Exit 8 Ramps Severity by Road Surface Condition

Road Surface Condition	Fatal	Injury	PDO	Total
Dry	0	1	4	5
Wet	0	0	0	0
Other (Standing Water; Ice)	0	0	0	0
Total	**0**	**1**	**4**	**5**

Source: SC Department of Public Safety Crash Reports, 2017-2019

2.4 U.S. 278 Crashes

2.4.1 U.S. 278 Segment

The crashes analyzed in this section of U.S 278 span from the Americas Best Value Inn driveway to the Exxon station driveway, excluding crashes in the signalized intersection area of the U.S. 278 at I-95 southbound intersection. Between 2017 and 2019, there were 41 crashes on U.S. 278. No fatalities or injuries occurred on this segment. No fatalities and 14 injury crashes occurred on U.S. 278 during this time.

Table 10 summarizes the crash severity types by year from 2017 to 2019 on U.S. 278. Of the 41 crashes, 66% were property damage only and 34% were injury crashes. The number and type of crashes were consistent across the three-year period.

Table 10. U.S. 278 Crash Severity by Year

Year	Fatal	Injury	PDO	Total
2017	0	5	10	15
2018	0	4	9	13
2019	0	5	8	13
Total	**0**	**14**	**27**	**41**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Of the 41 crashes that occurred in this area from 2017 to 2019, 66% were angle crashes. Two head-on crashes occurred.

Table 11. U.S. 278 Manner of Collision by Year

Year	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
2017	10	0	1	0	3	1	15
2018	9	0	0	0	2	2	13
2019	8	0	1	0	2	2	13
Total	**27**	**0**	**2**	**0**	**7**	**5**	**41**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Table 12 summarizes manner of collision by severity. Of the 41 crashes, 37% were property damage only angle crashes and 29% were injury crashes.

Of the 12 injury angle crashes, 83% had a probable cause of failure to yield right-of-way. Driver behavior was the largest contributing factor in the injury crashes, including aggressive driving, speeding, and disregarding signs and signals.

Table 12. U.S. 278 Manner of Collision by Severity

Severity	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
PDO	15	0	1	0	6	5	27
Injury	12	0	1	0	1	0	14
Fatal	0	0	0	0	0	0	0
Total	**27**	**0**	**2**	**0**	**7**	**5**	**41**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Table 13 summarizes the crash data by severity by road surface condition. Of the 41 crashes, 85% crashes occurred in dry road surface conditions with 23 property damage only crashes and 12 injury crashes. Two injury crashes occurred in wet road surface conditions.

Table 13. U.S. 278 Severity by Road Surface Condition

Road Surface Condition	Fatal	Injury	PDO	Total
Dry	0	12	23	35
Wet	0	2	4	6
Other (Standing Water; Ice)	0	0	0	0
Total	**0**	**14**	**27**	**41**

Source: SC Department of Public Safety Crash Reports, 2017-2019

2.4.2 U.S. 278/I-95 Southbound Intersection

The intersection of U.S. 278 with the I-95 southbound ramps includes a segment of U.S. 278 (from Mile Point 32.341 to 32.39) and parts of Ramps 8656 and 8657 that are included in this signalized intersection. Twelve crashes occurred at this intersection between 2017 and 2019.

Table 14 summarizes the crash severity types by year from 2017 to 2019. Twelve crashes occurred at this intersection from 2017 to 2019. Five crashes occurred in 2018 and were primarily property damage only crashes. Four injury crashes occurred from 2017-2019.

Table 14. Southbound Ramps Intersection Crash Severity by Year

Year	Fatal	Injury	PDO	Total
2017	0	2	2	4
2018	0	1	4	5
2019	0	1	2	3
Total	**0**	**4**	**8**	**12**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Two injury crashes occurred in 2017, one of which resulted in seven injuries and the other resulted in one injury. The probable cause of the crash that resulted in seven injuries was aggressive operation of a vehicle. The probable cause of the crash that resulted in one injury was disregarded signs and signals.

The injury crash that occurred in 2018 resulted in one injury. The probable cause of this crash was failure to yield right-of-way.

The one injury crash that occurred in 2019 resulted in three injuries. The probable cause of this crash was followed too closely.

Of the 12 crashes that occurred in this area from 2017 to 2019, eight were angle crashes. Four of the 12 crashes at this intersection were rear-end crashes.

Table 15. U.S. 278/I-95 Southbound Intersection Manner of Collision by Year

Year	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
2017	3	0	0	0	1	0	4
2018	3	0	0	0	2	0	5
2019	2	0	0	0	1	0	3
Total	**8**	**0**	**0**	**0**	**4**	**0**	**12**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Table 16 summarizes the crash data by manner of collision by severity. Five of the 12 crashes at this intersection were property damage only angle crashes. There were three angle crashes resulting in nine injuries and one rear-end crash resulting in three injuries. One of the angle crashes resulted in seven injuries. Half of the crashes occurred in approximately the middle of the intersection.

The three angle crashes that resulted in injuries had probable causes of aggressive operation of vehicle, failure to yield right-of-way, and disregarded signs and signals. The probable cause of the rear-end crash was followed too closely.

Table 16. U.S. 278/I-95 Southbound Intersection Manner of Collision by Severity

Severity	Angle	Backed Into	Head-On	Not Collision with Motor Vehicle	Rear-End	Sideswipe	Total
PDO	5	0	0	0	3	0	8
Injury	3	0	0	0	1	0	4
Fatal	0	0	0	0	0	0	0
Total	**8**	**0**	**0**	**0**	**4**	**0**	**12**

Source: SC Department of Public Safety Crash Reports, 2017-2019

Table 17 summarizes the crash data by severity by road surface condition. Seven of the 12 crashes at this intersection occurred in dry conditions and were property damage only crashes. One crash occurred in wet conditions and was a property damage only crash. Four crashes occurred in dry conditions and resulted in 12 injuries.

Table 17. U.S. 278/I-95 Southbound Intersection Severity by Road Condition

Road Surface Condition	Fatal	Injury	PDO	Total
Dry	0	4	7	11
Wet	0	0	1	1
Other (Standing Water; Ice)	0	0	0	0
Total	**0**	**4**	**8**	**12**

Source: SC Department of Public Safety Crash Reports, 2017-2019US 278 Segment (U.S. 278/I-95 Southbound Intersection to Exxon Station)

2.5 Safety Recommendations

FHWA's Proven Safety Countermeasures (PSC) are improvements that can be implemented to keep vehicles on the roadway, supply space for safe recovery, and reduce crash severity. This guide was consulted for the recommendations below.

Single-vehicle collisions, rear-end collisions, angle collisions, and sideswipes were common crash types in the I-95 corridor. Single-vehicle collisions classified as "Not Collision with Motor Vehicle" were a common type of collision on I-95, accounting for 29% of crash crashes, half of the fatal collisions, and 33% of the injury collisions. This type of crash is often the result of roadway departures and may include collisions with objects such as trees or guardrails. Potential countermeasures for reducing roadway departures include:

- Increasing pavement friction
- Implementation of rumble strips and stripes
- Speed-feedback signing
- Installing median barriers
- Evaluating horizontal curve safety
- Improving nighttime visibility
- Increasing clear zones
- Flattening side slopes

Rumble strips are currently installed on I-95 in the project corridor. It is recommended that additional clear zones and flattening side slopes be implemented with the future improvements on I-95 in the project corridor.

Rear-end collisions were another common type of collision on I-95. Rear-end collisions are typically the result of congestion on the roadway, following too closely, and driving too fast for conditions. Of the 388 crashes in the I-95 corridor, 49% were rear-end collisions. There were no fatal rear-end crashes in the I-95 corridor between 2017 and 2019, but 58% of the injury crashes were rear-end crashes. Potential countermeasures that may reduce rear-end collisions include:

- Improving pavement friction
- Increasing the number of lanes
- Increasing the length of acceleration/deceleration lanes
- Installing dynamic collision warning signs

All of the above countermeasures are recommended to be implemented with future improvements on the I-95 project corridor. The proposed improvements on I-95 will include the addition of lanes to ease congestion in the corridor.

Angle crashes were the primary manner of collisions on U.S. 278 at the I-95 ramp intersections and business driveways. Signalizing intersections, where appropriate, may reduce the number of angle crashes by allowing turning vehicles right-of-way.

3. STUDY VOLUMES

The development of traffic volumes used in this study relied on four sources of information:

- Interstate and highway volumes from SCDOT's Traffic Monitoring Program and GIS resources
- Interstate and surface street volumes collected for this project
- Local and statewide travel demand models
- Projected development volumes

Volume collection data is provided in **Appendix B**.

Two proposed developments impact Exit 8, which are incorporated into the volume development sheets provided in Appendix B. The Riverport development is planned as a mixture of uses located south of the existing Exit 5 interchange. It straddles I-95 between the Savannah River and U.S. 17 and consists of the following land uses: industrial park, shopping center, single-family detached housing, and hotel. The information for this development is derived from a previous study of the estimated traffic associated with the proposed Riverport development, prepared by Stantec in 2021. The study evaluated proposed developments and determined trips generated by those developments using locally collected and approved information. This development is expected to double existing daily traffic volumes on I-95 by 2046. The proposed daily volumes are shown below.

Table 18: 2025 Riverport Development Trip Generation Estimates

Land Use	ITE LUC	Scale	Unit	Weekday PM Peak Hour	
				Enter	Exit
Industrial Park	130	3,934	KSF	331	1,243
Single-Family Detached Housing	210	1,060	DU	1,497	1,621
Hotel	310	250	Rooms	82	79
Shopping Center	820	700	KSF	415	243
			Gross Trips:	2,325	3,186
			- Internal Capture:	- 327	- 327
			- Pass-by Capture Trips:	- 37	- 37
			New, External Trips:	**1,961**	**2,822**

Source: Stantec, 2021

Table 19: 2046 Riverport Development Trip Generation Estimates

Land Use	ITE LUC	Scale	Unit	Weekday PM Peak Hour	
				Enter	Exit
Industrial Park	130	10,632	KSF	893	3,360
Single-Family Detached Housing	210	2,650	DU	2,948	3,194
Hotel	310	250	Rooms	82	79
Shopping Center	820	3,773	KSF	2,088	1,227
			Gross Trips:	6,011	7,860
			- Internal Capture:	- 1,112	- 1,112
			- Pass-by Capture Trips:	- 37	- 37
			New, External Trips:	**4,862**	**6,711**

Source: Stantec, 2021

The distribution of these trips on I-95 as estimated to be 35% to and from the north and 35% to and from the south of Exit 5.

The I-95 Logistics Center development is planned as an industrial warehouse located southwest of the Exit 8 interchange along U.S. 17. According to the *I-95 Logistics Center Traffic Impact Analysis* submitted in January 2022, the development is expected to generate 337 AM and 340 PM peak hour trips by 2026. Development traffic volumes were added to this project's network according to the study's proposed distribution at Exit 8 and the adjacent surface streets. The traffic impact study is provided for reference in Appendix B.

Three primary sources of information were reviewed to develop traffic volumes associated with background growth in the study area: historical AADT volumes provided by SCDOT, the South Carolina Statewide Model Version 4 (SCSWMV4), and the Lowcountry Regional Model. Travel demand models for the state and coastal region of Georgia were also reviewed and are discussed below. The following sections discuss the analysis of each of these sources to determine an appropriate traffic growth rate for the study area.

3.3.1 Historical AADT Analysis

Historical volumes recorded at SCDOT continuous and short-term count stations were reviewed to evaluate traffic growth trends over the period of 2009-2019. The count stations are:

- Station 0028: I-95 (from the South Carolina/Georgia State Line to US 17)

- Station 105: US 17 (from Deerfield Road to I-95)
- Station 103: US 17 (from I-95 to Lime House Road)
- Station 293: US 278 (from US 17 to I-95)
- Station 0067: US 278 (from I-95 to Argent Boulevard)

Table 20 provides the traffic count history for these stations and their associated linear growth rates.

Table 20: SCDOT Historical AADT Volumes and Resulting Growth Rates

Year	I-95 Station 0028	US 17 (North of I-95) Station 105	US 17 (South of I-95) Station 103	US 278 (West of I-95) Station 293	US 278 (East of I-95) Station 0067
2009	47,700	9,900	11,000	5,200	22,400
2010	48,400	10,200	9,300	4,400	22,400
2011	47,500	9,500	8,500	4,200	23,000
2012	47,700	9,700	9,000	4,400	23,400
2013	47,800	10,200	12,300	4,500	24,000
2014	50,700	10,600	12,000	4,800	25,000
2015	53,700	10,900	11,600	5,500	27,000
2016	56,700	11,200	11,900	5,600	29,800
2017	55,300	11,500	12,300	5,700	29,800
2018	57,000	12,400	13,300	6,200	29,700
2019	59,100	10,100	12,200	4,100	30,000
2009 to 2019 Growth Rate	**2.17%**	**0.18%**	**0.99%**	**-1.92%**	**3.08%**

The segments show a range of rates. The next section evaluates these segments through travel demand models.

3.3.2 Travel Demand Model Analysis

The following sections document the use of travel demand model data to establish appropriate growth rates for the I-95 corridor. Traffic volumes were extracted from the SCSWMv4 and LRM to establish growth rates for the study area. In addition, traffic volumes from the CORE MPO Travel Demand Model and the GSTDMv1.1 were used as a reasonableness check for model forecasted volumes on I-95 crossing the state border between South Carolina and Georgia.

South Carolina Statewide Model Version 4 (SCSWMV4)

The SCSWMv4 includes the entirety of South Carolina and is built upon existing TDMs from MPOs and Council of Governments (COG) within the state. It has a base year of 2015 and a forecast year of 2045, and it includes existing roadways as well as committed projects, including all planned and programmed improvements in the state that are set to open to traffic from 2016 to 2045. However, the proposed Riverport development project was not included in the 2045 existing plus committed highway network, which is why trip generation estimates are used separately. Projects are

typically only included in travel demand models when they have funding; however, these projects were incorporated into this study to maintain consistency with local planning efforts.

The analysis performed for this study used TransCAD Version 6 Release 2 (TC6r2). For the purposes of this analysis, the SCSWMv4 was not re-estimated or re-calibrated for the project study area. The model's forecast volumes for 2015 were compared with 2015 SCDOT AADT volumes as a reasonableness check. **Table 21** shows this comparison and summarizes the 2015 and 2045 forecast traffic volumes from the SCSWMv4 along with associated linear growth rates at selected segments on I-95 and surface streets in the study area.

Table 21: SCSWMv4 Analysis Summary

Roadway	Segment	2015 SCDOT AADT	2015 SCSWM Volume Estimate	Deviation	2045 SCSWM Volume Estimate	Annual Growth Rate (%)
I-95 SB	GA State Line to US 17 (Whyte Hardee Blvd)	28,350	28,350	0.00%	41,500	1.50%
I-95 NB	GA State Line to US 17 (Whyte Hardee Blvd)	28,350	28,350	0.00%	41,500	1.50%
US 17 S (Whyte Hardee Blvd)	S- 34 (Lime House Rd) to I- 95 (Jasper Hwy)	11,600	17,457	50.49%	28,806	2.10%
US 17 N (Whyte Hardee Blvd)	I- 95 (Jasper Hwy) to US 321 (Deerfield Rd)	10,900	8,325	-23.62%	21,224	5.00%
I-95 NB	US 17 (Whyte Hardee Blvd) to US 278 (Independence Blvd)	27,350	30,648	12.06%	42,074	1.20%
I-95 SB	US 17 (Whyte Hardee Blvd) to US 278 (Independence Blvd)	27,350	31,106	13.73%	42,270	1.16%
US 278 E (Independence Blvd)	I- 95 (Jasper Hwy) to S-442 (Argent Blvd)	27,000	34,104	26.31%	45,182	1.05%
US 278 W (Independence Blvd)	US 17 (Kato Bay Rd) to I-95 (Jasper Hwy)	5,500	5,483	-0.31%	11,106	3.31%
I-95 NB	I-95 NB Before Exit 8	24,800	25,686	3.57%	35,594	1.24%
I-95 SB	I-95 SB Before Exit 8	24,800	25,573	1.24%	35,049	1.20%

The SCSWMv4 model-estimated volumes for 2015 are reasonably close to the 2015 SCDOT AADT volumes except for the shaded segments. When evaluating growth rates, the SCDOT AADT was given preference. These modified growth rates are also shaded in the recommendation section.

Lowcountry Regional Model (LRM)

The Lowcountry Council of Governments (LCOG) is the MPO responsible for transportation planning for the municipalities of Beaufort, Port Royal, Hardeeville, Hilton Head, Bluffton and partners with Beaufort and Jasper counties in this effort. The latest update of the LRM has a base year of 2019, two interim years of 2030 and 2040 and a final forecast year of 2045. The 2045 forecast year includes all existing roadways and committed projects programmed for completion by the year 2045, including: the US 17 widening in the southern study area and I-95 widening from the GA state line to mile marker 33. The proposed Riverport development project was not included in the 2045 existing plus committed highway network because it is not a committed project, which is why trip generation estimates are used separately. Projects are typically only included in travel demand models when they have funding; however, these projects were incorporated into this study to maintain consistency with local planning efforts.

The analysis performed for this study used TransCAD 8 (Build 22440) and TransCAD 9 (Build 32665). For the purposes of this analysis, the LRM was not re-estimated or re-calibrated for the project study area. The model's forecast volumes for 2019 were compared with 2019 SCDOT AADT volumes as a reasonableness check. **Table 22** shows this comparison and summarizes the 2019 and 2045 forecast traffic volumes from the LRM along with associated linear growth rates at selected segments on I-95 and surface streets in the study area.

Table 22: LRM Analysis Summary

Roadway	Segment	2019 AADT	2019 LRM Volume Estimate	Deviation	2045 LRM Volume Estimate	Annual Growth Rate (%)
I-95 SB	GA State Line to US 17 (Whyte Hardee Blvd)	29,550	29,491	-0.20%	40,926	1.44%
I-95 NB	GA State Line to US 17 (Whyte Hardee Blvd)	29,550	29,490	-0.20%	40,926	1.44%
US 17 S (Whyte Hardee Blvd)	S- 34 (Lime House Rd) to I- 95 (Jasper Hwy)	10,100	8,028	-20.51%	10,849	1.30%
US 17 N (Whyte Hardee Blvd)	I- 95 (Jasper Hwy) to US 321 (Deerfield Rd)	12,200	12,693	4.04%	20,314	2.22%
I-95 NB	US 17 (Whyte Hardee Blvd) to US 278 (Independence Blvd)	31,350	27,796	-11.34%	42,758	1.99%
I-95 SB	US 17 (Whyte Hardee Blvd) to US 278 (Independence Blvd)	31,350	28,294	-9.75%	43,401	1.98%
US 278 E (Independence Blvd)	I- 95 (Jasper Hwy) to S- 442 (Argent Blvd)	30,000	24,022	-19.93%	36,630	1.94%
US 278 W (Independence Blvd)	US 17 (Kato Bay Rd) to I- 95 (Jasper Hwy)	4,100	8,127	98.22%	7,096	-0.47%
I-95 NB	I-95 NB Before Exit 8	27,692	27,015	-2.44%	41,604	2.00%
I-95 SB	I-95 SB Before Exit 8	28,396	27,040	-4.77%	40,677	1.87%

The model-estimated volumes for 2019 are reasonably close to the 2019 SCDOT AADT volumes except for the shaded segments. When evaluating growth rates, the SCDOT AADT was given preference. These modified growth rates are also shaded in the recommendation section.

CORE MPO and GSTDMv1.1

As a reasonableness check, the estimated volumes from both the CORE MPO model and the GSTDMV1.1 were compared to those from the LRM and the SCSWMv4. This was done to validate the volumes on I-95 segments across the South Carolina - Georgia border. The CORE MPO is in the greater Savannah area and includes all of Chatham County in Georgia and a portion of Bryan and Effingham counties. The CORE MPO is the custodian of the CORE MPO TDM, which is a four step TDM with a base year of 2015 and a forecast year of 2045. This TDM covers the counties of Chatham, Bryan, and Effingham. The GSTDMV1.1 is the TDM for the State of Georgia. It is a national model

with higher network density within the state that thins out as it goes out of state, focusing on interstate travel in areas outside the state. Its national network covers the entirety of the US to better capture external travel outside the state. It has a base year of 2015 and a forecast year of 2050.

Table 23 and **Table 24** summarize the Georgia models' volume comparison of the South Carolina I-95 segments for base and forecast years.

Table 23: Comparison of 2015 Model Forecasted Volumes by State

Segment	2015 SCSWM	2015 CORE MPO TDM	2015 GSTDM	SCSWM vs. CORE MPO TDM	SCSWM vs. GSTDM
I-95 SB from GA State Line to US 17 (Whyte Hardee Blvd)	28,350	27,602	21,555	-2.64%	-23.97%
I-95 NB from GA State Line to US 17 (Whyte Hardee Blvd)	28,350	27,610	23,276	-2.61%	-17.90%

Table 24: Comparison of Future Year Model Forecasted Volumes by State

Segment	2045 SCSWM	2045 LRM	2045 CORE MPO TDM	2050 GSTDM	SCSWM vs. CORE MPO TDM	SCSWM vs. GSTDM	LRM vs. CORE MPO TDM	LRM vs. GSTDM
I-95 SB from GA State Line to US 17 (Whyte Hardee Blvd)	41,500	40,926	49,316	29,276	18.83%	-29.46%	20.50%	-28.47%
I-95 NB from GA State Line to US 17 (Whyte Hardee Blvd)	41,500	40,926	49,326	31,805	18.86%	-23.36%	20.53%	-22.29%

Table 23 shows that the SCSWMv4 has a higher estimated base year volume than either Georgia model but is closer to the CORE MPO model. Table 24 shows that, in the future, the CORE MPO estimates more growth than the SCSWMv4 or LRM, while the GSTDMV1.1 estimates much lower growth. It must be noted that I-95 segment is not an external link in the GSTDMV1.1, and national models like the GSTDMV1.1 tend to be better at estimating in-state links compared to national network ones.

Using the base and future volumes shown in the previous tables results in a 2.54% linear annual growth rate for the CORE MPO TDM and a 1.02% linear annual growth rate for the GSTDMV1.1. These rates were used in the estimation of an appropriate growth rate for the I-95 corridor, but based on the previous analysis, were considered outliers.

3.3.3 Recommended Growth Rates

The estimated growth rates from the sources discussed in the previous sections are combined and presented for the three study corridors in **Table 25**, **Table 26**, and **Table 27**.

Table 25 presents a summary of the annual linear growth rates for I-95 presented in Sections 3.3.1 through 0. The rates presented for the statewide and Lowcountry models represent the average of the three I-95 segments.

Table 25: I-95 Annual Growth Rate Summary

Source	Growth Rate
SCDOT Historical Counts ('09-'19)	2.17%
SC Statewide Model (avg.) ('15-'45)	1.30%
LRM Model (avg.) ('19-'45)	1.79%
GA Statewide Model	1.02%
Coastal Region MPO (GA)	2.54%
Average	1.76%
Recommendation	***2%***

The historical counts reflect a higher rate than the South Carolina travel demand models, but over a shorter period of time. The South Carolina travel demand models predict roughly similar growth trends, while the Georgia travel demand models differ by 1.5 percentage points. Considering all sources equally gives an average growth rate of 1.76%. For this study, more weight was given to the LRM and historical rates. Comparing these two sources, a 2% annual linear growth rate was determined to be an appropriate conservative linear growth rate and was applied to the interstate and ramp volumes.

Table 26 summarizes the annual linear growth rates for U.S. 17 presented in Sections 3.3.1 and 3.3.2.

Table 26: US 17 Annual Growth Rate Summary

Source	Growth Rates	
	North of I-95	South of I-95
SCDOT Historical Counts ('09-'19)	0.18%	0.99%
SC Statewide Model ('15-'45)	3.16%	4.94%
LRM Model ('19-'45)	0.27%	2.22%
Average	1.20%	2.72%
Recommendation	***1%***	***2%***

Evaluating the LRM vs. the historical rates and considering the averages, the appropriate conservative linear growth rates were determined to be 1% for the north side of I-95 and 2% for the south side of I-95.

Table 27 summarizes the annual linear growth rates for US 278 presented in Sections 3.3.1 and 3.3.2.

Table 27: US 278 Annual Growth Rate Summary

Source	Growth Rate	
	West of I-95	East of I-95
SCDOT Historical Counts ('09-'19)	-1.92%	3.08%
SC Statewide Model ('15-'45)	3.40%	2.24%
LRM Model ('19-'45)	2.71%	0.82%
Average	1.40%	2.05%
Recommendation	***1%***	***2%***

Evaluating the LRM vs. the historical rates and considering the averages, the appropriate conservative linear growth rates were determined to be 1% for the west side of I-95 and 2% for the east side of I-95.

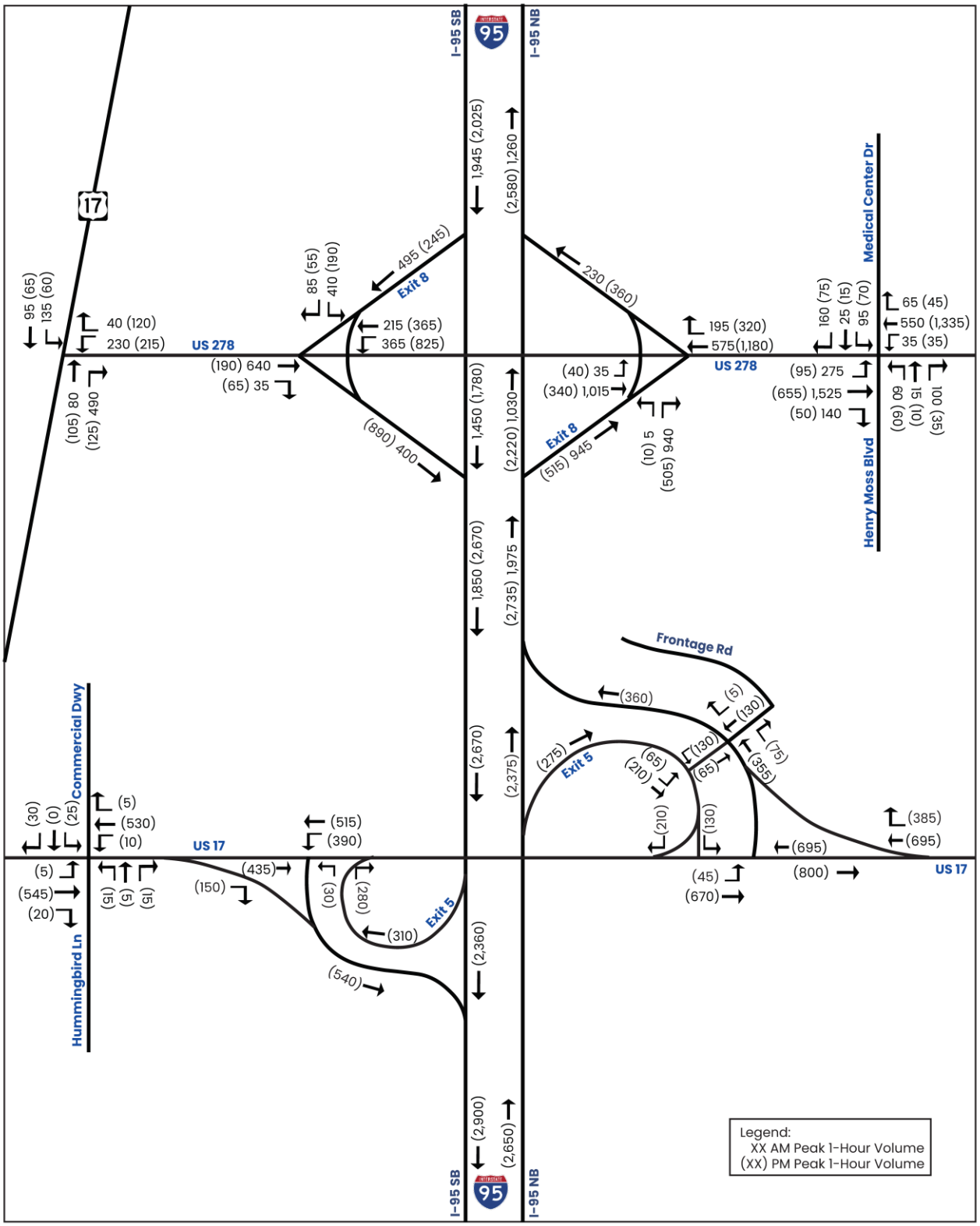
Below is a summary of the recommended rates for open- and design-year background traffic based on the analysis presented above:

- I-95 ..... 2%
- Ramp volumes traveling north or west of I-95..... 1%
- Ramp volumes traveling south or east of I-95..... 2%
- Surface street vehicles travelling from north or west of I-95 1%
- Surface street vehicles travelling from south or east of I-95 2%

3.3.4 Estimated Volumes

Figure 8 shows the balanced and rounded 2022 Base Year volumes derived from the collected 2021 data. **Figure 9** and **Figure 10** show the estimated 2030 Opening Year and 2050 Design Year volumes, which are a combination of the Base Year traffic grown at the determined annual growth rates and the direct application of estimated new development traffic. Volume development sheets are provided in Appendix B.

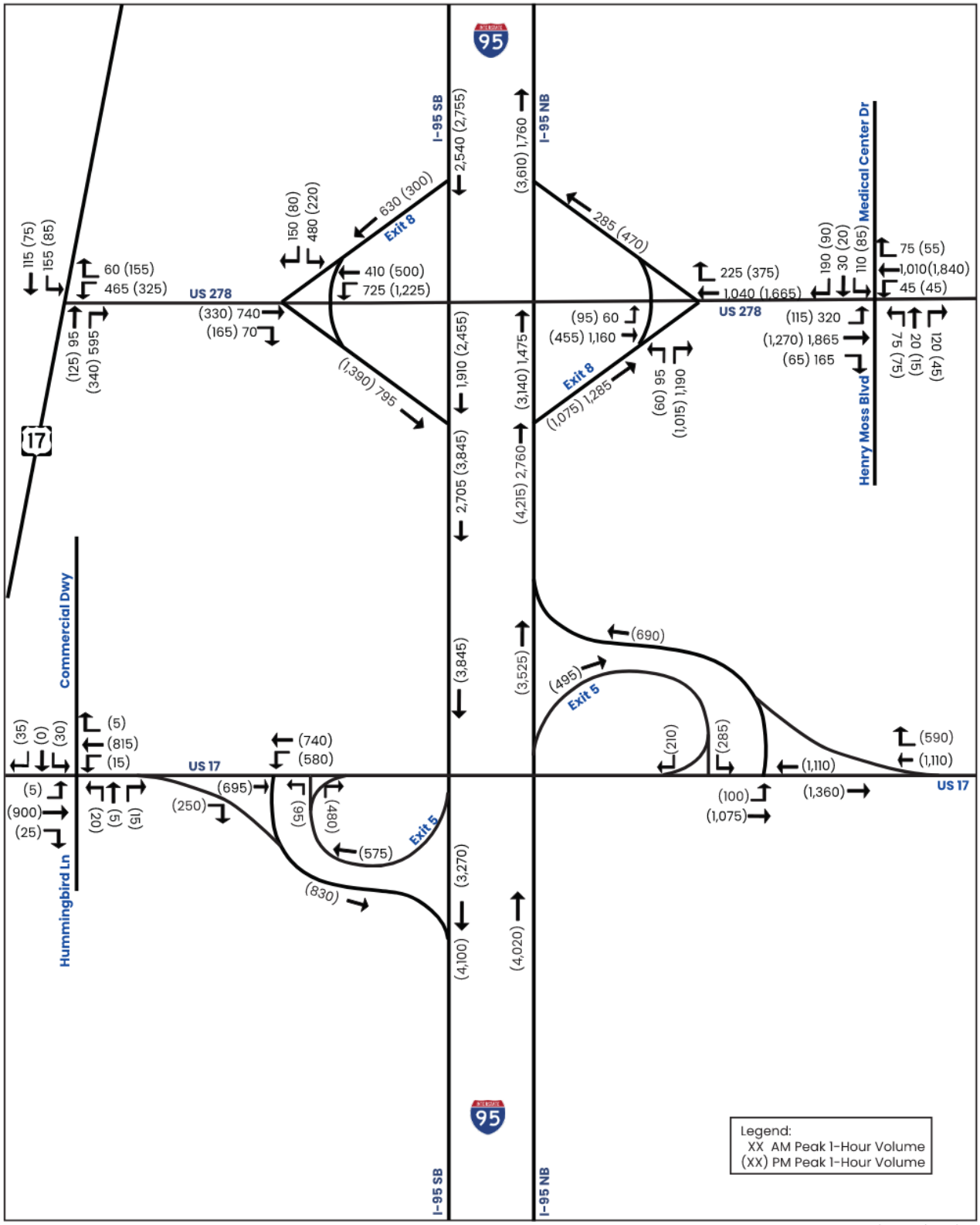
Figure 8: 2022 Design Hour Traffic Volumes



South Carolina Department of Transportation

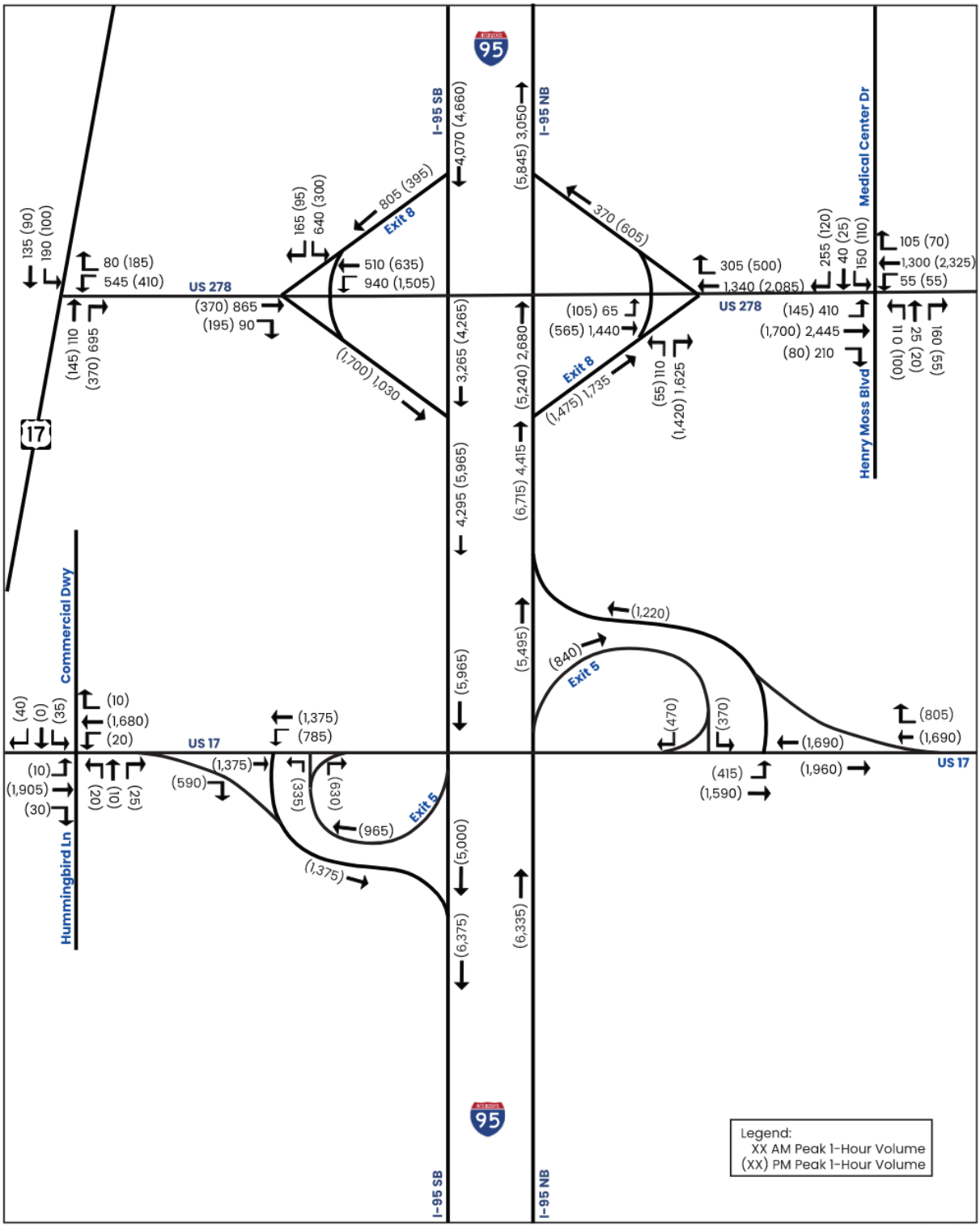
I-95 Corridor Widening
2022 Peak Hour Traffic Volumes

Figure 9: 2030 Design Hour Traffic Volumes



I-95 Corridor Widening
2030 Peak Hour Traffic Volumes

Figure 10: 2050 Design Hour Traffic Volumes



4. OPERATIONAL AND CAPACITY ANALYSIS

4.1 Analysis Methodology

Traffic modeling software used in the capacity analyses process were Trafficware Synchro 11 (Version 11.1.2.9) and PTV Vissim (Version 2020 -14). Synchro was used only for initial signal timing optimization.

Intersection performance can be measured by density in delay and the ratio of demand flow rate to capacity (v/c). Each of these measures is an indication of how well traffic is accommodated by the intersection. The LOS measure used in this analysis is delay and the following sections outline LOS criteria for unsignalized and signalized intersections. Typically, LOS C is considered the minimum threshold for acceptable LOS.

The LOS for unsignalized intersections is based on the average control delay in seconds per vehicle. **Table 28** shows the HCM LOS criteria for unsignalized intersections.

Table 28: HCM Unsignalized Intersection LOS Criteria

LOS	Control Delay (s/veh)
A	< 10
B	>10 and <15
C	>15 and <25
D	>25 and <35
E	>35 and <50
F	> 50

The LOS for signalized intersections is based on the average control delay in seconds per vehicle. LOS can be identified for the entire intersection, individual intersection approaches, and each movement/lane-group. **Table 29** shows the HCM LOS criteria for signalized intersections.

Table 29: HCM Signalized Intersection LOS Criteria

LOS	Control Delay (s/veh)
A	≤ 10
B	>10 and <20
C	>20 and <35
D	>35 and <55
E	>55 and <80
F	F >80

5. EXIT 8 CAPACITY ANALYSIS

The following section describes the evaluation of the Exit 8 interchange intersections and ramps, as well as proposed alternative interchange configurations to address deficiencies.

5.1 Existing Conditions

Vissim was used to analyze the existing, No Build, and Build freeway networks. A detailed account of the 2022 existing conditions Vissim calibration methodology can be found in the *I-95 Vissim Calibration Memo* submitted in August 2022, in **Appendix C.**

5.2 No Build Conditions

The evaluation of existing and future volumes under current geometry for the interchange and adjacent intersections is discussed in the sections below. Current interchange conditions include signalization for the southbound ramps intersection only; the northbound ramps intersection is stop controlled on the ramp approach. The intersection of U.S. 278 at U.S. 17 to the west of the interchange is a T intersection that is stop controlled for the westbound U.S. 278 approach. The intersection of U.S. 278 at Henry Moss Boulevard/Medical Center Drive is signalized.

The results of the analysis of the existing interchange and intersections is shown in **Table 30**. LOS, delay, and queue results by movement are provided in **Appendix D.** Signal timing information is provided in **Appendix H**.

Table 30: HCM Exit 8 Intersection Capacity Analysis Results

	Scenario	U.S. 278 at U.S. 17 (Unsignalized)	U.S. 278 at I-95 SB Ramps (Signalized)	U.S. 278 at I-95 NB Ramps (Unsignalized)	U.S. 278 at Henry Moss Blvd. (Signalized)
AM	2022 Existing	B (12.7)	B (18.6)	C (18.3)	E (58.7)
	2030 No Build	D (32.5)	C (31.6)	F (78.7)	E (74.6)
	2050 No Build	E (39.0)	E (76.4)	F (97.5)	E (73.3)
PM	2022 Existing	B (11.6)	B (15.2)	B (12.4)	B (13.4)
	2030 No Build	C (20.3)	C (23.7)	D (29.7)	D (37.2)
	2050 No Build	C (15.7)	C (27.6)	F (51.3)	E (65.6)

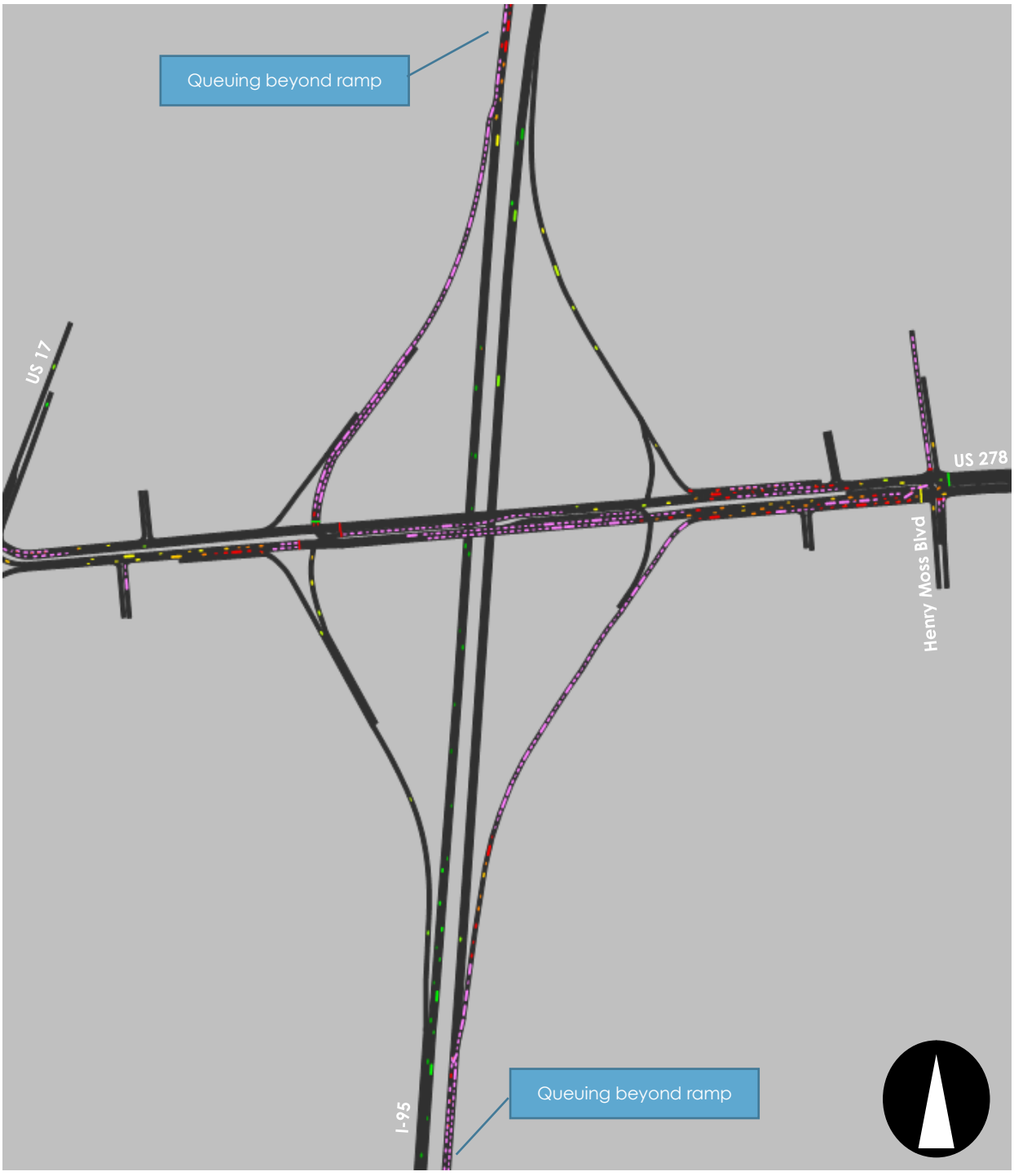
Table 30 shows that the interchange intersections perform at an acceptable LOS under 2022 conditions, but the northbound intersection is estimated to degrade by 2030, and both intersections are estimated to degrade in the AM peak by 2050. The northbound ramp approach and the eastbound U.S. 278 left turn at the unsignalized ramp intersection are estimated to consistently experience poor conditions by 2030. The breakdown of multiple approaches in 2050 could potentially cause queues to exceed their available storage at both ramp intersections in both peak periods.

The U.S. 17 intersection also performs acceptably under 2022 conditions but is estimated to degrade in the AM peak by 2030. This is primarily due to the stop-controlled westbound approach. The Henry Moss Boulevard/Medical Center Drive intersection operates at undesirable LOS under 2022 AM conditions and through future periods. The eastbound U.S. 278 and southbound Medical Center Drive approaches consistently show poor conditions in the AM peak, with the eastbound approach consistently queueing beyond capacity.

Another indicator of congestion issues identified in the Vissim analysis is the percent of the volume served at the intersection approach. Percent volume served is the number of vehicles that pass through the intersection compared to the volume input coded into the model. If the volume input cannot be served, this results in an operational or capacity issue at the intersection. This study uses a throughput threshold of 80% to identify significant locations for these issues. This means that any movement that could only serve less than 80% of the volume put into the model was inspected more closely to ensure the issue was not related to model coding and was a result of the intersection characteristics. These results are provided in **Appendix E** where 2030 and 2050 AM and PM peak hour results are summarized by movement for existing and alternative conditions for the interchange and adjacent intersections. Movements below the 80% threshold are highlighted.

For No Build conditions, the volume served results correlate with the LOS results, showing an inability to accommodate northbound ramp volume in 2030 AM conditions and an inability to process the volume for multiple approaches at each intersection in 2050. This failure could lead to extensive queueing on the ramps. Visual observation of the model indicated that both ramp approaches may extend into the I-95 mainline under AM peak conditions by 2050. **Figure 11** illustrates an example of Vissim analysis resulting in operational breakdown during the AM peak period.

Figure 11: 2050 No Build AM Peak Vissim Snapshot at Exit 8



These results suggest that the Exit 8 interchange will likely exceed acceptable LOS by 2030 and reach undesirable queueing conditions for the off-ramps by 2050. For these reasons alternative interchange concepts were evaluated.

5.3 Preliminary Alternative Screening

FHWA's Capacity Analysis for Planning of Junctions (CAP-X) tool was used for a planning level assessment of potential interchange alternatives to determine appropriate options for Vissim modeling. Using the estimated 2050 PM peak volumes, preliminary screening identified four interchange configurations that could provide acceptable volume-to-capacity conditions. **Figure 12** and **Figure 13** shows the interchange configuration rankings for the 2050 AM and PM peak periods. The acceptable configurations include:

- Diverging Diamond Interchange (DDI)
- Partial Cloverleaf Interchange (ParClo)
- Single Point Urban Interchange (SPUI)
- Diamond Interchange

Figure 12: 2050 AM Peak Preliminary CAP-X

Capacity Analysis for Planning of Junctions

Dynamic Results Summary

TYPE OF INTERSECTION	Overall V/C Ratio	V/C Ranking	Pedestrian Accommodations	Bicycle Accommodations	
Partial Cloverleaf A E-W	0.45	1	#DIV/0!	#DIV/0!	✓
Single Point N-S	0.59	2	Good	Excellent	
Diverging Diamond Interchange E-W	0.63	3	Good	Excellent	✓
Partial Cloverleaf A N-S	0.74	4	#DIV/0!	#DIV/0!	
Single Point E-W	0.77	5	Good	Excellent	✓
Displaced Left Turn (Interchange) E-W	0.83	6	#DIV/0!	#DIV/0!	
Diamond E-W	0.85	7	#DIV/0!	#DIV/0!	✓
Diverging Diamond Interchange N-S	0.92	8	Good	Excellent	
Contraflow Left Interchange E-W	1.11	9	#DIV/0!	#DIV/0!	
Displaced Left Turn (Interchange) N-S	1.15	10	#DIV/0!	#DIV/0!	

Use the "yes/no" drop-down menus in Step 2 (Base and Alt Selection) to exclude intersection types from summary rankings, if they are not applicable.

✓ Design works in both AM and PM

v/c < 1

v/c > 1

Figure 13: 2050 AM Peak Preliminary CAP-X

Capacity Analysis for Planning of Junctions

Dynamic Results Summary

TYPE OF INTERSECTION	Overall V/C Ratio	V/C Ranking	Pedestrian Accommodations	Bicycle Accommodations	
Diverging Diamond Interchange E-W	0.50	1	Good	Excellent	✓
Partial Cloverleaf A E-W	0.62	2	#DIV/0!	#DIV/0!	✓
Single Point E-W	0.72	3	Good	Excellent	✓
Diamond E-W	0.87	4	#DIV/0!	#DIV/0!	✓
Partial Cloverleaf A N-S	0.98	5	#DIV/0!	#DIV/0!	
Single Point N-S	0.98	5	Good	Excellent	
Displaced Left Turn (Interchange) E-W	1.00	7	#DIV/0!	#DIV/0!	
Diverging Diamond Interchange N-S	1.07	8	Good	Excellent	
Echelon E-W	1.08	9	#DIV/0!	#DIV/0!	
Center Turn Overpass	1.28	10	#DIV/0!	#DIV/0!	

Use the "yes/no" drop-down menus in Step 2 (Base and Alt Selection) to exclude intersection types from summary rankings, if they are not applicable.

✓ Design works in both AM and PM
v/c < 1
v/c > 1

After an initial comparison of volume, operations, and potential construction limits, the ParClo option was expanded to a ParClo A in the northwest quadrant of the interchange and a ParClo B in the southwest quadrant, impacting the southbound direction. Preliminary analysis also showed that only the DDI could potentially accommodate future volumes on the existing bridge structure, so the DDI was evaluated under two configurations: a 4-lane bridge (existing) and a 6-lane bridge (new). Only the DDI and the expansion of the existing diamond interchange ramps utilizes the existing bridge structure for analysis. This ultimately resulted in six alternatives that were progressed to Vissim analysis:

1. Expanded Diamond Interchange (addition of ramp lanes)
2. Single Point Urban Interchange (SPUI)
3. Diverging Diamond Interchange (4-lane DDI)
4. Diverging Diamond Interchange (6-lane DDI)
5. Partial Cloverleaf Interchange – Northwest Quadrant (ParClo NW)
6. Partial Cloverleaf Interchange – Southwest Quadrant (ParClo SW)

Each of the six alternatives was modeled in Vissim under the Build scenario of I-95 (three lanes in each direction). The adjacent U.S. 278 intersections with U.S. 17 and Henry Moss Boulevard/Medical Center Drive were also included due to their proximity. The intersections are evaluated with LOS C as the standard of acceptable LOS based on the design criteria for rural freeways presented in SCDOT's 2021 Roadway Design Manual.

Major volume flow was an important consideration at the interchange because the majority of existing and estimated future volume travels to and from the east. This has implications for both peak periods. The two major flows are:

- From I-95 northbound to U.S. 278 eastbound
  - 2050 AM: 1,625 and 2050 PM: 1,420
- From U.S. 278 westbound to I-95 southbound
  - 2050 AM: 940 and 2050 PM: 1,505

These flows drove control and capacity decisions during analysis and will be a focal point of the discussion of each alternative.

The analysis of each of the six alternatives is described in detail in the following sections, including geometric layout, model operational observations, and queueing results. Intersection-level capacity analysis results are summarized and compared following the discussion of each alternative. A summary of movement level LOS and delay results is provided in **Appendix F**.

5.3.1 Exit 8 – Expanded Diamond Interchange

Expanding the existing diamond interchange was evaluated due to the potential cost savings of retaining the existing bridge through limited changes. The proposed expansion would include signalization of the northbound ramps intersection and conversion to a triple right turn lane to mitigate the northbound off-ramp volume. The intersection of U.S. 17 with U.S. 278 would also be signalized to improve traffic flow for the westbound U.S. 278 movement and reduce queueing on U.S. 278, and the interchange traffic signals would be coordinated with Henry Moss Boulevard/Medical Center Drive due to their proximity. Signal warrant information is provided in **Appendix G.**

Mitigating PM westbound left turn queues would require a dual left turn to the southbound on-ramp, leaving a single westbound through lane. The cross section of U.S. 278 would also be widened to three lanes in each direction on the east side of the interchange beyond the adjacent intersection to accommodate east-west traffic. This would require protected left turn movements for the U.S. 278 approaches. The potential layout is shown in **Figure 14**. Though not shown, the I-95 northbound off-ramp is two lanes when diverging from the interstate, becoming four lanes after this diverge. The two lanes are added to the outside. The I-95 southbound on-ramp uses two acceleration lanes.

Figure 14: Expanded Diamond Interchange Alternative



The results of the analysis of the interchange and adjacent intersections is shown in **Table 31**. LOS, delay, and queue results by movement are provided in **Appendix F**. Signal timing information is provided in **Appendix H.**

Table 31: VISSIM Expanded Diamond Interchange Capacity Analysis Results

Scenario	U.S. 278 at U.S. 17 (Signalized)	U.S. 278 at I-95 SB Ramps (Signalized)	U.S. 278 at I-95 NB Ramps (Signalized)	U.S. 278 at Henry Moss Blvd. (Signalized)
AM 2030	C (28.1)	F (119.4)	E (73.6)	D (53.2)
AM 2050	D (50.0)	F (112.3)	E (78.1)	E (61.1)
PM 2030	B (11.9)	C (27.9)	D (42.3)	D (46.0)
PM 2050	B (12.0)	D (37.1)	C (32.4)	D (43.3)

Despite improvements, the intersections still show an inability to process demand, decreasing in LOS in some cases. Each scenario and peak period exhibit undesirable LOS at multiple intersections. This is due to the increased volume flow made possible by the additional lanes, as well as control delay introduced at the northbound ramps. Under the No Build scenario, volume from the northbound ramp is restricted by the ramp's capacity, and free-flow eastbound U.S. 278 traffic is the primary impact to the Henry Moss Boulevard/Medical Center Drive intersection. By improving the northbound off-ramp flow, more volume reaches the already saturated Henry Moss Boulevard/Medical Center Drive intersection. This causes queuing between the ramps and Henry Moss Boulevard/Medical Center Drive, which cascades upstream, causing further congestion. This is more significant in the AM peak when eastbound U.S. 278 and northbound off-ramp volumes are higher. This also affects the southbound off-ramp by reducing its portion of signal time, exacerbating the queuing problem, which cannot be mitigated with additional lanes.

The 2030 and 2050 westbound PM peak left turn volume to the southbound on-ramp appears acceptable from an LOS perspective but is not being processed at the intersection according to the throughput summary. Vissim will remove vehicles that queue excessively, and if this is intermittent it will not appear to affect vehicle delay. Like the No Build scenario, the 2050 Expanded Diamond scenario reiterates the problems of congestion with multiple approaches that cannot process the volume, though primarily in the AM peak. PM peak volume processing issues are specific to the westbound movements from Henry Moss Boulevard/Medical Center Drive to the southbound ramps intersection, due to the high volume.

Figure 15 provides a snapshot from Vissim of one example of operational breakdown and queueing during the AM peak period at the ramps and along U.S. 278.

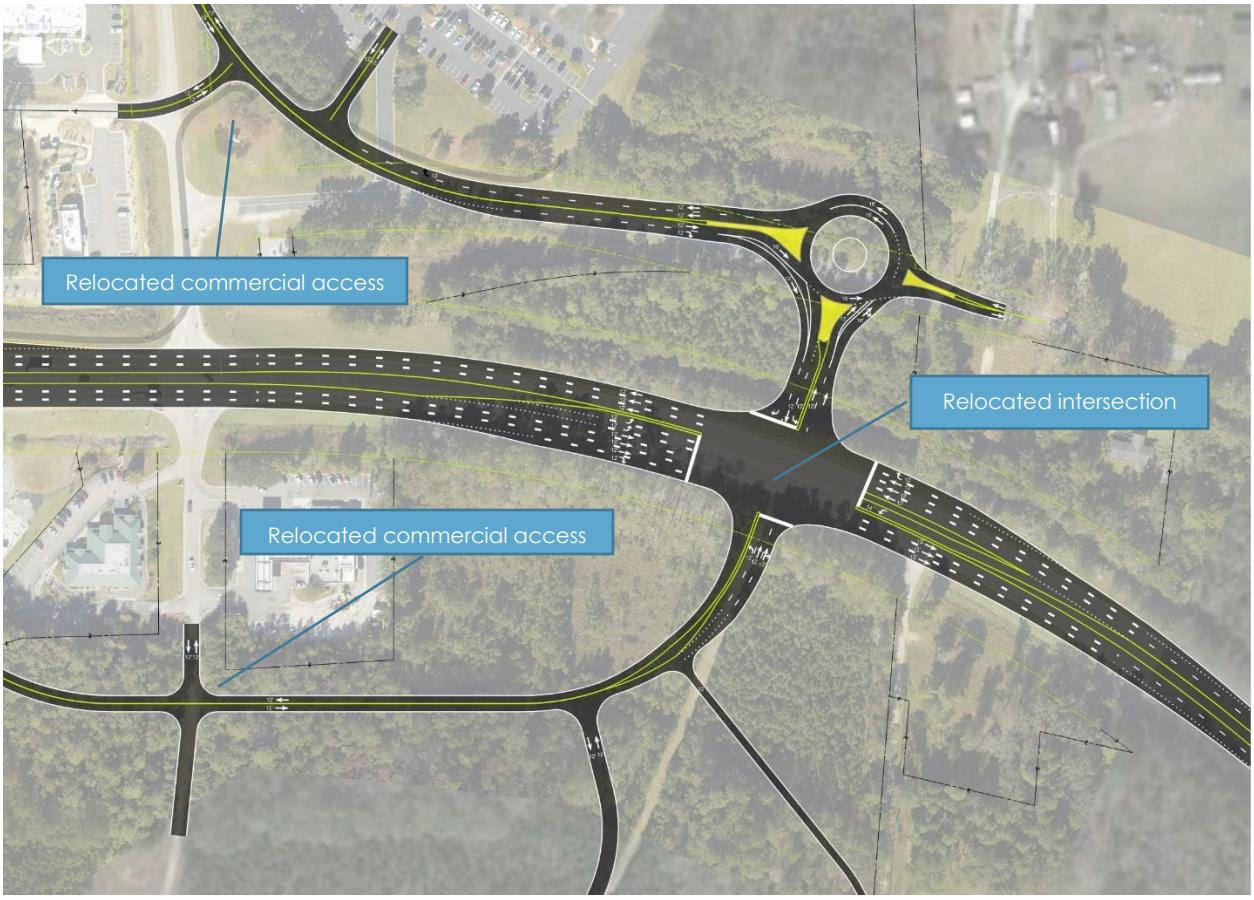
Figure 15: 2050 AM Peak Expanded Diamond Interchange Vissim Snapshot



Relocation of Henry Moss/Medical Center Drive Intersection

Analysis of the Expanded Diamond interchange showed operational impacts due to the proximity of the Henry Moss Boulevard/Medical Center Drive intersection to the Exit 8 interchange. Modifications at the intersection such as additional lanes and signal optimization could not alleviate the conflict, and the issue was noted in all preliminary alternative analysis. In addition, weaving conditions between the northbound off-ramp and eastbound approach to Henry Moss Boulevard/Medical Center Drive for vehicles turning left to Medical Center Drive are anticipated to deteriorate as volumes increase, especially with the impact of commercial driveway activity in between. For these reasons, it is proposed that the Henry Moss Boulevard/Medical Center Drive intersection be relocated further east of the interchange, and all further analysis of alternatives in the following sections includes this modification. This relocation included an expansion of the intersection to better handle the proposed traffic volumes and consolidation of the existing driveway access to the new intersection. The new geometry is shown in **Figure 16**.

Figure 16: Relocated Henry Moss Boulevard/Medical Center Drive Intersection

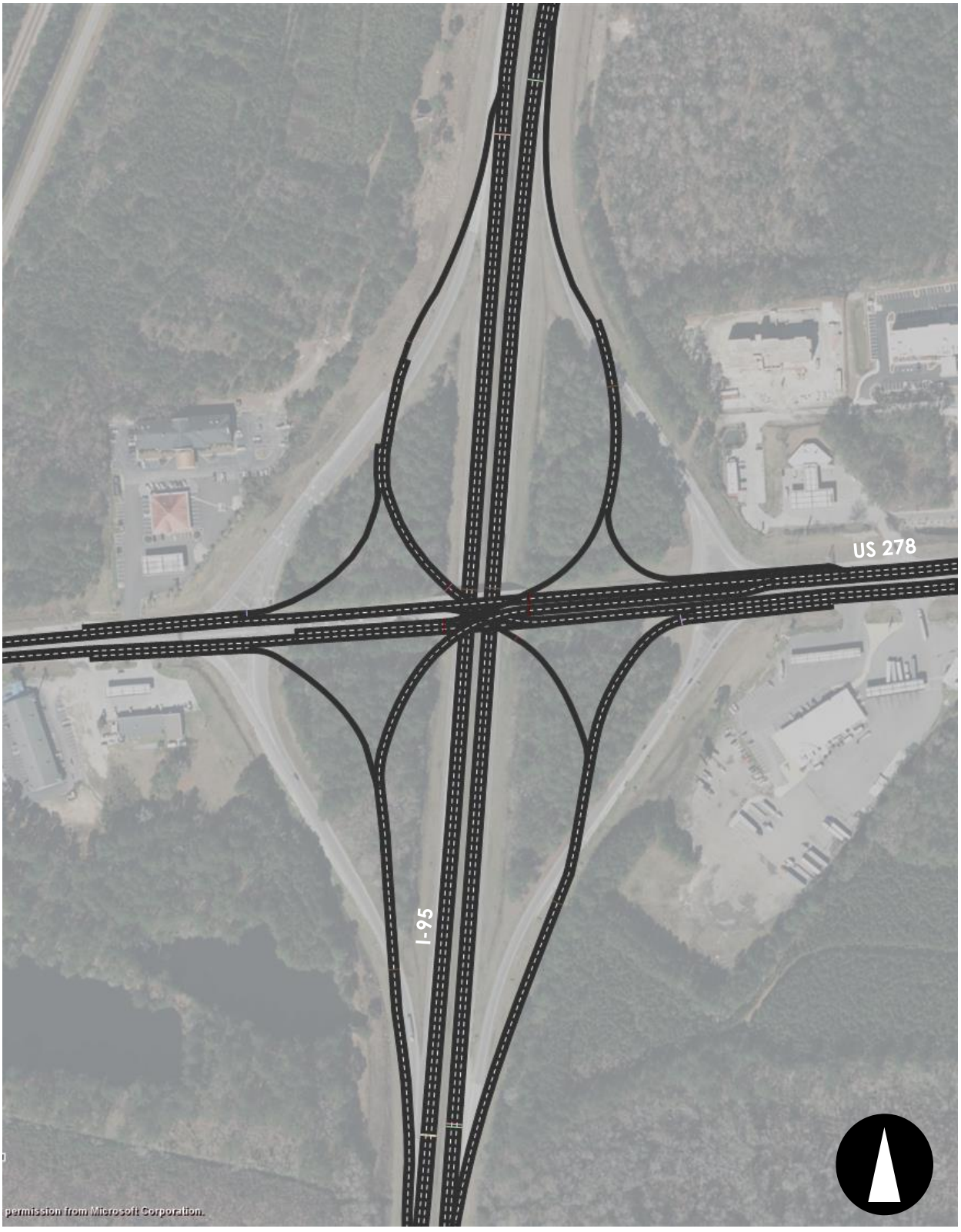


U.S. 278 is widened to three lanes in each direction and a dual left turn lane is added to the eastbound approach. The cross-section tapers to two lanes in each direction approximately 750 feet east of the intersection. Both side street approaches are widened to three lanes with exclusive left turn lanes. A roundabout intersection was added north of the new main intersection and the operational analysis of this roundabout is discussed following the analysis of the alternatives. The roundabout is referred to here as the Medical Center Drive roundabout.

5.3.2 Exit 8 – Single Point Urban Interchange

The proposed SPUI alternative would require a new bridge across I-95 and would include signalization of the combined ramps intersection. As with each the following alternatives, the cross section of U.S. 278 would be widened to three lanes in each direction on the east side of the interchange, the existing commercial driveways would be consolidated and relocated, the U.S. 17 intersection would be signalized, and the Henry Moss Boulevard/Medical Center Drive intersection would be relocated. The potential interchange layout is shown in **Figure 17**. Though not shown, the I-95 southbound on-ramp uses two acceleration lanes.

Figure 17: SPUI Alternative Interchange



The results of the analysis of the interchange and adjacent intersections is shown in **Table 32**. LOS, delay, and queue results by movement are provided in **Appendix F**. Signal timing information is provided in **Appendix H.**

Table 32: VISSIM SPUI Capacity Analysis Results

Scenario	U.S. 278 at U.S. 17 (Signalized)	U.S. 278 at I-95 Ramps (Signalized)	U.S. 278 at Henry Moss Blvd. (Signalized)
AM 2030	B (14.5)	D (35.9)	C (31.0)
AM 2050	C (22.4)	D (46.2)	C (28.4)
PM 2030	B (11.8)	D (35.3)	C (28.5)
PM 2050	C (23.5)	D (36.5)	C (24.3)

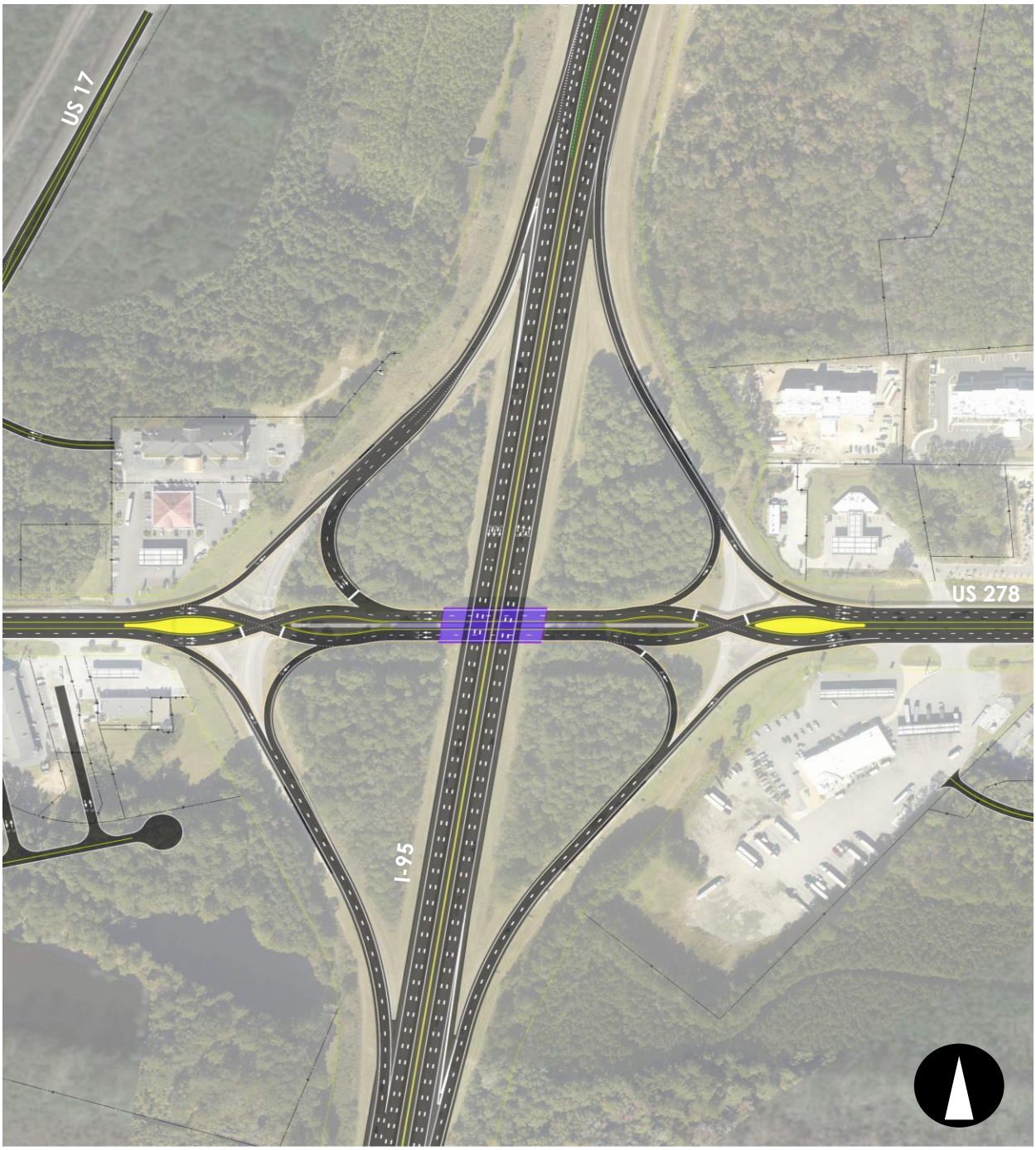
The proposed SPUI configuration is unable to meet the acceptable LOS in either scenario or period. The northbound right turn is improved over existing conditions, but the southbound, eastbound, and westbound left turn movements cannot be accommodated with this geometry and signal timing. In addition, the 2050 westbound left turn volume is anticipated to exceed its available storage in both peak periods. Further lane additions were not explored because the bridge cross section would be larger than the other alternatives.

The U.S. 17 intersection should operate at an acceptable LOS through 2030, but the southbound and northbound approaches could deteriorate by 2050 if the westbound approach is given preference in timing. Visual observations showed that the relocation of the Henry Moss Boulevard/Medical Center Drive intersection improved vehicle flow between the two intersections. However, side street operation deteriorates by 2030 and the AM peak eastbound left turn exceeds its available storage in both peak periods. None of the approaches exhibited issues with throughput.

5.3.3 Exit 8 – Diverging Diamond Interchange (4-Lane Cross Section)

A DDI on the existing bridge was evaluated due to the potential cost savings of retaining the bridge. The DDI would require signalized intersections on each side of the interchange, as well as the widened U.S. 278 cross section on the east side of the interchange, consolidated commercial driveways, signalization of the U.S. 17 intersection, and relocation of the Henry Moss Boulevard/Medical Center Drive intersection. The four traffic signals in the corridor should also be coordinated during the peak hours to improve traffic flow, especially between the northbound ramps intersection and the Henry Moss/Medical Center Drive intersection. The potential interchange layout is shown in **Figure 18**. Though not shown, the I-95 northbound off-ramp is two lanes when diverging from the interstate. The two lanes are added to the outside. The I-95 southbound on-ramp uses two acceleration lanes.

Figure 18: 4-Lane DDI Alternative Interchange



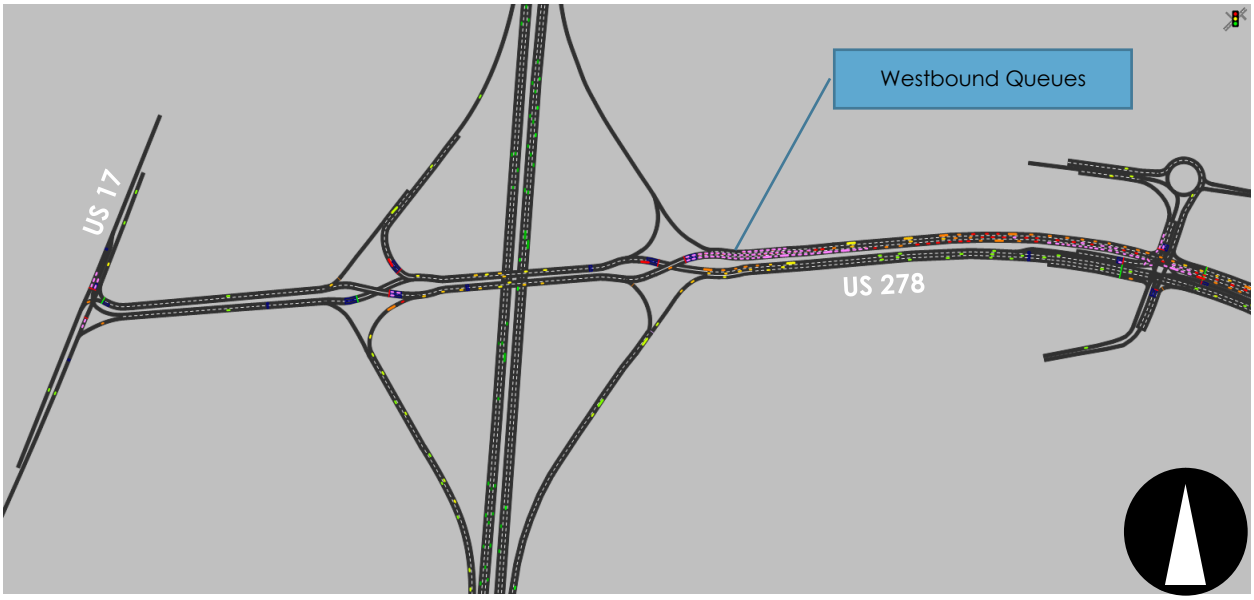
The results of the analysis of the interchange and adjacent intersections is shown in **Table 33**. LOS, delay, and queue results by movement are provided in **Appendix F**. Signal timing information is provided in **Appendix H.**

Table 33: VISSIM 4-Lane DDI Capacity Analysis Results

Scenario	U.S. 278 at U.S. 17 (Signalized)	U.S. 278 at I-95 SB Ramps (Signalized)	U.S. 278 at I-95 NB Ramps (Signalized)	U.S. 278 at Henry Moss Blvd. (Signalized)
AM 2030	B (12.2)	B (14.3)	B (13.7)	B (17.7)
AM 2050	B (11.9)	B (15.8)	C (28.2)	C (22.1)
PM 2030	B (14.8)	A (8.4)	B (13.7)	A (8.7)
PM 2050	B (15.2)	A (8.8)	C (23.9)	B (15.7)

Table 33 indicates that the interchange and adjacent intersections will perform at an acceptable LOS through 2050. Additionally, the volume served met the acceptable threshold for each scenario. However, delay and queueing issues are apparent for the eastbound and westbound directions at the northbound ramps intersection by 2030, extending to 2-5 times the available storage length by 2050. By 2050, the eastbound AM peak movement showed consistent queues between the DDI intersections, impacting the southbound ramps. The northbound AM peak off-ramp movement shows the potential to reach its storage limit, though this had a limited occurrence in the model runs.

Figure 19: 2050 PM Peak 4-Lane DDI Vissim Snapshot



In **Figure 19**, visual observations of the ramp intersections indicated a potential problem for the PM peak westbound approach to the northbound ramps intersection. The lane reduction at this point presents a capacity problem for the high volume of traffic proceeding to the southbound on ramp, resulting in extensive queueing. It could also present a problem if vehicles are not positioned in the proper lane on approach as it could lead to last-minute lane changes and potential crashes. The westbound congestion at the northbound ramps intersection causes the operation to appear

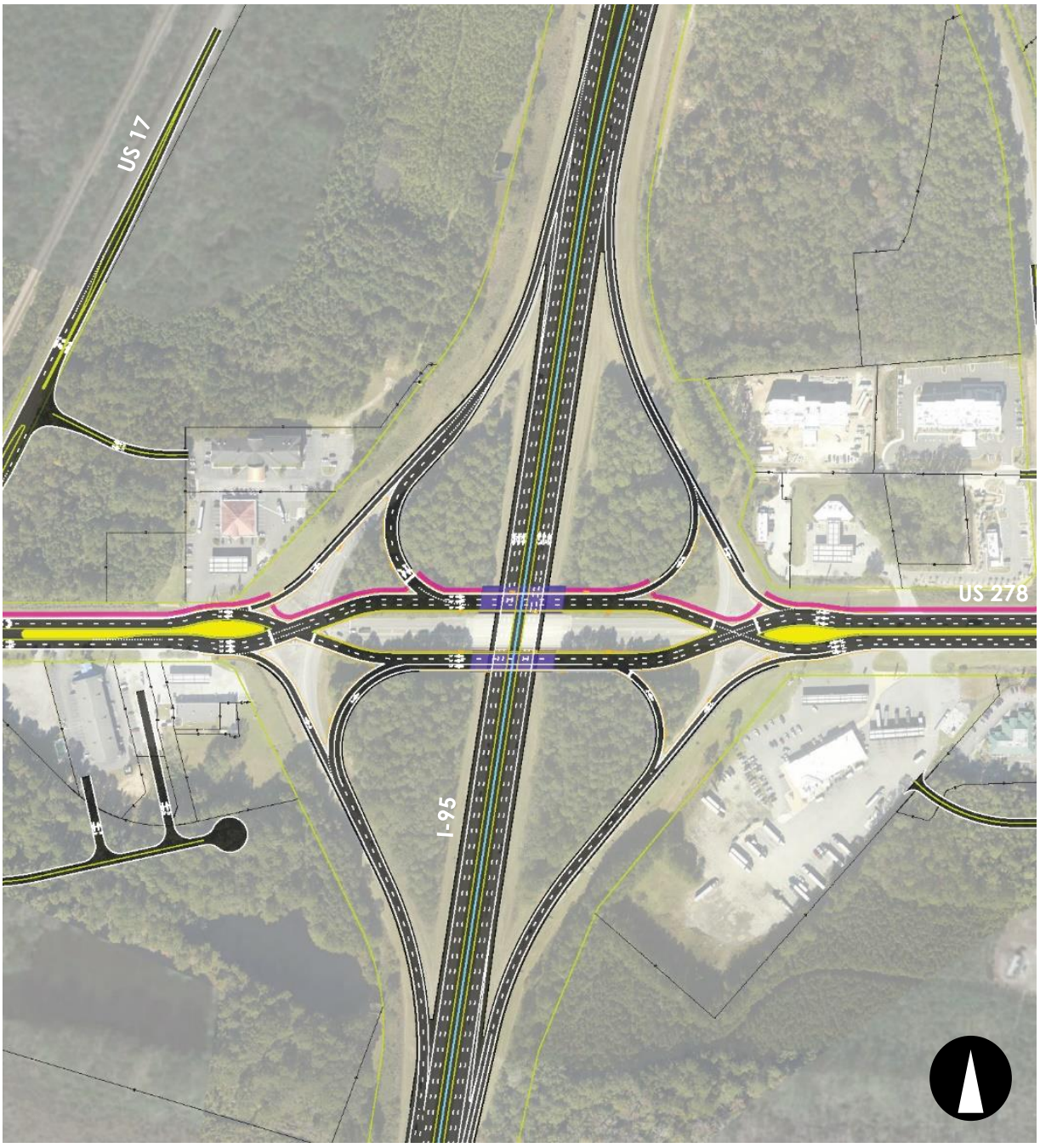
better at the southbound on-ramp for the westbound through-left by metering the traffic that reaches the ramp. If flow were released at the northbound ramps intersection, there is still potential for congestion because the westbound on-ramp movement can be blocked by through movements sharing the lane, which is a concern for the PM peak.

The northbound and southbound turning movements at the U.S. 17 intersection exceed their storage by 2030, lengthening to roughly double the capacity by 2050. Coordination with the interchange intersections keeps the westbound approach from queuing into the area of influence of the southbound ramps. The eastbound left turn at the Henry Moss Boulevard/Medical Center Drive intersection is estimated to fall below an acceptable LOS by 2030, due to the coordination requirements that reduce available signal time.

5.3.4 Exit 8 – Diverging Diamond Interchange (6-Lane Cross Section)

The proposed 6-lane DDI alternative would require new dual bridges across I-95 and would include signalized intersections on each side of the interchange. Like the 4-lane DDI, this alternative would include a widened U.S. 278 cross section on the east side of the interchange, consolidated commercial driveways, signalization of the U.S. 17 intersection, and relocation of the Henry Moss Boulevard/Medical Center Drive intersection. The four traffic signals in the corridor should also be coordinated during the peak hours to improve traffic flow, especially between the northbound ramps intersection and the Henry Moss Boulevard/Medical Center Drive intersection. The potential interchange layout is shown in **Figure 20**. Though not shown, the I-95 northbound off-ramp is two lanes when diverging from the interstate. The two lanes are added to the outside. The I-95 southbound on-ramp uses two acceleration lanes.

Figure 20: 6-Lane DDI Alternative Interchange



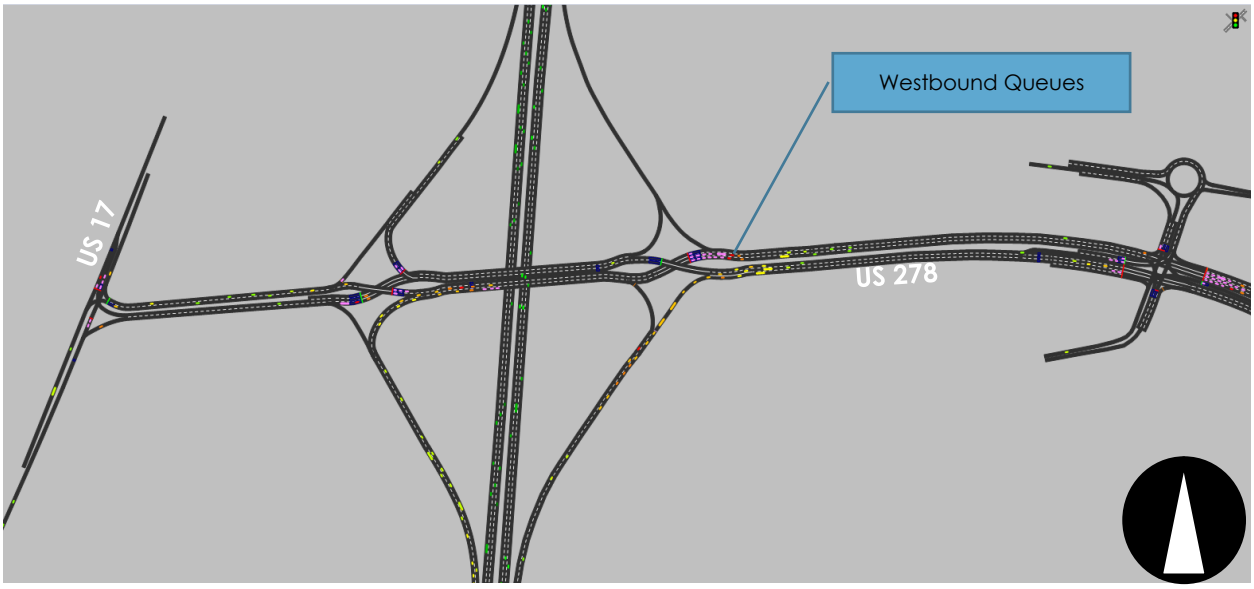
The result of the analysis of the interchange and adjacent intersections is shown in **Table 34**. LOS, delay, and queue results by movement are provided in **Appendix F**. Signal timing information is provided in **Appendix H.**

Table 34:VISSIM 6-Lane DDI Capacity Analysis Results

Scenario	U.S. 278 at U.S. 17 (Signalized)	U.S. 278 at I-95 SB Ramps (Signalized)	U.S. 278 at I-95 NB Ramps (Signalized)	U.S. 278 at Henry Moss Blvd. (Signalized)
AM 2030	B (11.1)	B (12.8)	B (14.1)	B (16.7)
AM 2050	B (12.0)	B (13.3)	B (19.4)	C (23.0)
PM 2030	B (12.7)	A (7.3)	B (11.5)	A (8.0)
PM 2050	B (15.2)	A (7.7)	B (14.5)	A (9.4)

Table 34 indicates that the interchange and adjacent intersections will perform at an acceptable LOS through 2050. Additionally, the volume served met the acceptable threshold for each scenario. Delay conditions are favorable for the movements at the ramp intersections in 2030 (an improvement over the 4-lane DDI). 2050 conditions are also improved over the 4-lane DDI, particularly for the westbound through movement at the northbound ramps intersection, decreasing queuing by 40% or more as shown in **Figure 21**. Queuing continues to impact the westbound on-ramp movement, though less severely. Queuing for the northbound right turn from the off-ramp is also reduced significantly, reaching at most 30% of its capacity.

Figure 21: 2050 PM Peak 6-Lane DDI Vissim Snapshot

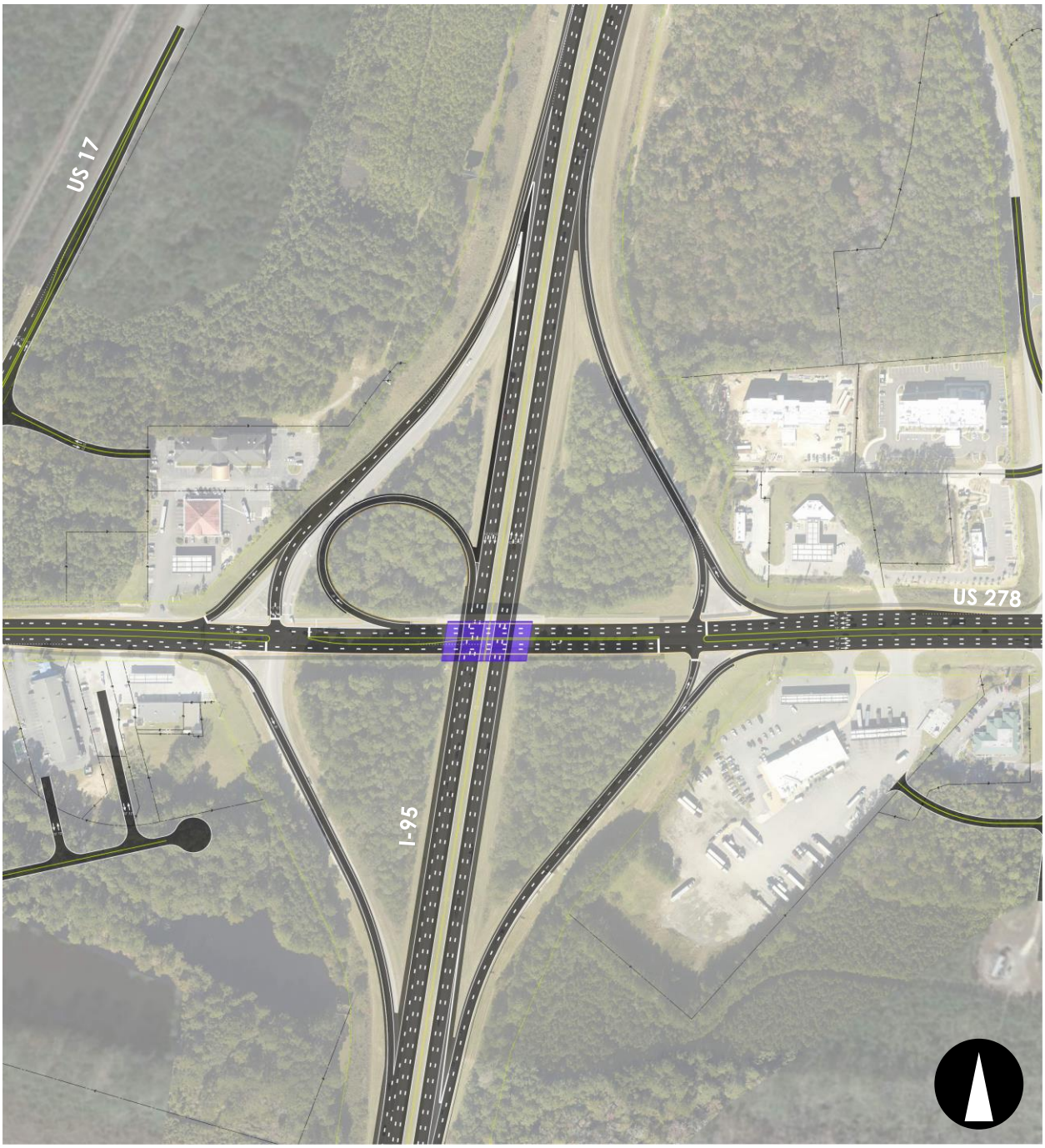


The northbound and southbound turning movements at the U.S. 17 intersection exceed their storage by 2030, lengthening to roughly double the capacity by 2050. Coordination with the interchange intersections keeps the westbound approach from queuing into the area of influence of the southbound ramps. The eastbound left turn at the Henry Moss Boulevard/Medical Center Drive intersection is estimated to fall below an acceptable LOS by 2030 due to the coordination requirements that reduce available signal time.

5.3.5 Exit 8 – Partial Cloverleaf (Northwest Quadrant)

A partial cloverleaf option was analyzed with the cloverleaf ramp position in the northwest quadrant of the interchange to allow vehicles travelling from U.S. 278 westbound to I-95 southbound to access the interstate via a free-flow ramp. This alternative would require a new bridge across I-95 and signalization of the northbound ramps intersection, as well as the widened U.S. 278 cross section on the east side of the interchange, consolidated commercial driveways, signalization of the U.S. 17 intersection, and relocation of the Henry Moss Boulevard/Medical Center Drive intersection. The interchange and U.S. 17 intersection traffic signals should be coordinated during the peak hours to improve traffic flow. The potential interchange layout is shown in **Figure 22**. Though not shown, the I-95 northbound off-ramp is two lanes when diverging from the interstate. The two lanes are added to the outside.

Figure 22: ParClo - NW Alternative Interchange



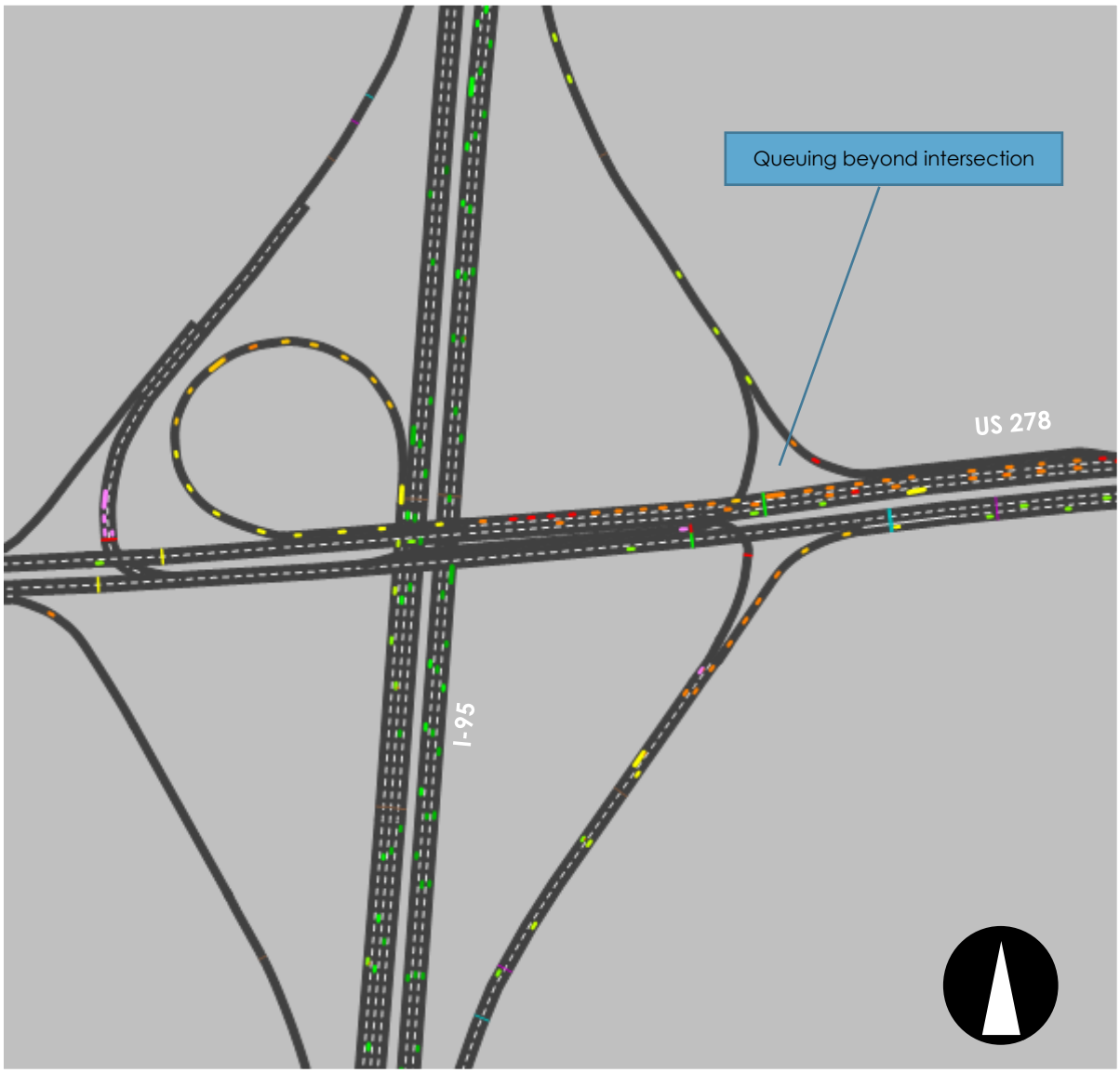
The results of the analysis of the interchange and adjacent intersections are shown in Table 35. LOS, delay, and queue results by movement are provided in **Appendix F**. Signal timing information is provided in **Appendix H.**

Table 35: VISSIM ParClo - NW Capacity Analysis Results

Scenario	U.S. 278 at U.S. 17 (Signalized)	U.S. 278 at I-95 SB Ramps (Signalized)	U.S. 278 at I-95 NB Ramps (Signalized)	U.S. 278 at Henry Moss Blvd. (Signalized)
AM 2030	B (12.2)	B (13.1)	A (8.5)	B (13.4)
AM 2050	B (15.2)	B (15.0)	A (6.9)	B (17.8)
PM 2030	B (13.1)	A (8.8)	A (8.6)	B (12.5)
PM 2050	B (17.5)	B (12.2)	A (10.0)	B (14.3)

Table 35 indicates that the interchange and adjacent intersections will perform at an acceptable LOS through 2050. Additionally, the volume served met the acceptable threshold for each scenario. Delay conditions are favorable for the movements at the ramp intersections in 2030. The eastbound and northbound left turn movements at the northbound ramps intersection could degrade by 2050. The high volume of PM peak hour traffic oriented to southbound I-95 are better served with a free-flow loop ramp connection but queueing from the ramp entrance in 2050 is estimated to extend through the upstream intersection, impacting the northbound on-ramp. Visual observations reaffirmed the results, showing conflicts due to the vehicles sharing a lane.

Figure 23 : 2050 PM Peak Parclo - NW Vissim Snapshot

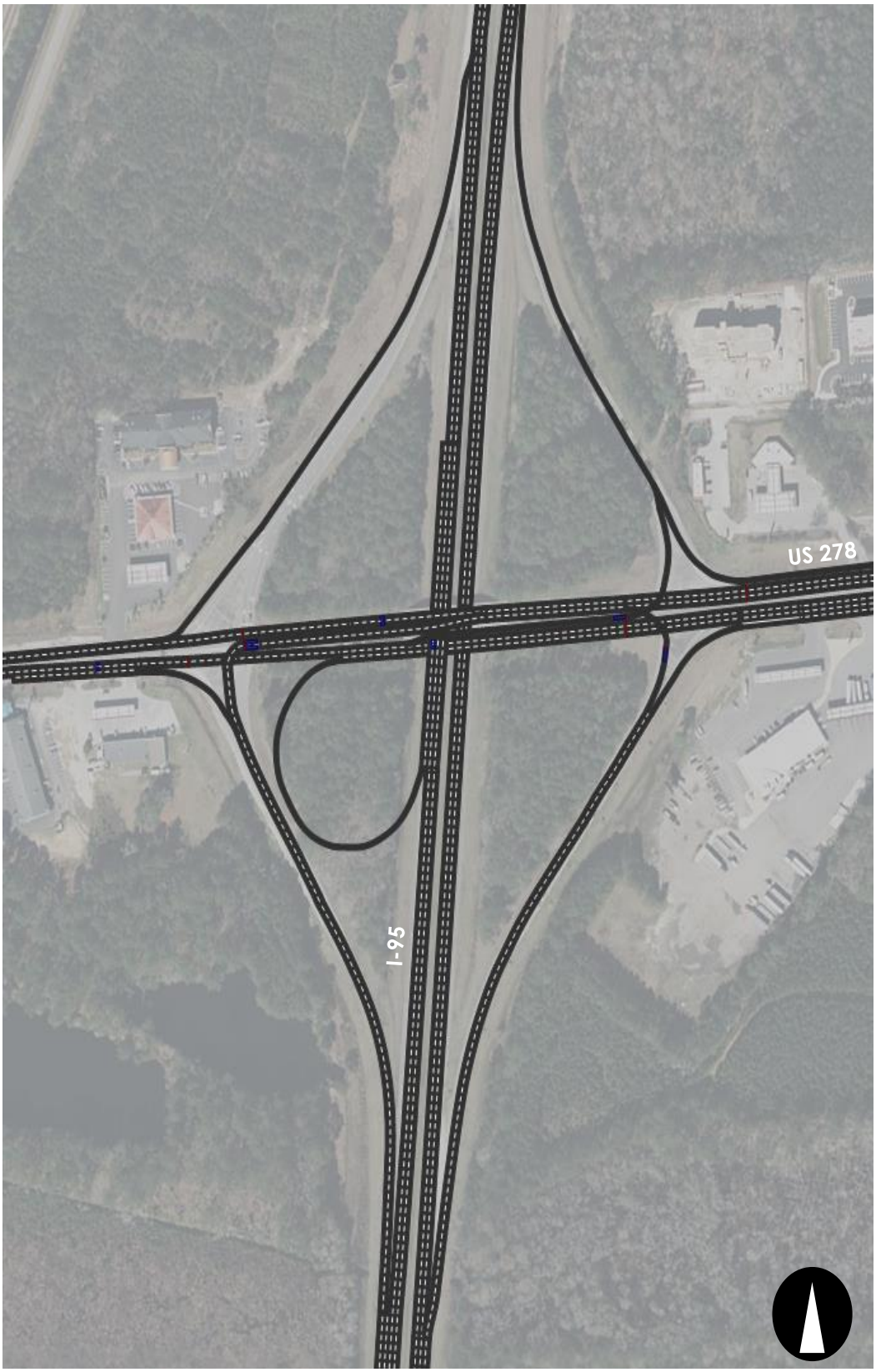


This alternative is expected to have a favorable impact to the U.S. 17 intersection, with the primary negative impact of coordination being to the southbound left turn movement in 2050. Coordination with the interchange intersections keeps the westbound approach queues below 50% of their capacity. The Henry Moss Boulevard/Medical Center Drive intersection operates favorably in both scenarios as an isolated intersection. Though there are queueing concerns similar to the DDI intersections. The eastbound left turn at the Henry Moss Boulevard/Medical Center Drive intersection is also estimated to fall below an acceptable LOS by 2030.

5.3.6 Exit 8 – Partial Cloverleaf (Southwest Quadrant)

A partial cloverleaf option was analyzed with the cloverleaf ramp position in the southwest quadrant of the interchange to allow vehicles travelling from southbound I-95 to access eastbound U.S. 278 via a free-flow ramp. This alternative would require a new bridge across I-95 and signalization of the northbound ramps intersection, as well as the widened U.S. 278 cross section on the east side of the interchange, consolidated commercial driveways, signalization of the U.S. 17 intersection, and relocation of the Henry Moss Boulevard/Medical Center Drive intersection. The interchange and U.S. 17 intersection traffic signals should be coordinated during the peak hours to improve traffic flow. The potential interchange layout is shown in **Figure 24**.

Figure 24: ParClo - SW Alternative Interchange



The results of the analysis of the interchange and adjacent intersections are shown in **Table 36.** LOS, delay, and queue results by movement are provided in **Appendix F**. Signal timing information is provided in **Appendix H.**

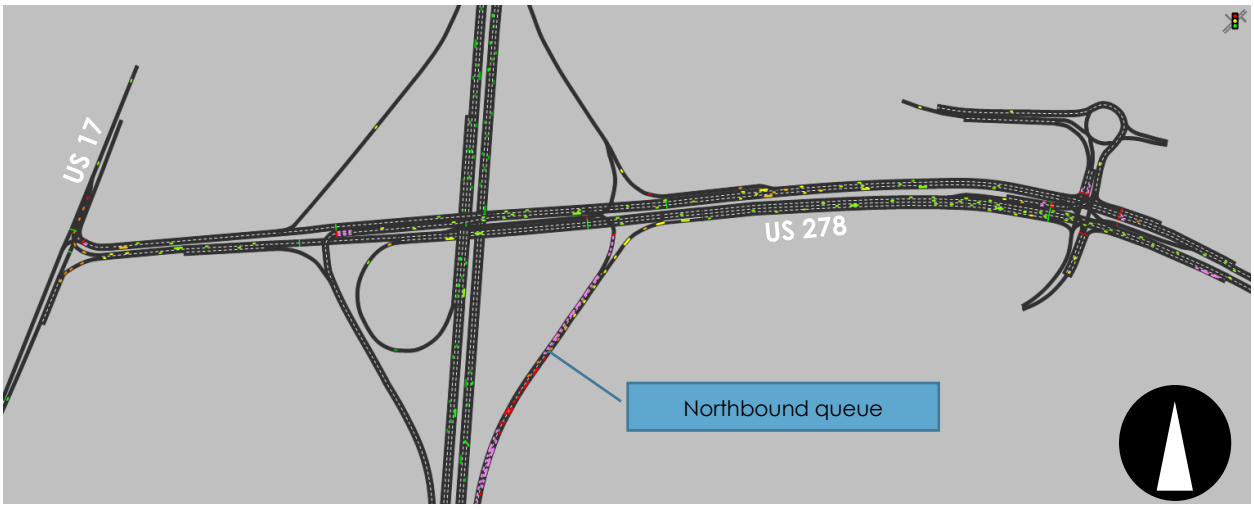
Table 36: VISSIM ParClo - SW Capacity Analysis Results

Scenario	U.S. 278 at U.S. 17 (Signalized)	U.S. 278 at I-95 SB Ramps (Signalized)	U.S. 278 at I-95 NB Ramps (Signalized)	U.S. 278 at Henry Moss Blvd. (Signalized)
AM 2030	B (11.7)	A (0.8)	A (6.9)	B (15.8)
AM 2050	B (16.7)	B (10.6)	A (9.2)	B (19.7)
PM 2030	B (11.6)	B (13.7)	A (6.3)	B (13.0)
PM 2050	B (19.2)	B (11.7)	A (5.5)	B (15.2)

Table 36 indicates that the interchange and adjacent intersections will perform at an acceptable LOS through 2050. Additionally, the volume served met the acceptable threshold for each scenario.

Delay conditions are favorable for most movements at the ramp intersections in 2030, though the eastbound and northbound approaches experience delay issues in both peak periods. These issues persist into 2050, though the impact is greater to the northbound AM movement than the others as shown in **Figure 25**. The westbound left turn to the southbound on-ramp consistently reached its storage limit in the 2050 AM peak, which causes some turbulence between the ramp intersections but does not affect the northbound ramps intersection.

Figure 25: 2050 AM Peak Parclo - SW Vissim Snapshot



The alternative's impact to the U.S. 17 intersection is expected to be favorable, with the primary negative impact of coordination being to the southbound left turn movement in 2050. Coordination with the interchange intersections keeps the westbound approach queues below 50% of their capacity. The Henry Moss Boulevard/Medical Center Drive intersection operates favorably in both scenarios as an isolated

intersection. Though there are queueing concerns similar to the DDI intersections. The eastbound left turn at the Henry Moss Boulevard/Medical Center Drive intersection is also estimated to fall below an acceptable LOS by 2030.

5.4 Medical Center Drive Roundabout Intersection

As part of the intersection relocation, a roundabout is proposed to connect the existing Brickyard Road north of the relocated Henry Moss Boulevard/Medical Center Drive intersection with the southbound approach to U.S. 278. This relocation was tested using the geometric configuration shown in **Figure 26**.

Figure 26: Medical Center Drive Roundabout Intersection



To analyze the operations between the roundabout and the adjacent intersection, it was assumed that the original southbound Medical Center Drive approach volume would become the eastbound roundabout approach volume. Using the Brickyard Road AADT estimate from count station 27-0295, it was assumed that 20 vehicles would travel to and from the east side of the roundabout. The AADT summary from SCDOT's count website is shown in **Table 37**.

Table 37: SCDOT Count Station 27-0295 AADT

	2021	2020	2019
AADT	350	350	350
Truck %	5%	5%	5%

Table 38 displays the capacity analysis results.

Table 38: VISSIM 2050 Medical Center Drive Roundabout Delay, LOS, and Queues

		AM			PM		
Movement	Available Storage (ft)	LOS (Delay)	% Served	Max. Queue (ft)	LOS (Delay)	% Served	Max. Queue (ft)
EBTR	325	A (5.8)	100%	19	A (4.9)	93%	3
WBL	-	A (4.1)	90%	-	A (3.1)	85%	-
NBLR	220	A (2.4)	100%	78	A (0.6)	100%	4
Intersection		**A (5.8)**			**A (2.8)**		

*Note: Output below 80% in **red***

The results were evaluated from the alternative that showed the worst roundabout performance, the 2050 SPUI, to show a conservative estimate. The results show an acceptable LOS in both peak periods. However, the PM peak westbound left turn throughput is below the 80% used in this study, indicating that westbound volumes may not have the opportunity to enter the roundabout due to U.S. 278 traffic. The estimated westbound traffic accounts for only roughly 5% of roundabout traffic, so this impact may be acceptable.

Additionally, a queue analysis was completed to ensure that the southbound approach to U.S. 278 would not queue into the roundabout. The southbound through lane is the only lane of the southbound approach with potential to block roundabout operations, and it has 200 feet of storage from U.S. 278 to the circulatory lane. **Table 39** shows that the only alternative that experiences queueing that will back into the roundabout (queue > 200 feet) was the SPUI alternative. This is likely due to the signal coordination effort between the Henry Moss Boulevard intersection and the SPUI, which requires a longer cycle length.

Table 39: VISSIM 2050 Medical Center Drive Roundabout Queue Analysis

Alternative	AM SBT Queue (ft)	PM SBT Queue (ft)
SPUI	**251**	**248**
DDI 4 Lane	187	178
DDI 6 Lane	176	109
NW ParClo	157	161
SW ParClo	157	161

*Note: Queues exceeding available storage in **bold***

5.5 Exit 8 Interchange Alternatives Capacity Analysis Summary

Table 40 and **Table 41** show the AM and PM peak hour intersection Vissim LOS and delay at each of the Exit 8 intersections for all existing and future scenarios.

Table 40: VISSIM Exit 8 AM Peak Hour Intersection LOS and Delay Summary

Scenario	U.S. 278 at U.S. 17	U.S. 278 at I-95 SB Ramps	U.S. 278 at I-95 NB Ramps	U.S. 278 at Henry Moss Blvd.
2022 Existing	B (12.7)	B (18.6)	C (18.3)	E (58.7)
2030 No Build	D (32.5)	C (31.6)	F (78.7)	E (74.6)
2030 Expanded Diamond	C (28.1)	F (119.4)	E (73.6)	D (53.2)
2030 SPUI	B (14.5)	D (35.9)		C (31.0)
2030 4-Lane DDI	B (12.2)	B (14.3)	B (13.7)	B (17.7)
2030 6-Lane DDI	B (11.1)	B (12.8)	B (14.1)	B (16.7)
2030 ParClo - NW	B (12.2)	B (13.1)	A (8.5)	B (13.4)
2030 ParClo - SW	B (11.7)	A (0.8)	A (6.9)	B (15.8)
2050 No Build	E (39.0)	E (76.4)	F (97.5)	E (73.3)
2050 Expanded Diamond	D (50.0)	F (112.3)	E (78.1)	E (61.1)
2050 SPUI	C (22.4)	D (46.2)		C (28.4)
2050 4-Lane DDI	B (11.9)	B (15.8)	C (28.2)	C (22.1)
2050 6-Lane DDI	B (12.0)	B (13.3)	B (19.4)	C (23.0)
2050 ParClo - NW	B (15.2)	B (15.0)	A (6.9)	B (17.8)
2050 ParClo - SW	B (16.7)	B (10.6)	A (9.2)	B (19.7)

Table 41: VISSIM Exit 8 PM Peak Hour Intersection LOS and Delay Summary

Scenario	U.S. 278 at U.S. 17	U.S. 278 at I-95 SB Ramps	U.S. 278 at I-95 NB Ramps	U.S. 278 at Henry Moss Blvd.
2022 Existing	B (11.6)	B (15.2)	B (12.4)	B (13.4)
2030 No Build	C (20.3)	C (23.7)	D (29.7)	D (37.2)
2030 Expanded Diamond	B (11.9)	C (27.9)	D (42.3)	D (46.0)
2030 SPUI	B (11.8)	D (35.3)		C (28.5)
2030 4-Lane DDI	B (14.8)	A (8.4)	B (13.7)	A (8.7)
2030 6-Lane DDI	B (12.7)	A (7.3)	B (11.5)	A (8.0)
2030 ParClo - NW	B (13.1)	A (8.8)	A (8.6)	B (12.5)
2030 ParClo - SW	B (11.6)	B (13.7)	A (6.3)	B (13.0)
2050 No Build	C (15.7)	C (27.6)	F (51.3)	E (65.6)
2050 Expanded Diamond	B (12.0)	D (37.1)	C (32.4)	D (43.3)
2050 SPUI	C (23.5)	D (36.5)		C (24.3)
2050 4-Lane DDI	B (15.2)	A (8.8)	C (23.9)	B (15.7)
2050 6-Lane DDI	B (15.2)	A (7.7)	B (14.5)	A (9.4)
2050 ParClo - NW	B (17.5)	B (12.2)	A (10.0)	B (14.3)
2050 ParClo - SW	B (19.2)	B (11.7)	A (5.5)	B (15.2)

The results indicate that existing interchange intersection conditions will degrade to unacceptable levels by 2030 under projected volumes, potentially impacting the operation of I-95 by 2050. The adjacent intersections are also expected to deteriorate. Of the six alternatives evaluated for this study, the 6-lane DDI and ParClo alternatives have the best combination of improvements to both the interchange and adjacent intersections. Of these three, the ParClo alternatives have the best intersection-level service conditions for the northbound ramps and the southbound ramps in the AM peak, as well as the relocated Henry Moss Boulevard/Medical Center Drive intersections. However, the ParClo alternatives provide worse movement-level service conditions at the ramp intersections, specifically for the northbound off-ramp approach and the westbound left turn to the southbound on-ramp. Additionally, the operation of the ParClo – NW loop ramp has the potential to impact service to the northbound on-ramp.

Based on the analysis in this section it is recommended that the 6-lane DDI alternative be pursued as the preferred alternative at Exit 8. The following improvements are also recommended:

- the U.S. 17 intersection be signalized and coordinated with the interchange
- U.S. 278 be widened to six lanes east of the northbound ramps intersection
- the Henry Moss Boulevard/ Medical Center Drive intersection be relocated further east of its existing location and include
  - a dual left-turn lane and single right-turn storage lane for the eastbound U.S. 278 approach
  - single right-turn storage lane for the westbound approach
  - a left, through, and right-turn lane for each side street approach, with storage
  - a roundabout intersection connecting the existing Brickyard Road north of the relocated Henry Moss Boulevard/Medical Center Drive intersection with the southbound approach to U.S. 278
  - signal coordination with the interchange
- driveway openings on U.S. 278 west of the southbound intersection be relocated to connections on U.S. 17
- driveway openings on U.S. 278 between the northbound intersection and Henry Moss Boulevard/Medical Center Drive be consolidated and relocated to the new Henry Moss Boulevard/Medical Center Drive intersection

6. FHWA POLICY REQUIREMENTS

A policy statement for justifying the need for additional or modified access to the existing sections of an Interstate System was first published in the Federal Register on October 22, 1990, entitled "Access to the Interstate System". It was then modified and updated on February 11, 1998, on August 27, 2009, and on May 22, 2017. The objectives of this policy are to ensure that all new or revised access points do not adversely impact the operations and safety of the Interstate System, and all new or revised access points have been vetted through a systematic evaluation process.

To explain the intent and requirements of this new policy, FHWA published a Memorandum on May 22, 2017. This FHWA Guide was followed in preparing the Interstate Modification Report for the Exit 8 Interchange in Jasper County, South Carolina.

6.1 Policy Point 1

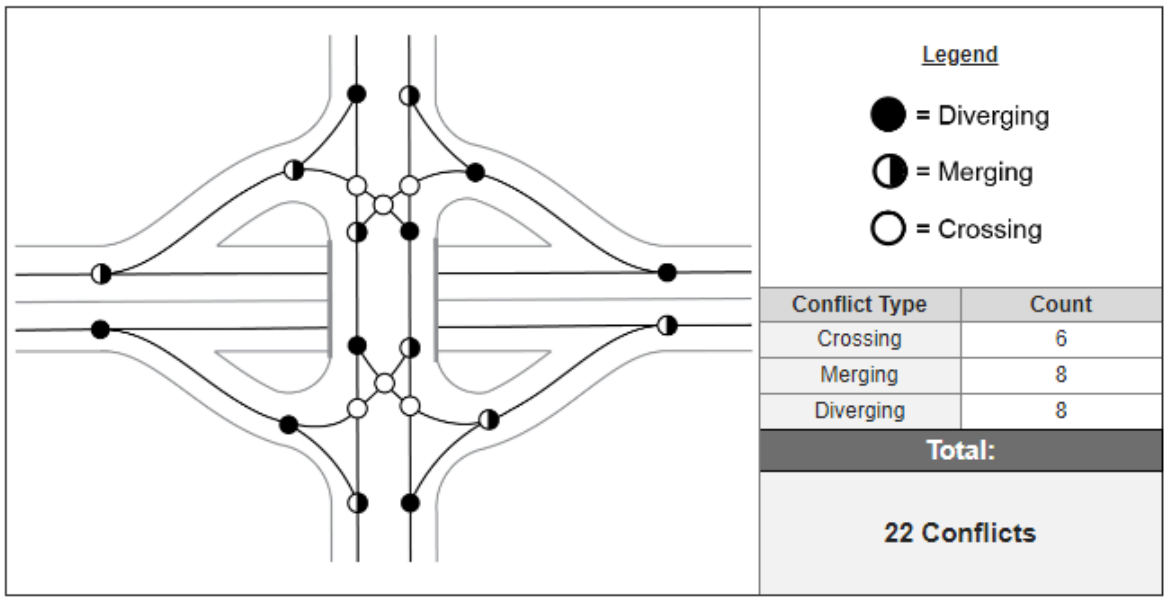
"An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections."

The purpose of the interchange modification is to increase capacity and improve operations at the existing I-95 Exit 8 interchange with U.S. 278. A traffic capacity and safety analysis were performed for the interchange and adjacent Exit 5 interchange with U.S. 17 for the future Opening Year (2030) and Horizon Year (2050) No Build and Build conditions. The existing Exit 8 interchange is estimated to reach failing conditions by 2050, which has the potential to impact northbound I-95 flow at Exit 5. This analysis indicates that the recommended improvements are not expected to cause adverse impacts to interstate or surface street operations and will improve traffic flow along I-95 over the No Build conditions.

Crash analysis presented in Section 2 shows that crash rates for the study interchange are lower than the statewide average, and no specific safety concern was presented for mitigation. The recommended 6-lane DDI will have fewer conflict points than the existing interchange, which should contribute to a reduction in crashes. The existing diamond interchange has 22 conflict points, as shown in **Figure 27**: 8 diverging, 8 merging, and 6 crossing conflict points. In contrast, a diverging diamond interchange has 18 conflict points: 8 diverging, 8 merging and only 2 crossing conflict points.

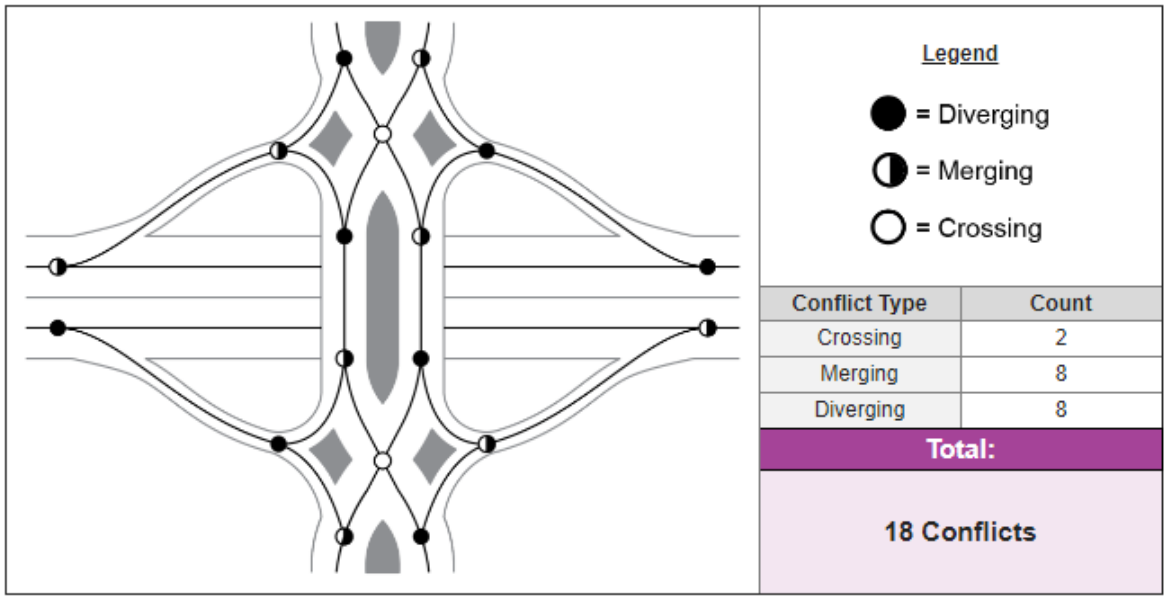
Figure 27: Interchange Conflict Point Comparison

Conventional Diamond Interchange: Conflict Points



Conflict Type	Count
Crossing	6
Merging	8
Diverging	8
Total:	
22 Conflicts	

DDI: Conflict Points



Conflict Type	Count
Crossing	2
Merging	8
Diverging	8
Total:	
18 Conflicts	

Reference: *Innovative Intersections and Interchanges - Info | Virginia Department of Transportation (virginiadot.org)*

Additionally, rear-end collisions were a common type of collision on I-95, which were 49% of the analyzed crashes. Rear-end collisions are typically the result of congestion on the roadway, following too closely, and driving too fast for conditions. The recommended improvements, in conjunction with the proposed interstate widening, are anticipated to mitigate congestion at the interchange, which should reduce crashes of this type.

"The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f))."

The I-95 Exit 18 interchange with State Road S-27-13 is located approximately 10 miles north of Exit 8. Exit 18 was omitted from the analysis due to the distance separating it from Exit 8 and the limited surface street connections between the two areas, negating it as a practical alternative route. The Exit 109 interchange with Augusta Road is approximately 12 miles south of Exit 8 in Georgia. Exit 109 was omitted from the analysis due to the distance separating it from Exit 8 and the lack of alternative river crossings to access the study area from this exit.

The Exit 5 interchange with U.S. 17 is located approximately 2.5 miles south of Exit 8 and was included in the microsimulation modeling. Exit 5 is not expected to be adversely impacted by the modification of Exit 8. Simulation of the future No Build conditions showed the potential of Exit 8 congestion to impact operations at Exit 5 for the northbound I-95 direction. This is expected to be alleviated by improvements to Exit 8.

"The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d))."

The first intersection to the west of the Exit 8 interchange is U.S. 278 at U.S. 17. The estimated future traffic volumes are expected to negatively impact the operation of this intersection, so additional modifications are recommended with the new interchange. A railroad corridor parallel to U.S. 17 limits the possible alternatives, but minor improvements should be able to bring the intersection to an acceptable level of service. Access management improvements on U.S. 278 should also reduce the potential for crashes in the segment between this intersection and the interchange.

The first intersection to the east of the Exit 8 interchange is U.S. 278 at Henry Moss Boulevard/Medical Center Drive. It is expected to impact interchange operations in the future, so this study recommends its relocation. Additional improvements are recommended that should allow the intersection to operate at an acceptable level of service. Access management improvements on U.S. 278 should also reduce the potential for crashes in the segment between this intersection and the interchange.

"Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and

location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).”

The preferred alternative for Exit 8 was presented in Figure 20. The conceptual plan of this interchange shows how each ramp will connect to the I-95 mainline, and analysis shows that these connections will adequately support interchange operations. Conceptual signing plans are provided in **Appendix I**.

6.2 Policy Point 2

The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

This requirement is met for the preferred alternative as the interchange connects to public road U.S. 278 and provides full access for all traffic movements.



APPENDIX A. CRASH DATA

Crash No	City Name	City Type	Roadway Number	Roadway Name	Roadway Type	Road Number	Road Name	Cross Roadway Number	Cross Roadway Name	Cross Roadway Category Name	Cross Roadway Type	Cross Road Number	Cross Road Name	Jurisdiction	# of Injuries	# of Fatalities	Fatality Code	Crash Date/Time	Day of Week	Crash Type	Light Condition	Weather Condition	Roadway Surface Condition	Roadway Defect	Roadway Description	Roadway Division	Roadway Feature	Roadway Character	Roadway Classification	Number of Lanes Involved	Crash Hour	2016	2017	2018
17662526	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA STATE LINE		0	0	0	11/22/2017 12:00:00 AM	932	WEDNESDAY	DRY	DAYLIGHT	33	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		32.2186	-81.14703056		2	SC Highway Patrol Troop 6	17010009500N	2017	
17583114	JASPER	Interstate	95	Main Line	Public	278	Main Line		INDEPENDENCE BLVD	US Primary		17	Main Line		0	0	0	6/19/2017 12:00:00 AM	705	MONDAY	DRY	DAYLIGHT	8	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		32.297	-81.06748889		2	Hardeeville Police Department	27010009550N	2017	
17015692	JASPER	US Route	278	Main Line	Interstate	95	Main Line		RAMP 865S	US Primary		17	Main Line		0	0	1	6/22/2017 12:00:00 AM	1700	THURSDAY	DRY	DAYLIGHT	9	WEST		ANGLE 2		MOTOR VEHICLE (IN TRANSPORT)		32.31238056	-80.05786111		2	Jasper County Sheriff's Office	27020027800E	2017	
17530859	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	Secondary		34	Main Line		0	0	0	3/10/2017 12:00:00 AM	1850	FRIDAY	DRY	DARK (NO LIGHTS)	125	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		32.25998889	-81.09641944		2	Hardeeville Police Department	27010009500N	2017	
17562276	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG ROAD	Other			Proposed Road		0	0	0	5/1/2017 12:00:00 AM	1300	MONDAY	DRY	DAYLIGHT	70	SOUTH		NOT COLLISION W/MOTOR VEHICLE		DITCH		CARGO		32.25396944	-81.10638056		2	SC Highway Patrol Troop 6	27010009500N	2017	
17560075	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	5/16/2017 12:00:00 AM	530	TUESDAY	DRY	DARK (NO LIGHTS)	22	SOUTH		NOT COLLISION W/MOTOR VEHICLE		UNKNOWN MOVABLE OBJECT		DEBRIS		32.25363889	-81.10833056		1	SC Highway Patrol Troop 6	27010009500N	2017	
17681608	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		SPEEDWAY BLVD	Secondary		34	Main Line		0	0	0	12/30/2017 12:00:00 AM	215	SATURDAY	DRY	DARK (NO LIGHTS)	300	SOUTH		NOT COLLISION W/MOTOR VEHICLE		OTHER MOVABLE OBJECT		DEBRIS		32.23901944	-81.14638056		2	SC Highway Patrol Troop 6	27010009500N	2017	
17522400	JASPER	US Route	278	Main Line	Interstate	95	Main Line		JASPER HWY	US Primary		17	Main Line		0	0	0	2/19/2017 12:00:00 AM	1515	SUNDAY	DRY	DAYLIGHT	14	EAST		ANGLE 2		MOTOR VEHICLE (IN TRANSPORT)		DISREGARDED SIGNS, SIGNALS, ETC		32.31213889	-81.06103056		2	Hardeeville Police Department	27020027800E	2017	
17643976	JASPER	US Route	278	Main Line	Interstate	95	Main Line		JASPER HWY	Secondary		422	Main Line		0	0	0	10/21/2017 12:00:00 AM	1242	SATURDAY	DRY	DAYLIGHT	0	EAST		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DISREGARDED SIGNS, SIGNALS, ETC		32.31241111	-81.05693056		2	Hardeeville Police Department	27020027800E	2017	
17675062	JASPER	US Route	278	Main Line	Interstate	95	Main Line		JASPER HWY	US Primary		17	Main Line		0	0	1	12/13/2017 12:00:00 AM	2250	WEDNESDAY	DRY	DARK (STREET LAMP LIT)	9	WEST		ANGLE 1		MOTOR VEHICLE (IN TRANSPORT)		DISREGARDED SIGNS, SIGNALS, ETC		32.31213056	-81.06096944		2	Hardeeville Police Department	27020027800E	2017	
17577820	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		JOHN SMITH RD	SC Primary		46	Main Line		0	0	0	6/9/2017 12:00:00 AM	616	FRIDAY	DRY	DAYLIGHT	47	NORTH		NOT COLLISION W/MOTOR VEHICLE		DITCH		OTHER IMP. ACT		32.29038889	-81.06576944		2	Hardeeville Police Department	27010009500N	2017	
17582986	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG ROAD	Other			Main Line		0	0	0	4/14/2017 12:00:00 AM	1838	FRIDAY	DRY	DAYLIGHT	80	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DISTRACTED/INATT.		32.25368056	-81.11276944		2	Hardeeville Police Department	27010009500N	2017	
17591918	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	SC Primary		46	Main Line		0	0	0	4/7/2017 12:00:00 AM	1724	FRIDAY	DRY	DAYLIGHT	1	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DISTRACTED/INATT.		32.2734	-81.08051944		3	Hardeeville Police Department	27010009500N	2017	
17601532	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	County		34	Main Line		0	0	0	7/8/2017 12:00:00 AM	1126	SATURDAY	DRY	DAYLIGHT	606	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DISTRACTED/INATT.		32.26078889	-81.09548889		2	Hardeeville Police Department	27010009500N	2017	
17611357	JASPER	Interstate	95	Main Line	SC Primary	141	Main Line		JOHN SMITH RD	Other			Main Line		0	0	1	8/11/2017 12:00:00 AM	834	FRIDAY	DRY	DAYLIGHT	8	SOUTH		SIDESWIPE SAME DIRECTION		TREE		DISTRACTED/INATT.		32.29123056	-81.06571111		1	SC Highway Patrol Troop 6	27010009500N	2017	
17616667	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA. STATE LINE		0	0	0	9/7/2017 12:00:00 AM	1218	THURSDAY	DRY	DAYLIGHT	293	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DISTRACTED/INATT.		32.25398056	-81.11751111		2	SC Highway Patrol Troop 6	27010009500N	2017	
17646065	JASPER	Interstate	95	Main Line	US Primary	278	Main Line		INDEPENDENCE BLVD	Secondary		210	Main Line		0	1	0	10/22/2017 12:00:00 AM	1225	SUNDAY	WET	DAYLIGHT	2	NORTH		NOT COLLISION W/MOTOR VEHICLE		SPILL(TWO-WHEELED VEH)		DISTRACTED/INATT.		32.31403056	-81.0950945		1	Hardeeville Police Department	27010009500N	2017	
17683939	JASPER	Interstate	95	Main Line	Secondary	141	Main Line		JOHN SMITH ROAD	US Primary		278	Main Line		0	0	0	12/28/2017 12:00:00 AM	1258	THURSDAY	DRY	DAYLIGHT	26	NORTH		SIDESWIPE SAME DIRECTION		MOTOR VEHICLE (IN TRANSPORT)		DISTRACTED/INATT.		32.28786944	-81.06681111		2	Hardeeville Police Department	27010009500N	2017	
17684078	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	SC Primary		46	Main Line		0	0	0	12/26/2017 12:00:00 AM	2045	TUESDAY	DRY	DARK (NO LIGHTS)	4	NORTH		SIDESWIPE SAME DIRECTION		MOTOR VEHICLE (IN TRANSPORT)		DISTRACTED/INATT.		32.27443889	-81.07906944		2	Hardeeville Police Department	27010009500N	2017	
17503125	JASPER	Interstate	95	Main Line	SC Primary	46	Main Line		E. MAIN STREET	Secondary		141	Main Line		0	0	0	1/2/2017 12:00:00 AM	1345	MONDAY	DRY	DAYLIGHT	4	NORTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.28051111	-81.07205		2	Hardeeville Police Department	27010009500N	2017	
17504008	JASPER	Interstate	95	Main Line	County		Main Line		PURRYSBURG RD	Other			GEORGIA STATE LINE		0	0	0	1/14/2017 12:00:00 AM	1100	SATURDAY	DRY	DAYLIGHT	213	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.24153056	-81.14298056		2	SC Highway Patrol Troop 6	27010009500N	2017	
17508463	JASPER	Interstate	95	Main Line	Secondary	141	Main Line		JOHN SMITH RD	SC Primary		46	Main Line		0	0	0	1/1/2017 12:00:00 AM	811	SUNDAY	WET	DAYLIGHT	51	SOUTH		NOT COLLISION W/MOTOR VEHICLE		MEDIAN BARRIER		DRIVING TOO FAST FOR CONDITIONS		32.29116111	-81.06573889		1	Hardeeville Police Department	27010009500N	2017	
17521455	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	1/1/2017 12:00:00 AM	2020	WEDNESDAY	DRY	DARK (NO LIGHTS)	118	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.25398056	-81.11726111		2	SC Highway Patrol Troop 6	27010009500N	2017	
17528701	JASPER	Interstate	95	Main Line	SC Primary	46	Main Line		E. MAIN STREET	Secondary		141	Main Line		0	1	1	3/10/2017 12:00:00 AM	1545	FRIDAY	DRY	DAYLIGHT	1	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.28028056	-81.07233889		2	Hardeeville Police Department	27010009500N	2017	
17530857	JASPER	Interstate	95	Main Line	SC Primary	46	Main Line		MAIN STREET	US Primary		17	Main Line		0	0	0	3/3/2017 12:00:00 AM	1715	FRIDAY	DRY	DAYLIGHT	3	SOUTH		REAR END		BRIDGE RAIL		DRIVING TOO FAST FOR CONDITIONS		32.2761	-81.08023889		2	Hardeeville Police Department	27010009500N	2017	
17530858	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	3/6/2017 12:00:00 AM	1200	MONDAY	DRY	DARK (NO LIGHTS)	25	SOUTH		NOT COLLISION W/MOTOR VEHICLE		TREE		DRIVING TOO FAST FOR CONDITIONS		32.25336111	-81.11243056		1	SC Highway Patrol Troop 6	27010009500N	2017	
17534898	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA STATE LINE		0	2	1	3/20/2017 12:00:00 AM	745	MONDAY	DRY	DAYLIGHT	427	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.25393056	-81.11668056		2	SC Highway Patrol Troop 6	27010009500N	2017	
17537927	JASPER	Interstate	95	Main Line	Secondary	141	Main Line		JOHN SMITH RD	SC Primary		46	Main Line		0	0	0	3/5/2017 12:00:00 AM	1330	SUNDAY	DRY	DAYLIGHT	100	SOUTH		NOT COLLISION W/MOTOR VEHICLE		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.29258056	-81.06488889		2	Hardeeville Police Department	27010009500N	2017	
17537929	JASPER	Interstate	95	Main Line	Secondary	141	Main Line		JOHN SMITH RD	US Primary		278	Main Line		0	0	0	1/26/2017 12:00:00 AM	955	SUNDAY	DRY	DAYLIGHT	14	NORTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.29521944	-81.06406111		2	Hardeeville Police Department	27010009500N	2017	
17539639	JASPER	Interstate	95	Main Line	County		Main Line		PURRYSBURG RD	Other			GEORGIA STATE LINE		0	1	2	3/31/2017 12:00:00 AM	1130	FRIDAY	DRY	DAYLIGHT	300	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.24706944	-81.13521944		4	SC Highway Patrol Troop 6	27010009500N	2017	
17563294	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	2/22/2017 12:00:00 AM	1640	MONDAY	WET	DAYLIGHT	259	SOUTH		SIDESWIPE SAME DIRECTION		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.25421944	-81.11766944		2	SC Highway Patrol Troop 6	27010009500N	2017	
17563638	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	5/22/2017 12:00:00 AM	1630	MONDAY	WET	DAYLIGHT	237	SOUTH		REAR END		BRIDGE PARAPET END		DRIVING TOO FAST FOR CONDITIONS		32.25363889	-81.12405		2	SC Highway Patrol Troop 6	27010009500N	2017	
17577823	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	SC Primary		46	Main Line		0	0	0	6/10/2017 12:00:00 AM	1247	SATURDAY	DRY	DAYLIGHT	10	NORTH		NOT COLLISION W/MOTOR VEHICLE		MEDIAN BARRIER		DRIVING TOO FAST FOR CONDITIONS		32.27411944	-81.07935		1	Hardeeville Police Department	27010009500N	2017	
17577849	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG ROAD	Other			Main Line		0	0	0	6/24/2017 12:00:00 AM	1130	SATURDAY	DRY	DAYLIGHT	100	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.25406111	-81.11516111		1	SC Highway Patrol Troop 6	27010009500N	2017	
17584407	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other		210	Main Line		0	1	1	7/17/2017 12:00:00 AM	1427	MONDAY	DRY	DAYLIGHT	0	NORTH		REAR END		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.33416944	-81.05946111		2	Hardeeville Police Department	27010009500N	2017	
17600405	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	7/30/2017 12:00:00 AM	1310	SUNDAY	DRY	DAYLIGHT	310	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.23673056	-81.14958056		2	SC Highway Patrol Troop 6	27010009500N	2017	
17600533	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GEORGIA STATE LINE		0	0	0	7/23/2017 12:00:00 AM	1634	SUNDAY	WET	DAYLIGHT	198	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.24688889	-81.13590556		2	SC Highway Patrol Troop 6	27010009500N	2017	
17601702	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	Secondary		34	Main Line		0	0	0	7/21/2017 12:00:00 AM	2238	FRIDAY	DRY	DARK (NO LIGHTS)	300	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.2540856	-81.12155		2	SC Highway Patrol Troop 6	27010009500N	2017	
17611892	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			WHYTE HARDEE BLVD		0	0	0	7/29/2017 12:00:00 AM	1558	SATURDAY	WATER (STANDING, ETC)	DAYLIGHT	16	NORTH		NOT COLLISION W/MOTOR VEHICLE		HIGHWAY TRAFFIC SIGN POST		32.25448056	-81.10411111		2	Hardeeville Police Department	27010009500N	2017	
17611893	JASPER	Interstate	95	Main Line	SC Primary	46	Main Line		E. MAIN ST	US Primary		17	Main Line		0	0	0	8/3/2017 12:00:00 AM	831	THURSDAY	WET	DAYLIGHT	164	SOUTH		NOT COLLISION W/MOTOR VEHICLE		GUARDRAIL FACE		32.27706111	-81.07635		1	Hardeeville Police Department	27010009500N	2017	
17611896	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		INDEPENDENCE BLVD	Secondary		210	Main Line		0	0	0	8/26/2017 12:00:00 AM	1800	SATURDAY	DRY	DAYLIGHT	21	NORTH		NOT COLLISION W/MOTOR VEHICLE		DITCH		OTHER IMP. ACT		32.33413889	-81.05945		2	Hardeeville Police Department	27010009500N	2017	
17612136	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	US Primary		141	Main Line		0	0	0	7/2/2017 12:00:00 AM	1330	SUNDAY	DRY	DAYLIGHT	1	NORTH		REAR END		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.27728056	-81.07571944		2	Hardeeville Police Department	27010009500N	2017	
17612143	JASPER	Interstate	95	Main Line	US Primary	278	Main Line		INDEPENDENCE BLVD	SC Primary		141	Main Line		0	1	0	8/7/2017 12:00:00 AM	2210	MONDAY	WET	DARK (NO LIGHTS)	1	SOUTH		NOT COLLISION W/MOTOR VEHICLE		FENCE		32.30618056	-81.05993056		2	Hardeeville Police Department	27010009500N	2017	
17616674	JASPER	US Route	278	Main Line	County		Main Line		PURRYSBURG RD	Other			GEORGIA STATE LINE		0	0	0	9/8/2017 12:00:00 AM	1605	FRIDAY	DRY	DAYLIGHT	300	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)				32.2453	-81.13773056		2	SC Highway Patrol Troop 6	27010009500N	2017	
17618516	JASPER	Interstate	95	Main Line	Secondary	141	Main Line		JOHN SMITH RD	US Primary		278	Main Line		0	0	0	9/7/2017 12:00:00 AM	1504	THURSDAY	DRY	DAYLIGHT	4	NORTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.311	-81.05948889		2	Hardeeville Police Department	27010009500N	2017	
17620368	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	1	0	9/8/2017 12:00:00 AM	1400	FRIDAY	DRY	DAYLIGHT	245	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.24011944	-81.14463889		2	SC Highway Patrol Troop 6	27010009500N	2017	
17622108	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		INDEPENDENCE BLVD	Secondary		141	Main Line		0	2	0	7/2/2017 12:00:00 AM	1807	SUNDAY	WET	DAYLIGHT	50	SOUTH		NOT COLLISION W/MOTOR VEHICLE		DITCH		OTHER IMP. ACT		32.30366111	-81.06043889		2	Hardeeville Police Department	27010009500N	2017	
17622908	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD.	Other			GA STATE LINE		0	0	0	9/16/2017 12:00:00 AM	1346	SATURDAY	DRY	DAYLIGHT	100	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.25343889	-81.12485		2	SC Highway Patrol Troop 6	27010009500N	2017	
17623997	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA. STATE LINE		0	0	0	9/16/2017 12:00:00 AM	1549	SATURDAY	DRY	DAYLIGHT	115	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.24808889	-81.13428889		2	SC Highway Patrol Troop 6	27010009500N	2017	
17635985	JASPER	US Route	278	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	Secondary		34	Main Line		0	1	0	10/10/2017 12:00:00 AM	1526	TUESDAY	DRY	DAYLIGHT	1	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.24903056	-81.06368889		2	Hardeeville Police Department	27010009500N	2017	
17638249	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE	Secondary		34	Main Line		0	1	0	9/1/2017 12:00:00 AM	717	FRIDAY	DRY	DAYLIGHT	274	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.28446944	-81.07966944		2	Hardeeville Police Department	27010009500N	2017	
17640547	JASPER	Interstate	95	Main Line	SC Primary	46	Main Line		E. MAIN STREET	Secondary		141	Main Line		0	1	2	10/23/2017 12:00:00 AM	1830	MONDAY	WET	DAYLIGHT	88	NORTH		NOT COLLISION W/MOTOR VEHICLE		TREE		DRIVING TOO FAST FOR CONDITIONS		32.28251111	-81.06993889		2	Hardeeville Police Department	27010009500N	2017	
17640549	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	US Primary		17	Main Line		0	0	0	8/22/2017 12:00:00 AM	605	TUESDAY	DRY	DARK (NO LIGHTS)	1	NORTH		NOT COLLISION W/MOTOR VEHICLE		JACKKNIFE		32.27116944	-81.08827		1	Hardeeville Police Department	27010009500N	2017	
17643711	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG ROAD	Other			GEORGIA STATE LINE		0	0	0	10/24/2017 12:00:00 AM	1857	TUESDAY	DRY	DARK (NO LIGHTS)	120	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.25238056	-81.12768889		2	SC Highway Patrol Troop 6	27010009500N	2017	
17644080	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	Secondary		34	Main Line		0	0	0	10/22/2017 12:00:00 AM	2130	SUNDAY	WET	DARK (NO LIGHTS)	9	SOUTH		NOT COLLISION W/MOTOR VEHICLE		DITCH		OTHER IMP. ACT		32.22778056	-81.08123889		1	Hardeeville Police Department	27010009500N	2017	
17656531	JASPER	Interstate	95	Main Line	County		Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	11/14/2017 12:00:00 AM	1830	TUESDAY	DRY	DARK (NO LIGHTS)	300	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)				32.24326111	-81.141		2	SC Highway Patrol Troop 6	27010009500N	2017	
17659598	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			Proposed Road		0	0	0	11/22/2017 12:00:00 AM	1740	WEDNESDAY	DRY	DARK (NO LIGHTS)	205	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.23646944	-81.15051111		2	SC Highway Patrol Troop 6	27010009500N	2017	
17659900	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA STATE LINE		0	0	0	11/25/2017 12:00:00 AM	1755	SATURDAY	DRY	DARK (NO LIGHTS)	100	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.25	-81.10781111		1	SC Highway Patrol Troop 6	27010009500N	2017	
17659901	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA STATE LINE		0	0	0	11/25/2017 12:00:00 AM	1755	SATURDAY	DRY	DARK (NO LIGHTS)	100	SOUTH		REAR END		MOTOR VEHICLE (STOPPED)		DRIVING TOO FAST FOR CONDITIONS		32.25513889	-81.12336111		2	SC Highway Patrol Troop 6	27010009500N	2017	
17660052	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA STATE LINE		0	0	0	11/22/2017 12:00:00 AM	2015	WEDNESDAY	DRY	DAYLIGHT	56	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.25403889	-81.11566111		2	SC Highway Patrol Troop 6	27010009500N	2017	
17662547	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GEORGIA STATE LINE		0	0	0	11/25/2017 12:00:00 AM	1053	SATURDAY	DRY	DAYLIGHT	442	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.25416111	-81.1168		2	SC Highway Patrol Troop 6	27010009500N	2017	
17665195	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	Secondary		34	Main Line		0	0	0	11/26/2017 12:00:00 AM	1047	SUNDAY	DRY	DAYLIGHT	3	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.28008889	-81.07275		1	Hardeeville Police Department	27010009500N	2017	
17679117	JASPER	Interstate	95	Main Line	Secondary	34	Main Line		PURRYSBURG RD	Other			GA STATE LINE		0	0	0	12/27/2017 12:00:00 AM	1029	WEDNESDAY	WET	DAYLIGHT	180	SOUTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		DRIVING TOO FAST FOR CONDITIONS		32.24948889	-81.13231944		2	SC Highway Patrol Troop 6	27010009500N	2017	
17682484	JASPER	Interstate	95	Main Line	County		Main Line		PURRYSBURG RD	US Primary		17	Main Line		0	0	0	12/21/2017 12:00:00 AM	256	THURSDAY	WET	DARK (STREET LAMP NOT LIT)	534	SOUTH		NOT COLLISION W/MOTOR VEHICLE		TREE		DRIVING TOO FAST FOR CONDITIONS		32.25988889	-81.09655		1	Hardeeville Police Department	27010009500N	2017	
17682490	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	County		34	Main Line		0	0	0	12/30/2017 12:00:00 AM	1545	SATURDAY	DRY	DAYLIGHT	1	SOUTH		NOT COLLISION W/MOTOR VEHICLE		MEDIAN BARRIER				32.29156111	-81.08225		1	Hardeeville Police Department	27010009500N	2017	
17537939	JASPER	Interstate	95	Main Line	US Primary	17	Main Line		WHYTE HARDEE BLVD	SC Primary		34	Main Line		0	0	0	3/31/2017 12:00:00 AM	1126	FRIDAY	DRY	DAYLIGHT	0	SOUTH		SIDESWIPE SAME DIRECTION		MOTOR VEHICLE (IN TRANSPORT)		FAIL TO YIELD R.O.W.		32.2637	-81.09091111		2	Hardeeville Police Department	27010009500N	2017	
17558538	JASPER	Interstate	95	Main Line	US Primary	278	Main Line		INDEPENDENCE BLVD	US Primary		141	Main Line		0	0	0	4/19/2017 12:00:00 AM	25	WEDNESDAY	DRY	DARK (NO LIGHTS)	1	SOUTH		SIDESWIPE SAME DIRECTION		MOTOR VEHICLE (IN TRANSPORT)		FAIL TO YIELD R.O.W.		32.31726111	-81.05871111		3	Hardeeville Police Department	27010009500N	2017	
17650707	JASPER	Interstate	95	Main Line	SC Primary	46	Main Line		WHYTE HARDEE BLVD	SC Primary		46	Main Line		0	0	0	11/7/2017 12:00:00 AM	1200	TUESDAY	DRY	DAYLIGHT	1	NORTH		REAR END		MOTOR VEHICLE (IN TRANSPORT)		FAIL TO YIELD R.O.W.		32.27328889	-81.08028889		2	Hardeeville Police Department	27010009500N	2017	
17646613	JASPER	Ramp	8650	Quad 2 On-Ramp

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18607352	JASPER	Interstate	95	Main Line	3.134	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	1	8/4/2018 12:00:00 AM	1511	SATURDAY	DRY	DAYLIGHT	1	NORTH	NOT COLLISION W/MOTOR VEHICLE	OVERTURN/ROLLOVER	TIRES/WHEEL	32.25431944	-81.30525	1	Hardeeville Police Department	27010009500N	2018						
18585445	JASPER	Interstate	95	Main Line	3.784	JASPER HWY	County	34	Main Line	PURRYSBURG RD	US Primary	17	Main Line	WHYTE HARDEE BLVD	1	0	4	6/3/2018 12:00:00 AM	2158	SUNDAY	DRY	DARK (NO LIGHTS)	533	SOUTH	NOT COLLISION W/MOTOR VEHICLE	OTHER (POST, POLE, SUPPORT, ETC)	UNDER THE INFLUENCE	32.25978056	-81.09665	1	Hardeeville Police Department	27010009500N	2018						
18691298	JASPER	Interstate	95	Main Line	7.722	JASPER HWY	Interstate	278	Main Line	INDEPENDENCE BLVD	Interstate	141	Main Line	JOHN SMITH	0	0	0	11/27/2018 12:00:00 AM	1504	TUESDAY	DRY	DAYLIGHT		NORTH	NOT COLLISION W/MOTOR VEHICLE	GUARDRAIL FACE	UNDER THE INFLUENCE	32.30571111	-81.0599889	1	Hardeeville Police Department	27010009500N	2018						
18644964	JASPER	Interstate	95	Main Line	7.706	JASPER HWY	Secondary	141	Main Line	JOHN SMITH RD	US Primary	278	Main Line	INDEPENDENCE BLVD	0	0	0	10/5/2018 12:00:00 AM	1500	FRIDAY	DRY	DAYLIGHT	300	NORTH	SIDESWIPE SAME DIRECTION	MOTOR VEHICLE (IN TRANSPORT)	UNKNOWN	32.30551111	-81.06025	1	Hardeeville Police Department	27010009500N	2018						
18659748	JASPER	Interstate	95	Main Line	8.23	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	SC Primary	210	Main Line	CROW FIELD ROAD	0	0	0	10/19/2018 12:00:00 AM	1430	FRIDAY	DRY	DAYLIGHT	7	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	UNKNOWN	32	-78	2	Hardeeville Police Department	27010009500N	2018						
18673835	JASPER	Interstate	95	Main Line	6.012	JASPER HWY	SC Primary	46	Main Line	MAIN ST	Secondary	141	Main Line	JOHN SMITH RD	0	0	0	12/9/2018 12:00:00 AM	1050	SUNDAY	WET	DAYLIGHT	87	NORTH	NOT COLLISION W/MOTOR VEHICLE	MEDIAN BARRIER	WEATHER CONDITION	32.28251111	-81.06998889	2	Hardeeville Police Department	27010009500N	2018						
18584601	JASPER	Interstate	95	Main Line	0.774	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	Other			STATE LINE	0	0	0	6/17/2018 12:00:00 AM	1618	SUNDAY	DRY	DAYLIGHT	147	SOUTH	ANGLE 1	MOTOR VEHICLE (IN TRANSPORT)	WRONG SIDE OR WRONG WAY	32.24301111	-81.14133889	2	SC Highway Patrol Troop 6	27010009500N	2018						
18625923	JASPER	Interstate	95	Main Line	3.968	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	8/29/2018 12:00:00 AM	2138	WEDNESDAY	DRY	DARK (LIGHTING UNSPECIFIED)	100	SOUTH	BACKED INTO	MOTOR VEHICLE (STOPPED)	WRONG SIDE OR WRONG WAY	32.26103056	-81.09037	2	Hardeeville Police Department	27010009500N	2018						
19567948	JASPER	Interstate	95	Main Line	4.269	JASPER HIGHWAY	US Primary	17	Main Line	WHYTE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG RD	0	0	0	5/3/2019 12:00:00 AM	1120	FRIDAY	WET	DAYLIGHT	505	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	AGGRESSIVE OPERATION OF VEHICLE	32.26428056	-81.09026944	2	Hardeeville Police Department	27010009500N		2019					
19582722	JASPER	Interstate	95	Main Line	5.088	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	6/11/2019 12:00:00 AM	1501	TUESDAY	WET	DAYLIGHT	0	SOUTH	ANGLE 3	BRIDGE OVERHEAD STRUCTURE	AGGRESSIVE OPERATION OF VEHICLE	32.27281111	-81.08081111	2	Hardeeville Police Department	27010009500N		2019					
19636039	JASPER	Interstate	95	Main Line	3.191	JASPER HWY	Secondary	34	Main Line	PURRYSBURG ROAD	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	9/13/2019 12:00:00 AM	1705	FRIDAY	DRY	DAYLIGHT	1	NORTH	ANGLE 1	MOTOR VEHICLE (OTHER ROADWAY)	AGGRESSIVE OPERATION OF VEHICLE	32.25416944	-81.10416944	2	Hardeeville Police Department	27010009500N		2019					
19506097	JASPER	Interstate	95	Main Line	8.491	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	210	Main Line	CROWFIELD RD	0	0	0	1/13/2019 12:00:00 AM	720	SUNDAY	DRY	DAYLIGHT	0	SOUTH	NOT COLLISION W/MOTOR VEHICLE	ANIMAL (DEER ONLY)	ANIMAL IN ROAD	32.31688889	-81.05591306	2	Hardeeville Police Department	27010009500N		2019					
19519976	JASPER	Interstate	95	Main Line	8.29	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	210	Main Line	CROWFIELD RD	0	0	0	2/17/2019 12:00:00 AM	342	SUNDAY	WET	DARK (NO LIGHTS)	1	NORTH	NOT COLLISION W/MOTOR VEHICLE	ANIMAL (DEER ONLY)	ANIMAL IN ROAD	32.31388889	-81.05856111	2	Hardeeville Police Department	27010009500N		2019					
19678040	JASPER	Interstate	95	Main Line	8.24	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	210	Main Line	CROWFIELD RD	0	0	0	12/14/2019 12:00:00 AM	1819	SATURDAY	DRY	DARK (NO LIGHTS)	25	NORTH	NOT COLLISION W/MOTOR VEHICLE	ANIMAL (DEER ONLY)	ANIMAL IN ROAD	32.31323056	-81.05951944	2	Hardeeville Police Department	27010009500N		2019					
19589357	JASPER	Interstate	95	Main Line	3.723	JASPER HWY	Secondary	34	Main Line	WHYTE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG RD	0	0	0	9/26/2019 12:00:00 AM	1320	WEDNESDAY	DRY	DAYLIGHT	300	NORTH	NOT COLLISION W/MOTOR VEHICLE	OTHER MOVABLE OBJECT	BRAKES	32.25846111	-81.09658056	2	SC Highway Patrol Troop 6	27010009500N		2019					
19566612	JASPER	Interstate	95	Main Line	2.519	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	Other			Proposed Road	GEORGIA STATE LINE	0	0	0	5/12/2019 12:00:00 AM	2031	SUNDAY	DRY	DARK (NO LIGHTS)	200	SOUTH	NOT COLLISION W/MOTOR VEHICLE	MEDIAN BARRIER	DEBRIS	32.25385	-81.11563889	1	SC Highway Patrol Troop 6	27010009500N		2019					
19591457	JASPER	Interstate	95	Main Line	2.507	JASPER HWY MM 3	Secondary	34	Main Line	PURRYSBURG ROAD	Other			Main Line	GEORGIA STAT LINE	0	0	0	7/2/2019 12:00:00 AM	1754	TUESDAY	DRY	DAYLIGHT	100	SOUTH	NOT COLLISION W/MOTOR VEHICLE	OTHER MOVABLE OBJECT	DEBRIS	32.25421111	-81.11158	1	Hardeeville Police Department	27010009500N		2019					
19604768	JASPER	Interstate	95	Main Line	4.026	JASPER HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG ROAD	0	0	0	7/21/2019 12:00:00 AM	1055	SUNDAY	DRY	DAYLIGHT	5	SOUTH	NOT COLLISION W/MOTOR VEHICLE	OTHER	DEBRIS	32.26218889	-81.09373889	1	Hardeeville Police Department	27010009500N		2019					
19617458	JASPER	Interstate	95	Main Line	5.233	JASPER HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	SC Primary	46	Main Line	MAIN ST	0	0	0	8/13/2019 12:00:00 AM	1020	TUESDAY	DRY	DAYLIGHT	4	NORTH	NOT COLLISION W/MOTOR VEHICLE	OTHER MOVABLE OBJECT	DEBRIS	32.27446111	-81.07093	1	Hardeeville Police Department	27010009500N		2019					
19548839	JASPER	Interstate	95	Main Line	4.487	JASPER HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG RD	0	4	1	3/22/2019 12:00:00 AM	1150	FRIDAY	DRY	DAYLIGHT	298	NORTH	SIDESWIPE SAME DIRECTION	MOTOR VEHICLE (IN TRANSPORT)	DISREGARDED SIGNS, SIGNALS, ETC	32.26661111	-81.08775	2	Hardeeville Police Department	27010009500N		2019					
19540212	JASPER	US Route	278	Main Line	12.359	INDEPENDENCE BLVD	Interstate	95	Main Line	JASPER HIGHWAY	SC Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	3/21/2019 12:00:00 AM	1705	THURSDAY	DRY	DAYLIGHT	16	WEST	ANGLE 2	MOTOR VEHICLE (IN TRANSPORT)	DISREGARDED SIGNS, SIGNALS, ETC	32.31215	-81.0611	2	Hardeeville Police Department	27020027800E		2019					
19560797	JASPER	US Route	278	Main Line	32.541	INDEPENDENCE BLVD	Interstate	95	Main Line	JASPER HWY	Secondary	422	Main Line	MEDICAL CENTER DR	0	2	2	5/3/2019 12:00:00 AM	1105	FRIDAY	WET	DAYLIGHT	4	EAST	HEAD ON	MOTOR VEHICLE (IN TRANSPORT)	DISREGARDED SIGNS, SIGNALS, ETC	32.31238889	-81.05783056	2	Hardeeville Police Department	27020027800E		2019					
19604166	JASPER	US Route	278	Main Line	32.45	INDEPENDENCE BLVD	Interstate	95	Main Line	JASPER HWY	US Primary	17	Main Line	KATO BAY RD	0	0	0	8/1/2019 12:00:00 AM	657	THURSDAY	DRY	DAYLIGHT	1	EAST	ANGLE 3	MOTOR VEHICLE (IN TRANSPORT)	DISREGARDED SIGNS, SIGNALS, ETC	32.51346944	-81.03908056	2	Hardeeville Police Department	27020027800E		2019					
19548844	JASPER	Interstate	95	Main Line	4.734	JASPER HWY	Secondary	34	Main Line	WHYTE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG RD	0	1	1	4/6/2019 12:00:00 AM	1300	SATURDAY	WET	DAYLIGHT	87	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.26921111	-81.08486111	2	Hardeeville Police Department	27010009500N		2019					
19590975	JASPER	Interstate	95	Main Line	5.087	JASPER HIGHWAY	US Primary	17	Main Line	WHYTE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG ROAD	0	0	0	6/12/2019 12:00:00 AM	1436	WEDNESDAY	WET	DAYLIGHT	10	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.27281111	-81.08083889	2	Hardeeville Police Department	27010009500N		2019					
19603447	JASPER	Interstate	95	Main Line	4.415	JASPER HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	County	34	Main Line	PURRYSBURG RD	0	2	2	7/23/2019 12:00:00 AM	914	TUESDAY	DRY	DAYLIGHT	0	SOUTH	ANGLE 3	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.26618056	-81.08901111	4	Hardeeville Police Department	27010009500N		2019					
19629669	JASPER	Interstate	95	Main Line	3.816	JASPER HWY	Secondary	34	Main Line	OKATIE HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	8/8/2019 12:00:00 AM	1312	THURSDAY	DRY	DAYLIGHT	607	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.2602	-81.09625	2	Hardeeville Police Department	27010009500N		2019					
19672106	JASPER	Interstate	95	Main Line	1.831	JASPER HWY	County		Main Line	PURRYSBURG RD	Other			STATE LINE	0	0	0	12/3/2019 12:00:00 AM	1820	TUESDAY	DRY	DARK (STREET LAMP NOT LIT)	250	SOUTH	SIDESWIPE SAME DIRECTION	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.25258056	-81.12718889	2	SC Highway Patrol Troop 6	27010009500N		2019					
19680221	JASPER	Interstate	95	Main Line	1.831	JASPER HWY	County		Main Line	PURRYSBURG RD	Other			Proposed Road	STATE LINE	0	0	0	12/3/2019 12:00:00 AM	1816	TUESDAY	DRY	DARK (STREET LAMP NOT LIT)	250	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.25258056	-81.12718889	2	SC Highway Patrol Troop 6	27010009500N		2019					
19681157	JASPER	Interstate	95	Main Line	7.56	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	141	Main Line	JOHN SMITH RD	0	1	1	11/30/2019 12:00:00 AM	1238	FRIDAY	DRY	DAYLIGHT	60	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.27276111	-81.09573944	3	Hardeeville Police Department	27010009500N		2019					
19686376	JASPER	Interstate	95	Main Line	0.686	JASPER HWY	Secondary	34	Main Line	OKATIE HWY	Other			Proposed Road	GEORGIA STATE LINE	0	0	0	12/30/2019 12:00:00 AM	1339	MONDAY	DRY	DAYLIGHT	25	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.24218056	-81.14248889	2	SC Highway Patrol Troop 6	27010009500N		2019					
19603448	JASPER	Ramp	8654	Quad 1 Exit-Ramp 1	0.332	RAMP 8654	Interstate	95	Main Line	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	0	0	0	7/26/2019 12:00:00 AM	1105	FRIDAY	DRY	DAYLIGHT	2	EAST	REAR END	MOTOR VEHICLE (STOPPED)	DISTRACTED/INATT.	32.31238056	-81.0571	2	Hardeeville Police Department	27050865414N		2019					
19535887	JASPER	Ramp	9655	Quad 2 On-Ramp 1	0.21	EXIT 8	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	210	Main Line	CROWFIELD RD	0	1	3	1/11/2019 12:00:00 AM	1608	WEDNESDAY	DRY	DAYLIGHT	NORTH		REAR END	MOTOR VEHICLE (IN TRANSPORT)	DISTRACTED/INATT.	32.31473056	-81.05891944	2	Hardeeville Police Department	27050865314N		2019					
19500330	JASPER	Interstate	95	Main Line	1.085	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	Other			Proposed Road	GEORGIA STATE LINE	0	1	1	1/2/2019 12:00:00 AM	1105	WEDNESDAY	DRY	DAYLIGHT	120	SOUTH	REAR END	MOTOR VEHICLE (STOPPED)	DRIVING TOO FAST FOR CONDITIONS	32.24573056	-81.1371	3	SC Highway Patrol Troop 6	27010009500N		2019					
19518058	JASPER	Interstate	95	Main Line	5.78	JASPER HWY	SC Primary	46	Main Line	MAIN STREET	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	2/12/2019 12:00:00 AM	1644	TUESDAY	WET	DAYLIGHT	1	SOUTH	ANGLE 3	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.46666944	-81.12471944	2	Hardeeville Police Department	27010009500N		2019					
19521738	JASPER	Interstate	95	Main Line	8.16	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD.	Secondary	210	Main Line	CROWFIELD RD	0	0	0	2/20/2019 12:00:00 AM	1644	WEDNESDAY	DRY	DAYLIGHT	1	NORTH	ANGLE 3	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.53186944	-81.09973944	2	Hardeeville Police Department	27010009500N		2019					
19523415	JASPER	Interstate	95	Main Line	7.783	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	141	Main Line	JOHN SMITH RD	0	0	0	2/24/2019 12:00:00 AM	1205	SUNDAY	WET	DAYLIGHT	50	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.30661944	-81.06013889	3	SC Highway Patrol Troop 6	27010009500N		2019					
19523714	JASPER	Interstate	95	Main Line	5.558		SC Primary	46	Main Line	MAIN ST	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	2/24/2019 12:00:00 AM	523	THURSDAY	WET	DARK (NO LIGHTS)	139	SOUTH	NOT COLLISION W/MOTOR VEHICLE	MEDIAN BARRIER		32.2777	-81.07526944	1	Hardeeville Police Department	27010009500N		2019					
19547241	JASPER	Interstate	95	Main Line	12.462	JASPER HWY	US Primary	17	Main Line	MAIN STREET	Secondary	141	Main Line	JOHN SMITH ROAD	0	0	0	4/13/2019 12:00:00 AM	1046	SATURDAY	DRY	DAYLIGHT	1	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.46735	-81.12331111	2	Hardeeville Police Department	27010009500N		2019					
19547330	JASPER	Interstate	95	Main Line	5.11	JASPER HIGHWAY	US Primary	17	Main Line	WHITE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG RD	0	0	0	4/13/2019 12:00:00 AM	1110	SATURDAY	DRY	DAYLIGHT	2	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.44443889	-81.15111111	2	Hardeeville Police Department	27010009500N		2019					
19547834	JASPER	Interstate	95	Main Line	5.361	JASPER HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	US Primary	46	Main Line	MAIN STREET	0	0	0	4/9/2019 12:00:00 AM	2050	TUESDAY	WET	DARK (NO LIGHTS)	1	NORTH	NOT COLLISION W/MOTOR VEHICLE	MEDIAN BARRIER		32.27556111	-81.07775	1	Hardeeville Police Department	27010009500N		2019					
19548843	JASPER	Interstate	95	Main Line	7.275	JASPER HIGHWAY	US Primary	17	Main Line	JOHN SMITH RD	US Primary	278	Main Line	INDEPENDENCE BLVD	0	0	0	4/13/2019 12:00:00 AM	928	SATURDAY	DRY	DAYLIGHT	55	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.29955944	-81.06233889	2	Hardeeville Police Department	27010009500N		2019					
19549012	JASPER	Interstate	95	Main Line	8.16	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	210	Main Line	CROW FIELD RD	0	0	0	4/13/2019 12:00:00 AM	1013	SATURDAY	DRY	DAYLIGHT	1	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.52583056	-81.08556111	2	Hardeeville Police Department	27010009500N		2019					
19551670	JASPER	Interstate	95	Main Line	0.986	JASPER HWY	County	34	Main Line	PURRYSBURG RD	Other			Proposed Road	GA STATE LINE	0	0	0	4/14/2019 12:00:00 AM	1058	SUNDAY	DRY	DAYLIGHT	150	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.24498889	-81.13856944	2	SC Highway Patrol Troop 6	27010009500N		2019					
19576642	JASPER	Interstate	95	Main Line	3.812	JASPER HWY	US Primary	17	Main Line	PURRYSBURG ROAD	US Primary	278	Main Line	WHYTE HARDEE BLVD	0	0	0	6/7/2019 12:00:00 AM	1825	FRIDAY	DRY	DAYLIGHT	3	NORTH	NOT COLLISION W/MOTOR VEHICLE	TREE		32.25936944	-81.09553111	3	Hardeeville Police Department	27010009500N		2019					
19578976	JASPER	Interstate	95	Main Line	6.85	JASPER HWY	Secondary	141	Main Line	JOHN SMITH RD	SC Primary	46	Main Line	MAIN ST	0	0	0	6/9/2019 12:00:00 AM	1438	SUNDAY	WET	DAYLIGHT	2	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.45221944	-81.13	2	Hardeeville Police Department	27010009500N		2019					
19578977	JASPER	Interstate	95	Main Line	4.513	JASPER HIGHWAY	US Primary	17	Main Line	WHYTE HARDEE BLVD	Secondary	34	Main Line	PURRYSBURG RD	0	0	0	6/9/2019 12:00:00 AM	1353	SUNDAY	WET	DAYLIGHT	46	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.26723889	-81.08791111	2	Hardeeville Police Department	27010009500N		2019					
19578984	JASPER	Interstate	95	Main Line	5.144	JASPER HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	SC Primary	46	Main Line	MAIN STREET	0	1	1	6/9/2019 12:00:00 AM	1350	SUNDAY	WET	DAYLIGHT	1	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.27353056	-81.08036111	2	Hardeeville Police Department	27010009500N		2019					
19579344	JASPER	Interstate	95	Main Line	8.16	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	141	Main Line	JOHN SMITH RD	0	0	0	6/12/2019 12:00:00 AM	1115	WEDNESDAY	WET	DAYLIGHT	1	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.52138889	-81.08583056	2	Hardeeville Police Department	27010009500N		2019					
19585135	JASPER	Interstate	95	Main Line	1.338	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	Other			Proposed Road	GA STATE LINE	0	2	2	6/16/2019 12:00:00 AM	1245	SUNDAY	DRY	DAYLIGHT	200	SOUTH	REAR END	MOTOR VEHICLE (STOPPED)		32.2483	-81.134	4	SC Highway Patrol Troop 6	27010009500N		2019					
19590522	JASPER	Interstate	95	Main Line	1.183	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	Other			Proposed Road	GEORGIA STATE LINE	0	3	3	6/28/2019 12:00:00 AM	1440	FRIDAY	DRY	DAYLIGHT	250	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.24638889	-81.136	2	SC Highway Patrol Troop 6	27010009500N		2019					
19593243	JASPER	Interstate	95	Main Line	8.151	JASPER HIGHWAY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	141	Main Line	JOHN SMITH RD	0	0	0	6/29/2019 12:00:00 AM	1650	SATURDAY	WET	DAYLIGHT	2	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.31193889	-81.05963889	2	Hardeeville Police Department	27010009500N		2019					
19593878	JASPER	Interstate	95	Main Line	6.286	JASPER HWY	SC Primary	46	Main Line	MAIN ST	Secondary	141	Main Line	JOHN SMITH RD	0	0	0	6/22/2019 12:00:00 AM	1403	SATURDAY	DRY	DAYLIGHT	3	SOUTH	REAR END	MOTOR VEHICLE (STOPPED)	DRIVING TOO FAST FOR CONDITIONS	32.28601111	-81.06783889	2	Hardeeville Police Department	27010009500N		2019					
19593880	JASPER	Interstate	95	Main Line	5.773	JASPER HWY	SC Primary	17	Main Line	MAIN ST	US Primary	17	Main Line	WHYTE HARDEE BLVD	0	0	0	6/22/2019 12:00:00 AM	1015	SATURDAY	DRY	DAYLIGHT	2	SOUTH	REAR END	MOTOR VEHICLE (STOPPED)	DRIVING TOO FAST FOR CONDITIONS	32.28011111	-81.07288056	2	Hardeeville Police Department	27010009500N		2019					
19595119	JASPER	Interstate	95	Main Line	7.532	JASPER HWY	US Primary	278	Main Line	INDEPENDENCE BLVD	Secondary	141	Main Line	JOHN SMITH ROAD	0	0	0	6/18/2019 12:00:00 AM	1313	TUESDAY	WET	DAYLIGHT	5	SOUTH	NOT COLLISION W/MOTOR VEHICLE	MEDIAN BARRIER		32.30306111	-81.06083056	2	Hardeeville Police Department	27010009500N		2019					
19597082	JASPER	Interstate	95	Main Line	2.394	JASPER HWY	County		Main Line	PURRYSBURG RD	Other			Proposed Road	GEORGIA STATE LINE	0	0	0	7/4/2019 12:00:00 AM	418	THURSDAY	DRY	DARK (LIGHTING UNSPECIFIED)	560	SOUTH	ANGLE 3	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.25423056	-81.11775	2	SC Highway Patrol Troop 6	27010009500N		2019					
19612925	JASPER	Interstate	95	Main Line	2.557	JASPER HWY	County		Main Line	PURRYSBURG RD	Other			Proposed Road	GEORGIA STATE LINE	0	0	0	8/4/2019 12:00:00 AM	1505	SUNDAY	DRY	DAYLIGHT	170	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	DRIVING TOO FAST FOR CONDITIONS	32.25381111	-81.11498889	2	SC Highway Patrol Troop 6	27010009500N		2019					
19625348	JASPER	Interstate	95	Main Line	5.32	JASPER HWY	US Primary	17	Main Line	WHYTE HARDEE BLVD	SC Primary	46	Main Line	MAIN ST.	0	2	2	8/26/2019 12:00:00 AM	2015	MONDAY	DRY	DARK (NO LIGHTS)	3	NORTH	NOT COLLISION W/MOTOR VEHICLE	MEDIAN BARRIER		32.27523889	-81.07811944	2	Hardeeville Police Department	27010009500N		2019					
19623220	JASPER	Interstate	95	Main Line	6.699		Secondary	141	Main Line	JOHN SMITH RD	SC Primary	46	Main Line	MAIN ST	1	3	3	8/26/2019 12:00:00 AM	55	MONDAY	DRY	DARK (NO LIGHTS)	48	SOUTH	NOT COLLISION W/MOTOR VEHICLE	OVERTURN/ROLLOVER		32.29165	-81.06551111	1	Hardeeville Police Department	27010009500N		2019					
19660479	JASPER	Interstate	95	Main Line	7.831	JASPER HWY	Secondary	141	Main Line	JOHN SMITH RD	US Primary	278	Main Line	INDEPENDENCE BLVD	0	0	0	11/16/2019 12:00:00 AM	307	SATURDAY	WET	DAYLIGHT	80	NORTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)	MEDIAN BARRIER		32.30728889	-81.05973889	2	Hardeeville Police Department	27010009500N		2019					
19664260	JASPER	Interstate	95	Main Line	2.489	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	Other			Proposed Road	GA STATE LINE	0	0	0	11/16/2019 12:00:00 AM	650	SATURDAY	WET	DAYLIGHT	50	SOUTH	NOT COLLISION W/MOTOR VEHICLE	MEDIAN BARRIER		32.25388056	-81.11613889	2	SC Highway Patrol Troop 6	27010009500N		2019					
19668856	JASPER	Interstate	95	Main Line	0.788	JASPER HWY	Secondary	34	Main Line	PURRYSBURG RD	Other			Proposed Road	GEORGIA STATE LINE	0	0	0	11/22/2019 12:00:00 AM	1550	FRIDAY	DRY	DAYLIGHT	180	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)		32.24313889	-81.14116111	2	SC Highway Patrol Troop 6	27010009500N		2019					
19670095	JASPER	Interstate	95	Main Line	7.775	JASPER HWY	Secondary	141	Main Line	JOHN SMITH RD	US Primary	278	Main Line	INDEPENDENCE BLVD	0	0	0	11/26/2019 12:00:00 AM	1730	TUESDAY	DRY	DARK (NO LIGHTS)	30	SOUTH	REAR END	MOTOR VEHICLE (IN TRANSPORT)		32.3065	-81.06013056	2	Hardeeville Police Department	27010009500N		2019				

COMBINED

I-95 from Georgia/South Carolina Border to US 278

Source for AADT segments: https://scdot.maps.arcgis.com/apps/MinimalGallery/index.html?appid=7420aa1f39d84400a6d7e8cdaacc89cd#

AADT		I-95 from Georgia/South Carolina Border to US 17 (Station 2353)	I-95 from US 17 to US 278 (Station 2355)	**I-95 from Georgia/South Carolina Border to US 278**	
	2017	55,300	58,300		
	2018	57,000	60,200		
	2019	59,100	62,700		
Avg AADT for 3 years		57,133	60,400	117,533	
Segment Length		5.11	3.05	8.16	
Number of Years		3	3	3	
MVM (VMT)		319.69	201.72	1,050	
Number of Crashes on Segment		214	155	369	
Segment Crash Rate		0.669	0.768	0.351	crashes per million VMT

COMBINED

US 278 from S-442 (Argent Blvd to US 17 (Whyte Hardee Blvd)

AADT		US 278 from I-95 to S-442 (Argent Blvd) (Station 0239)	US 278 from I-95 to US 17 (Whyte Hardee Blvd) (Station 0293)	**US 278 from Hardee Station Blvd to Milepoint 32.6 (approximately EnMarket driveway)**	
	2017	29,800	5,700		
	2018	29,700	6,200		
	2019	30,000	4,100		
		29,833	5,333	35,167	
Segment Length (Segment Length of Crash Data Available)		0.15	0.20	0.35	
Number of Years		3	3	3	
MVM (VMT)		4.90	1.17	13.48	
Number of Crashes on Segment		31	17	48	
Segment Crash Rate		6.326	14.555	3.56	crashes per million VMT

US 278 at I-95 SB Ramps Intersection

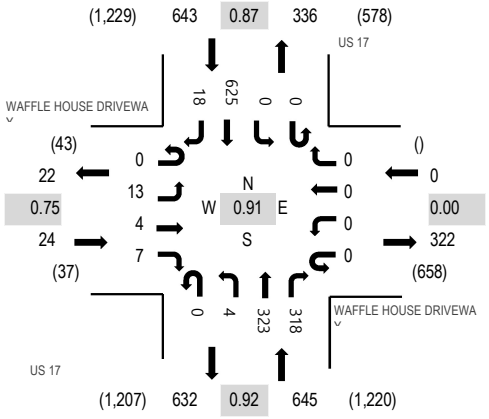
AADT		US 278 from I-95 to US 17 (Whyte Hardee Blvd) (Station 0293)	I-95 SB Ramp to US 278 (Station 8656)	*Ramp AADTs were not available at the SCDOT GIS site above (https://scdot.maps.arcgis.com/apps/MinimalGallery/index.html?appid=7420aa1f39d84400a6d7e8cdaacc89cd#), the SCDOT Traffic data link below had ramp volumes for 2018 and 2019
	2017	5,700	3400	
	2018	6,200	3400	https://scdottrafficdata.drakewell.com/annualsitestats.asp?node=SCDOT%5FPORTABLES&cosit=000000278656
	2019	4,100	3400	https://scdottrafficdata.drakewell.com/annualsitestats.asp?node=SCDOT%5FPORTABLES&cosit=000000278656
Avg AADT for 3 Years		5,333	3,400	
Total Entering Vehicles Avg AADT for 3 Years		8,733		
Number of Years		3		
MEV (Million Entering Vehicles)		9.563		
Number of Crashes in Intersection for 3 Years		12		
Intersection Crash Rate		1.255	crashes per million entering vehicles	

APPENDIX B. VOLUME COLLECTION DATA AND DEVELOPMENT INFORMATION

ALL TRAFFIC DATA SERVICES
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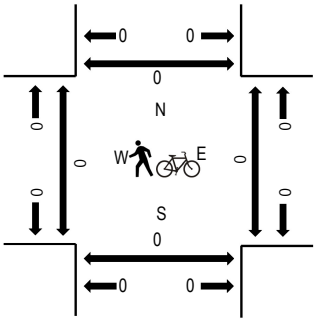
Location: 13 US 17 & WAFFLE HOUSE DRIVEWAY AM
Date: Thursday, December 2, 2021
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	WAFFLE HOUSE DRIVEWAY Eastbound				WAFFLE HOUSE DRIVEWAY Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	5	2	1	0	0	0	0	0	2	91	68	0	0	138	6	313	1,312	0	0	0	0
7:15 AM	0	1	0	4	0	0	0	0	0	2	93	80	0	0	175	4	359	1,280	0	0	0	0
7:30 AM	0	2	2	0	0	0	0	0	0	0	61	92	0	0	188	1	346	1,221	0	0	0	0
7:45 AM	0	5	0	2	0	0	0	0	0	0	78	78	0	0	124	7	294	1,185	0	0	0	0
8:00 AM	0	2	1	0	0	0	0	0	0	0	50	72	0	0	153	3	281	1,174	0	0	0	0
8:15 AM	0	2	0	1	0	0	0	0	0	0	65	85	1	0	144	2	300		0	0	0	0
8:30 AM	0	0	0	1	0	0	0	0	0	3	53	100	0	0	147	6	310		0	0	0	0
8:45 AM	0	2	0	4	0	0	0	0	0	3	66	78	1	0	125	4	283		0	0	0	0

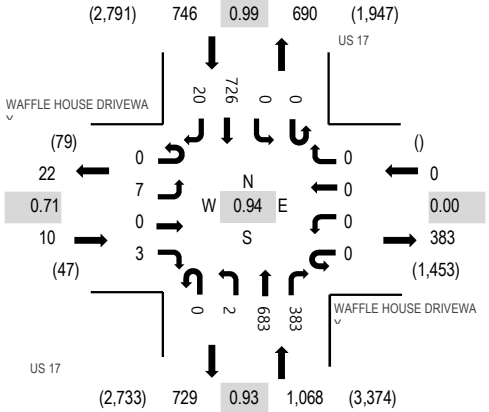
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	1	0	0	0	0	0	0	50	74	0	0	119	0	244
Lights	0	13	4	6	0	0	0	0	0	4	250	224	0	0	479	18	998
Mediums	0	0	0	0	0	0	0	0	0	0	23	20	0	0	27	0	70
Total	0	13	4	7	0	0	0	0	0	4	323	318	0	0	625	18	1,312

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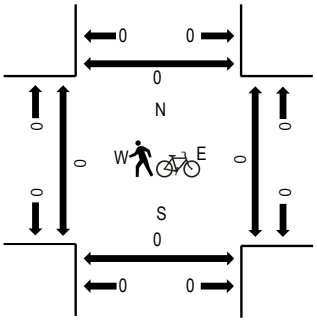
Location: 13 US 17 & WAFFLE HOUSE DRIVEWAY PM
Date: Thursday, December 2, 2021
Peak Hour: 04:30 PM - 05:30 PM
Peak 15-Minutes: 05:15 PM - 05:30 PM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	WAFFLE HOUSE DRIVEWAY Eastbound				WAFFLE HOUSE DRIVEWAY Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:00 PM	0	1	1	0	0	0	0	0	0	1	70	81	1	0	136	2	293	1,306	0	0	0	0
2:15 PM	0	1	0	0	0	0	0	0	0	0	70	85	0	0	176	4	336	1,375	0	0	0	0
2:30 PM	0	4	0	1	0	0	0	0	0	0	70	90	0	0	153	6	324	1,423	0	0	0	0
2:45 PM	0	6	0	0	0	0	0	0	0	0	88	81	0	0	173	5	353	1,462	0	0	0	0
3:00 PM	0	0	0	1	0	0	0	0	0	2	90	96	0	0	172	1	362	1,483	0	0	0	0
3:15 PM	0	3	0	2	0	0	0	0	0	1	114	79	1	0	179	5	384	1,515	0	0	0	0
3:30 PM	0	2	2	1	0	0	0	0	0	0	91	90	0	0	175	2	363	1,508	0	0	0	0
3:45 PM	0	0	0	0	0	0	0	0	0	0	109	94	0	0	170	1	374	1,581	0	0	0	0
4:00 PM	0	4	1	1	0	0	0	0	0	2	114	87	0	0	174	11	394	1,645	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0	0	1	107	98	0	0	168	3	377	1,715	0	0	0	0
4:30 PM	0	1	0	1	0	0	0	0	0	1	145	103	0	0	179	6	436	1,824	0	0	0	0
4:45 PM	0	2	0	0	0	0	0	0	0	1	161	90	0	0	178	6	438	1,822	0	0	0	0
5:00 PM	0	3	0	2	0	0	0	0	0	0	175	95	0	0	184	5	464	1,778	0	0	0	0
5:15 PM	0	1	0	0	0	0	0	0	0	0	202	95	0	0	185	3	486		0	0	0	0
5:30 PM	0	1	1	1	0	0	0	0	0	1	180	103	0	0	144	3	434		0	0	0	0
5:45 PM	0	3	0	0	0	0	0	0	0	3	127	81	0	0	177	3	394		0	0	0	0

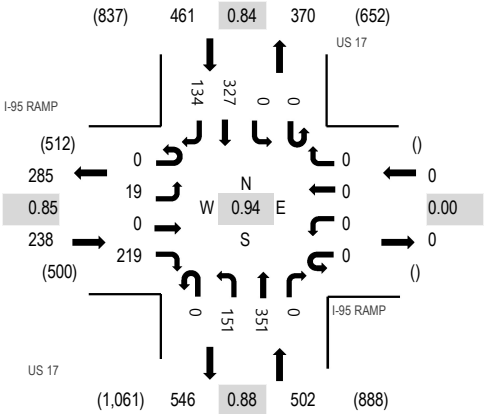
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	0	0	0	0	1	57	68	0	0	117	0	243
Lights	0	7	0	3	0	0	0	0	0	1	607	307	0	0	581	20	1,526
Mediums	0	0	0	0	0	0	0	0	0	0	19	8	0	0	28	0	55
Total	0	7	0	3	0	0	0	0	0	2	683	383	0	0	726	20	1,824

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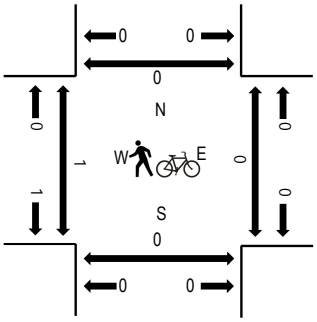
Location: 18 US 17 & I-95 RAMP AM
Date: Thursday, December 2, 2021
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	I-95 RAMP Eastbound				I-95 RAMP Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	3	0	46	0	0	0	0	0	38	104	0	0	0	78	34	303	1,201	0	0	0	0
7:15 AM	0	3	0	69	0	0	0	0	0	34	105	0	0	0	87	21	319	1,167	0	0	0	0
7:30 AM	0	7	0	59	0	0	0	0	0	41	66	0	0	0	98	40	311	1,119	0	0	0	0
7:45 AM	0	6	0	45	0	0	0	0	0	38	76	0	0	0	64	39	268	1,041	1	0	0	0
8:00 AM	0	9	0	70	0	0	0	0	0	25	59	0	0	0	76	30	269	1,024	0	0	0	0
8:15 AM	0	8	0	57	0	0	0	0	0	36	68	0	0	0	75	27	271		0	0	0	0
8:30 AM	0	6	0	50	0	0	0	0	0	26	62	0	0	0	72	17	233		0	0	0	0
8:45 AM	0	2	0	60	0	0	0	0	0	42	68	0	0	0	55	24	251		0	0	0	0

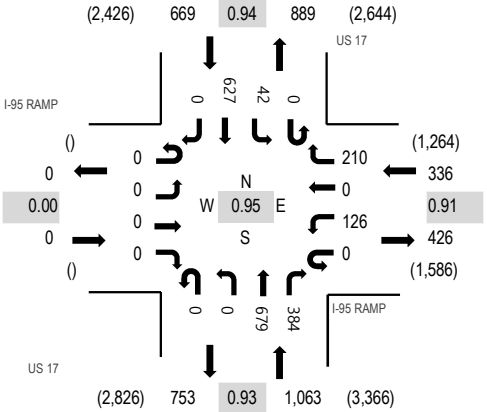
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	1	0	67	0	0	0	0	0	36	30	0	0	0	27	6	167
Lights	0	18	0	144	0	0	0	0	0	108	300	0	0	0	285	126	981
Mediums	0	0	0	8	0	0	0	0	0	7	21	0	0	0	15	2	53
Total	0	19	0	219	0	0	0	0	0	151	351	0	0	0	327	134	1,201

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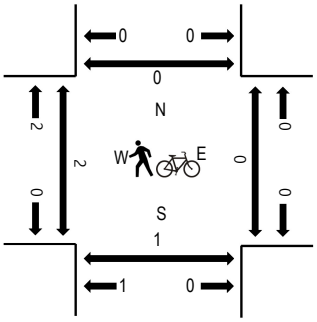
Location: 15 US 17 & I-95 RAMP PM
Date: Thursday, December 2, 2021
Peak Hour: 04:30 PM - 05:30 PM
Peak 15-Minutes: 05:15 PM - 05:30 PM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	I-95 RAMP Eastbound				I-95 RAMP Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:00 PM	0	0	0	0	0	27	0	35	0	0	74	85	0	7	116	0	344	1,497	0	0	0	0
2:15 PM	0	0	0	0	2	41	0	35	0	0	69	85	0	9	140	0	381	1,565	1	0	0	0
2:30 PM	0	0	0	0	0	39	0	39	0	0	76	89	0	6	131	0	380	1,621	1	0	0	0
2:45 PM	0	0	0	0	1	34	0	34	0	0	93	81	1	4	144	0	392	1,661	0	0	0	0
3:00 PM	0	0	0	0	0	47	0	43	0	0	91	96	0	6	129	0	412	1,685	0	0	0	0
3:15 PM	0	0	0	0	0	27	0	49	0	0	116	79	0	7	159	0	437	1,729	0	0	0	0
3:30 PM	0	0	0	0	0	40	0	47	0	0	93	93	0	11	136	0	420	1,718	0	0	0	0
3:45 PM	0	0	0	0	0	28	0	43	0	0	110	95	0	8	132	0	416	1,794	0	0	0	0
4:00 PM	0	0	0	0	0	37	0	52	0	0	119	88	0	9	151	0	456	1,878	1	0	0	0
4:15 PM	0	0	0	0	0	30	0	45	0	0	101	95	0	8	147	0	426	1,949	2	0	0	0
4:30 PM	0	0	0	0	0	32	0	61	0	0	142	102	0	8	151	0	496	2,068	0	0	0	0
4:45 PM	0	0	0	0	0	29	0	53	0	0	164	90	0	8	156	0	500	2,057	0	0	0	0
5:00 PM	0	0	0	0	0	32	0	46	0	0	173	98	0	17	161	0	527	1,996	0	0	0	0
5:15 PM	0	0	0	0	0	33	0	50	0	0	200	94	0	9	159	0	545		2	0	1	0
5:30 PM	0	0	0	0	0	30	0	52	0	0	172	103	0	6	122	0	485		0	0	0	0
5:45 PM	0	0	0	0	0	26	0	45	0	0	121	79	0	8	160	0	439		0	0	0	0

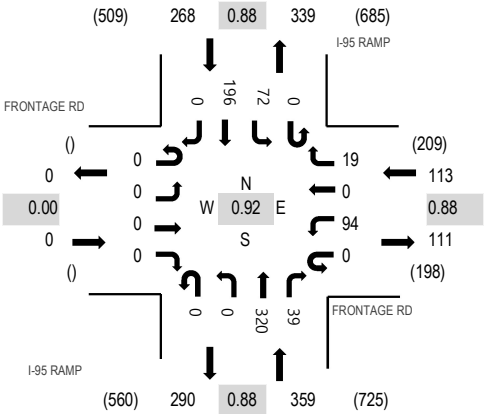
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	40	0	5	0	0	56	68	0	1	79	0	249
Lights	0	0	0	0	0	81	0	195	0	0	604	307	0	40	524	0	1,751
Mediums	0	0	0	0	0	5	0	10	0	0	19	9	0	1	24	0	68
Total	0	0	0	0	0	126	0	210	0	0	679	384	0	42	627	0	2,068

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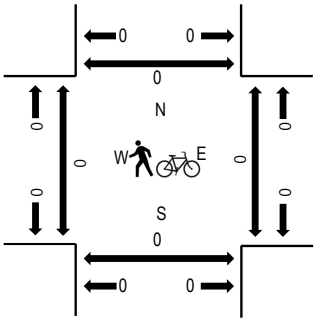
Location: 16 I-95 RAMP & FRONTAGE RD AM
Date: Thursday, December 2, 2021
Peak Hour: 07:15 AM - 08:15 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	FRONTAGE RD Eastbound				FRONTAGE RD Westbound				I-95 RAMP Northbound				I-95 RAMP Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	0	0	0	0	19	0	5	0	0	73	6	0	13	51	0	167	734	0	0	0	0
7:15 AM	0	0	0	0	0	26	0	6	0	0	79	13	0	18	60	0	202	740	0	0	0	0
7:30 AM	0	0	0	0	0	21	0	4	0	0	89	9	0	16	55	0	194	707	0	0	0	0
7:45 AM	0	0	0	0	0	22	0	4	0	0	77	8	0	16	44	0	171	705	0	0	0	0
8:00 AM	0	0	0	0	0	25	0	5	0	0	75	9	0	22	37	0	173	709	0	0	0	0
8:15 AM	0	0	0	0	0	16	0	3	0	0	84	8	0	14	44	0	169		0	0	0	0
8:30 AM	0	0	0	0	0	28	0	4	0	0	97	8	0	9	46	0	192		0	0	0	0
8:45 AM	0	0	0	0	0	20	0	1	0	0	79	11	0	18	46	0	175		0	0	0	0

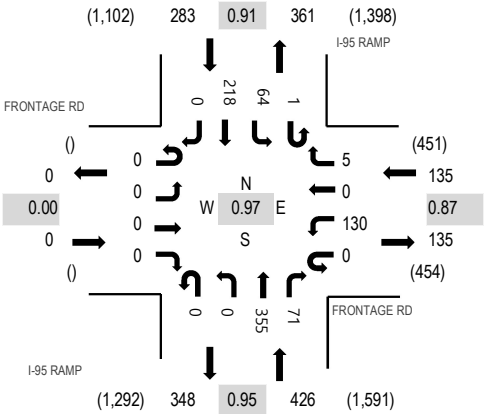
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	83	0	0	1	41	0	125
Lights	0	0	0	0	0	93	0	19	0	0	217	35	0	67	142	0	573
Mediums	0	0	0	0	0	1	0	0	0	0	20	4	0	4	13	0	42
Total	0	0	0	0	0	94	0	19	0	0	320	39	0	72	196	0	740

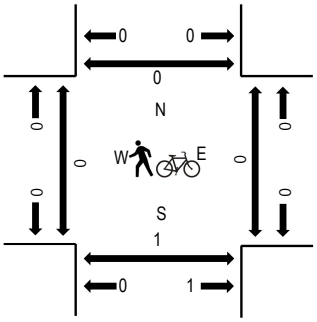
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Location: 16 I-95 RAMP & FRONTAGE RD PM
Date: Thursday, December 2, 2021
Peak Hour: 04:15 PM - 05:15 PM
Peak 15-Minutes: 04:30 PM - 04:45 PM

Peak Hour - Motorized Vehicles



Peak Hour - Pedestrians/Bicycles in Crosswalk



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	FRONTAGE RD Eastbound				FRONTAGE RD Westbound				I-95 RAMP Northbound				I-95 RAMP Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:00 PM	0	0	0	0	0	15	0	4	0	0	84	8	1	10	48	0	170	728	0	0	0	0
2:15 PM	0	0	0	0	0	19	0	3	0	0	83	14	2	12	66	0	199	766	0	0	0	0
2:30 PM	0	0	0	0	0	23	0	4	0	0	83	12	1	9	55	0	187	740	0	0	0	0
2:45 PM	0	0	0	0	0	14	0	1	0	0	73	16	0	13	55	0	172	754	0	0	0	0
3:00 PM	0	0	0	0	0	23	0	3	0	0	93	8	0	13	68	0	208	773	0	0	0	0
3:15 PM	0	0	0	0	0	29	0	1	0	0	77	9	0	10	47	0	173	772	0	0	0	0
3:30 PM	0	0	0	0	0	35	0	1	0	0	87	17	0	10	51	0	201	800	0	0	0	0
3:45 PM	0	0	0	0	0	24	0	2	0	0	82	20	1	13	49	0	191	816	0	0	0	0
4:00 PM	0	0	0	0	0	29	0	6	0	0	86	13	0	12	61	0	207	838	0	0	0	0
4:15 PM	0	0	0	0	0	34	0	1	0	0	84	18	0	16	48	0	201	844	0	0	0	0
4:30 PM	0	0	0	0	0	40	0	1	0	0	95	15	1	16	49	0	217	842	0	0	0	0
4:45 PM	0	0	0	0	0	30	0	1	0	0	85	16	0	20	61	0	213	837	0	0	0	0
5:00 PM	0	0	0	0	0	26	0	2	0	0	91	22	0	12	60	0	213	805	0	0	1	0
5:15 PM	0	0	0	0	0	26	0	0	1	0	87	17	0	17	51	0	199		0	0	0	0
5:30 PM	0	0	0	0	0	31	0	2	0	0	91	19	0	16	53	0	212		0	0	0	0
5:45 PM	0	0	0	0	0	15	0	6	0	0	73	12	0	19	56	0	181		0	0	0	0

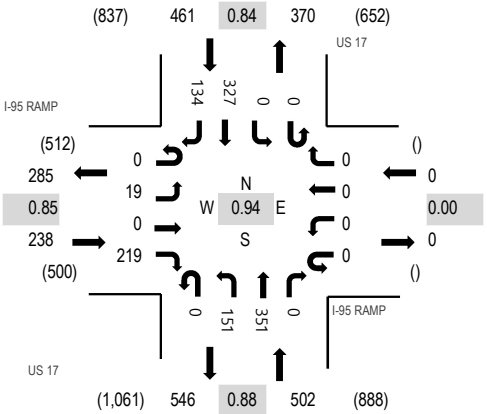
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	76	0	0	0	42	0	118
Lights	0	0	0	0	0	122	0	5	0	0	260	71	1	64	169	0	692
Mediums	0	0	0	0	0	8	0	0	0	0	19	0	0	0	7	0	34
Total	0	0	0	0	0	130	0	5	0	0	355	71	1	64	218	0	844

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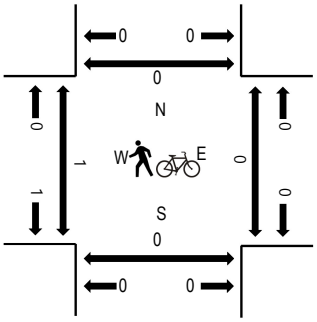
Location: 18 US 17 & I-95 RAMP AM
Date: Thursday, December 2, 2021
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	I-95 RAMP Eastbound				I-95 RAMP Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	3	0	46	0	0	0	0	0	38	104	0	0	0	78	34	303	1,201	0	0	0	0
7:15 AM	0	3	0	69	0	0	0	0	0	34	105	0	0	0	87	21	319	1,167	0	0	0	0
7:30 AM	0	7	0	59	0	0	0	0	0	41	66	0	0	0	98	40	311	1,119	0	0	0	0
7:45 AM	0	6	0	45	0	0	0	0	0	38	76	0	0	0	64	39	268	1,041	1	0	0	0
8:00 AM	0	9	0	70	0	0	0	0	0	25	59	0	0	0	76	30	269	1,024	0	0	0	0
8:15 AM	0	8	0	57	0	0	0	0	0	36	68	0	0	0	75	27	271		0	0	0	0
8:30 AM	0	6	0	50	0	0	0	0	0	26	62	0	0	0	72	17	233		0	0	0	0
8:45 AM	0	2	0	60	0	0	0	0	0	42	68	0	0	0	55	24	251		0	0	0	0

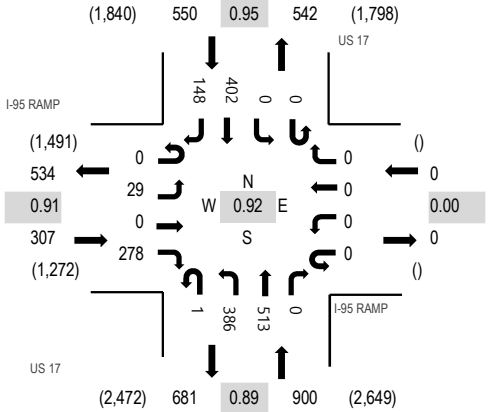
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	1	0	67	0	0	0	0	0	36	30	0	0	0	27	6	167
Lights	0	18	0	144	0	0	0	0	0	108	300	0	0	0	285	126	981
Mediums	0	0	0	8	0	0	0	0	0	7	21	0	0	0	15	2	53
Total	0	19	0	219	0	0	0	0	0	151	351	0	0	0	327	134	1,201

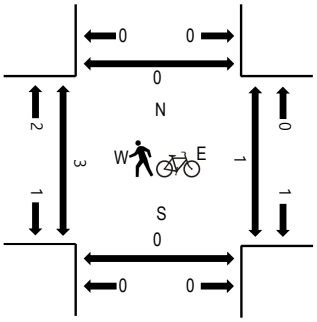
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Location: 18 US 17 & I-95 RAMP PM
Date: Thursday, December 2, 2021
Peak Hour: 04:30 PM - 05:30 PM
Peak 15-Minutes: 05:15 PM - 05:30 PM

Peak Hour - Motorized Vehicles



Peak Hour - Pedestrians/Bicycles in Crosswalk



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	I-95 RAMP Eastbound				I-95 RAMP Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:00 PM	0	10	0	59	0	0	0	0	0	30	79	0	0	0	62	25	265	1,159	0	0	0	0
2:15 PM	0	5	0	73	0	0	0	0	0	41	68	0	0	0	76	28	291	1,211	0	0	0	0
2:30 PM	1	4	0	74	0	0	0	0	0	26	88	0	0	0	69	25	287	1,283	0	0	0	0
2:45 PM	0	10	0	73	0	0	0	0	0	39	90	0	0	0	81	23	316	1,318	0	0	0	0
3:00 PM	0	5	0	65	0	0	0	0	0	40	93	0	0	0	78	36	317	1,337	0	0	0	0
3:15 PM	0	14	0	78	0	0	0	0	0	39	115	0	0	0	90	27	363	1,385	0	0	1	0
3:30 PM	0	6	0	78	0	0	0	0	0	44	91	0	0	0	74	29	322	1,389	0	1	1	0
3:45 PM	0	7	0	71	0	0	0	0	0	50	103	0	0	0	75	29	335	1,473	0	0	0	0
4:00 PM	0	9	0	87	0	0	0	0	0	56	101	0	0	0	76	36	365	1,571	1	0	0	0
4:15 PM	0	8	0	75	0	0	0	0	1	59	99	0	0	0	80	45	367	1,649	0	0	0	0
4:30 PM	0	11	0	69	0	0	0	0	0	80	120	0	0	0	97	29	406	1,757	2	0	0	0
4:45 PM	0	8	0	69	0	0	0	0	0	86	133	0	0	0	103	34	433	1,747	1	1	0	0
5:00 PM	0	3	0	77	0	0	0	0	0	88	133	0	0	0	97	45	443	1,694	0	0	0	0
5:15 PM	0	7	0	63	0	0	0	0	1	132	127	0	0	0	105	40	475		0	0	0	0
5:30 PM	0	8	0	65	0	0	0	0	0	96	129	0	0	0	60	38	396		0	0	0	0
5:45 PM	0	8	0	72	0	0	0	0	0	66	106	0	0	0	99	29	380		0	0	0	0

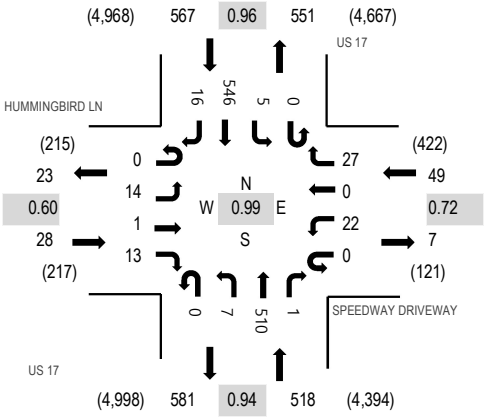
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	3	0	65	0	0	0	0	0	33	28	0	0	0	18	5	152
Lights	0	26	0	202	0	0	0	0	1	340	470	0	0	0	369	140	1,548
Mediums	0	0	0	11	0	0	0	0	0	13	15	0	0	0	15	3	57
Total	0	29	0	278	0	0	0	0	1	386	513	0	0	0	402	148	1,757

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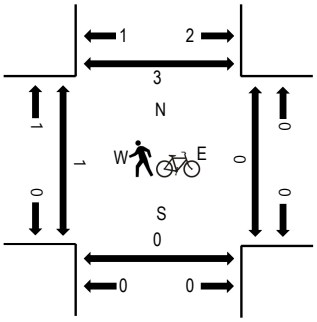
Location: 21 US 17 & SPEEDWAY DRIVEWAY AM
Date: Thursday, December 2, 2021
Peak Hour: 04:30 PM - 05:30 PM
Peak 15-Minutes: 05:15 PM - 05:30 PM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	HUMMINGBIRD LN Eastbound				SPEEDWAY DRIVEWAY Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	6	3	2	0	4	1	8	0	0	103	0	0	1	111	0	239	899	0	0	0	0
7:15 AM	0	3	0	0	0	5	0	3	0	0	110	1	0	4	105	0	231	844	1	0	2	0
7:30 AM	0	2	0	4	0	7	0	7	0	0	61	1	0	4	135	4	225	805	0	0	0	0
7:45 AM	0	2	0	7	0	1	0	9	0	3	83	0	0	2	96	1	204	750	0	0	0	1
8:00 AM	0	0	0	2	0	2	0	4	0	4	64	0	0	0	107	1	184	717	0	0	0	1
8:15 AM	0	3	0	0	0	3	0	6	0	1	70	1	0	1	106	1	192	697	0	0	0	0
8:30 AM	0	2	1	2	0	4	0	6	0	1	62	1	0	1	86	4	170	667	0	1	0	2
8:45 AM	0	2	1	2	0	3	0	10	0	2	69	0	0	3	79	0	171	646	0	1	0	2
9:00 AM	0	2	0	4	0	1	0	4	0	3	70	1	0	1	78	0	164	634	0	0	0	0
9:15 AM	0	2	0	3	0	5	0	10	0	4	60	1	0	5	70	2	162	631	0	1	0	0
9:30 AM	0	0	0	4	0	4	0	1	0	2	50	1	0	0	84	3	149	621	0	0	1	1
9:45 AM	0	3	0	7	0	3	1	5	0	0	72	0	0	0	65	3	159	631	0	0	2	2
10:00 AM	0	1	0	6	0	1	0	6	0	2	60	0	0	3	81	1	161	618	0	0	0	0
10:15 AM	0	3	0	3	0	3	0	5	0	1	48	0	0	3	84	2	152	660	0	0	0	1
10:30 AM	0	0	0	0	0	1	0	6	0	1	70	0	0	1	77	3	159	673	2	0	1	1
10:45 AM	0	2	0	2	0	2	0	7	0	2	42	0	0	4	81	4	146	679	0	0	0	0
11:00 AM	0	3	0	2	0	5	0	7	0	1	101	0	1	1	81	1	203	721	0	0	0	0
11:15 AM	0	3	0	1	0	0	0	3	0	0	77	0	0	5	76	0	165	694	0	0	0	0
11:30 AM	0	0	0	2	0	1	0	7	0	2	75	0	0	1	76	1	165	716	0	0	0	1
11:45 AM	0	2	0	3	0	5	0	6	0	1	80	1	0	2	86	2	188	769	0	0	0	0
12:00 PM	0	0	0	4	0	0	0	3	0	0	80	0	0	1	87	1	176	789	0	0	1	0
12:15 PM	0	3	0	2	0	1	0	4	0	3	86	0	0	1	84	3	187	801	0	2	0	0
12:30 PM	0	5	0	3	0	2	0	11	0	3	95	0	0	0	92	7	218	794	1	1	0	1
12:45 PM	0	3	0	0	0	1	0	3	1	2	100	2	0	2	91	3	208	797	0	0	0	0
1:00 PM	0	2	1	1	0	2	0	2	0	0	84	1	0	0	92	3	188	772	0	0	0	2
1:15 PM	0	0	0	0	0	3	0	4	0	0	79	1	0	3	89	1	180	770	0	0	0	0
1:30 PM	0	5	0	1	0	3	0	3	0	2	103	0	0	2	100	2	221	789	1	1	0	1
1:45 PM	0	0	0	0	0	4	0	4	0	2	94	2	0	1	75	1	183	767	0	1	0	1
2:00 PM	0	1	0	2	0	1	0	6	0	0	93	0	0	1	80	2	186	809	0	3	0	2
2:15 PM	0	0	0	2	0	0	0	5	0	4	72	0	0	1	114	1	199	854	1	0	0	0
2:30 PM	0	2	0	3	0	4	0	3	0	1	88	0	0	3	93	2	199	923	0	0	0	0
2:45 PM	0	1	0	3	0	3	0	5	0	1	99	1	0	6	101	5	225	944	0	0	0	0
3:00 PM	0	3	0	3	0	4	0	6	0	1	95	0	0	2	114	3	231	945	0	0	0	0
3:15 PM	0	0	0	3	0	2	0	10	0	0	129	0	0	0	120	4	268	958	0	0	0	0
3:30 PM	0	2	0	1	0	4	0	4	0	1	103	0	0	1	102	2	220	938	0	0	0	0

3:45 PM	0	3	0	0	0	1	0	5	0	0	105	1	0	1	106	4	226	1,007	1	1	0	2
4:00 PM	0	3	0	2	0	1	0	9	0	5	103	1	0	1	116	3	244	1,073	0	0	0	0
4:15 PM	0	3	0	1	0	2	0	7	0	3	93	1	0	1	131	6	248	1,116	0	0	0	0
4:30 PM	0	5	0	2	0	3	0	7	0	3	121	1	0	2	138	7	289	1,162	0	0	0	1
4:45 PM	0	2	0	4	0	5	0	7	0	2	133	0	0	1	134	4	292	1,134	0	0	0	0
5:00 PM	0	7	1	4	0	6	0	4	0	0	127	0	0	1	133	4	287	1,113	1	0	0	1
5:15 PM	0	0	0	3	0	8	0	9	0	2	129	0	0	1	141	1	294	1,117	0	0	0	1
5:30 PM	0	1	0	3	0	0	0	4	0	1	140	1	0	3	102	6	261	1,039	1	0	0	1
5:45 PM	0	2	0	1	0	5	0	8	0	1	111	1	0	4	136	2	271	969	0	0	0	2
6:00 PM	0	0	0	2	0	1	0	11	1	3	131	2	0	3	136	1	291	911	2	0	0	0
6:15 PM	0	0	0	1	0	6	0	8	1	4	93	1	0	0	94	8	216		0	0	0	0
6:30 PM	0	2	0	1	0	2	0	5	0	5	77	0	0	4	90	5	191		2	0	0	0
6:45 PM	0	3	0	3	0	2	0	7	0	4	93	1	0	1	93	6	213		1	0	0	1

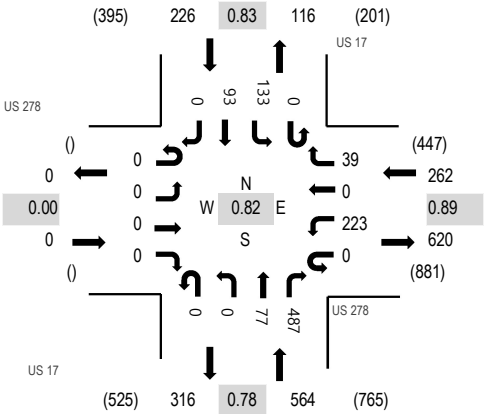
Peak Rolling Hour Flow Rates

	Eastbound				Westbound				Northbound				Southbound				
Vehicle Type	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total
Articulated Trucks	0	0	0	0	0	3	0	0	0	0	31	0	0	0	22	0	56
Lights	0	13	1	12	0	18	0	27	0	7	466	1	0	5	508	16	1,074
Mediums	0	1	0	1	0	1	0	0	0	0	13	0	0	0	16	0	32
Total	0	14	1	13	0	22	0	27	0	7	510	1	0	5	546	16	1,162

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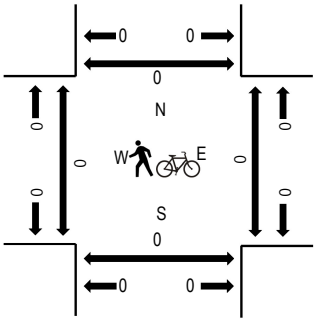
Location: 24 US 17 & US 278 AM
Date: Thursday, December 2, 2021
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	US 278 Eastbound				US 278 Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	0	0	0	0	46	0	4	0	0	14	112	0	30	22	0	228	1,052	0	0	0	0
7:15 AM	0	0	0	0	0	66	0	8	0	0	21	159	0	32	36	0	322	1,002	0	0	0	0
7:30 AM	0	0	0	0	0	62	0	14	0	0	25	111	0	38	20	0	270	825	0	0	0	0
7:45 AM	0	0	0	0	0	49	0	13	0	0	17	105	0	33	15	0	232	685	0	0	0	0
8:00 AM	0	0	0	0	1	42	0	17	0	0	13	58	0	29	18	0	178	555	0	0	0	0
8:15 AM	0	0	0	0	1	34	0	9	0	0	7	40	0	31	23	0	145		0	0	0	0
8:30 AM	0	0	0	0	0	36	0	6	0	0	15	33	0	22	18	0	130		0	0	0	0
8:45 AM	0	0	0	0	0	27	0	12	0	0	6	29	0	17	11	0	102		0	0	0	0

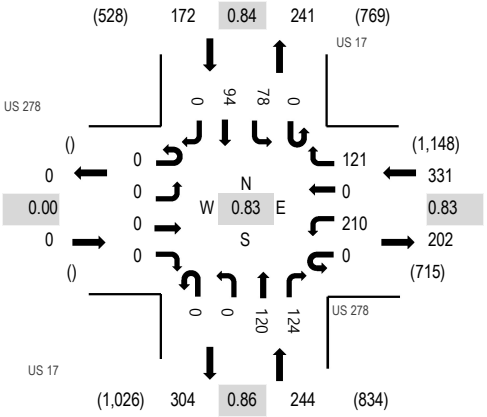
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	5	0	1	0	0	1	5	0	3	2	0	17
Lights	0	0	0	0	0	205	0	36	0	0	64	462	0	125	88	0	980
Mediums	0	0	0	0	0	13	0	2	0	0	12	20	0	5	3	0	55
Total	0	0	0	0	0	223	0	39	0	0	77	487	0	133	93	0	1,052

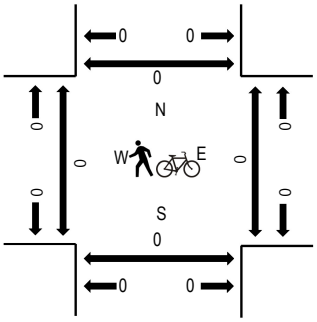
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Location: 24 US 17 & US 278 PM
Date: Thursday, December 2, 2021
Peak Hour: 03:30 PM - 04:30 PM
Peak 15-Minutes: 04:00 PM - 04:15 PM

Peak Hour - Motorized Vehicles



Peak Hour - Pedestrians/Bicycles in Crosswalk



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	US 278 Eastbound				US 278 Westbound				US 17 Northbound				US 17 Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:00 PM	0	0	0	0	0	44	0	6	0	0	16	32	0	8	18	0	124	535	0	0	0	4
2:15 PM	0	0	0	0	0	37	0	24	0	0	19	23	0	16	11	0	130	561	0	0	0	0
2:30 PM	0	0	0	0	0	43	0	15	0	0	13	39	0	13	10	0	133	567	0	0	0	0
2:45 PM	0	0	0	0	0	52	0	24	0	0	15	22	0	19	16	0	148	576	0	0	0	0
3:00 PM	0	0	0	0	0	47	0	27	0	0	23	28	0	10	15	0	150	608	0	0	0	0
3:15 PM	0	0	0	0	0	37	0	20	0	0	23	25	0	16	15	0	136	682	0	0	0	0
3:30 PM	0	0	0	0	0	37	0	20	0	0	26	27	0	14	18	0	142	747	0	0	0	0
3:45 PM	0	0	0	0	0	44	0	30	0	0	24	37	0	22	23	0	180	739	0	0	0	0
4:00 PM	0	0	0	0	0	64	0	38	0	0	41	30	0	23	28	0	224	705	0	0	0	0
4:15 PM	0	0	0	0	0	65	0	33	0	0	29	30	0	19	25	0	201	649	0	0	0	0
4:30 PM	0	0	0	0	0	39	0	24	0	0	19	21	0	17	14	0	134	636	0	0	0	0
4:45 PM	0	0	0	0	0	32	0	25	0	0	21	29	0	17	22	0	146	668	0	0	0	0
5:00 PM	0	0	0	0	0	49	0	31	0	0	25	35	0	12	16	0	168	662	0	0	0	0
5:15 PM	0	0	0	0	0	59	0	33	0	0	27	36	0	15	18	0	188		0	0	0	0
5:30 PM	0	0	0	0	0	58	0	22	0	0	38	22	0	11	15	0	166		0	0	0	0
5:45 PM	0	0	0	0	0	43	0	26	0	0	12	27	0	20	12	0	140		0	0	0	0

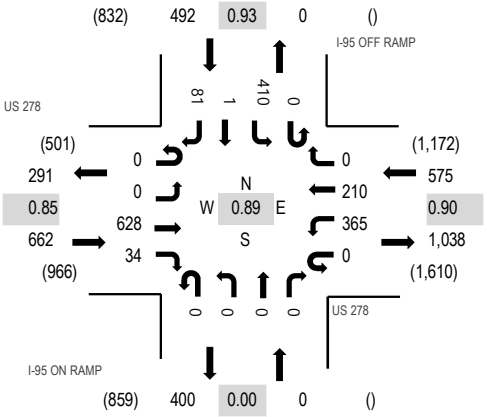
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	6	0	1	0	0	2	3	0	1	1	0	14
Lights	0	0	0	0	0	197	0	117	0	0	114	118	0	70	87	0	703
Mediums	0	0	0	0	0	7	0	3	0	0	4	3	0	7	6	0	30
Total	0	0	0	0	0	210	0	121	0	0	120	124	0	78	94	0	747

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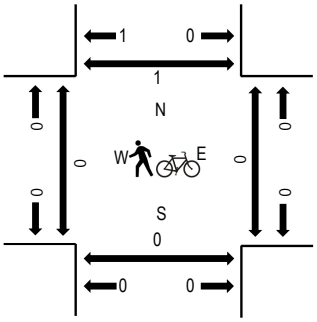
Location: 29 I-95 ON RAMP & US 278 AM
Date: Thursday, December 2, 2021
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	US 278 Eastbound				US 278 Westbound				I-95 ON RAMP Northbound				I-95 OFF RAMP Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	0	143	5	0	80	35	0	0	0	0	0	0	96	0	23	382	1,729	0	0	0	0
7:15 AM	0	0	185	10	0	105	54	0	0	0	0	0	0	106	1	25	486	1,689	0	0	0	0
7:30 AM	0	0	168	10	0	103	68	0	0	0	0	0	0	113	0	16	478	1,544	0	0	0	1
7:45 AM	0	0	132	9	0	77	53	0	0	0	0	0	0	95	0	17	383	1,339	0	0	0	0
8:00 AM	0	0	102	3	0	89	56	0	0	0	0	0	0	83	0	9	342	1,241	0	0	0	0
8:15 AM	0	0	70	9	1	129	38	0	0	0	0	0	0	86	0	8	341		1	0	0	0
8:30 AM	0	0	64	4	0	104	34	0	0	0	0	0	0	48	0	19	273		0	0	1	0
8:45 AM	0	0	42	10	0	111	35	0	0	0	0	0	0	76	0	11	285		0	0	0	0

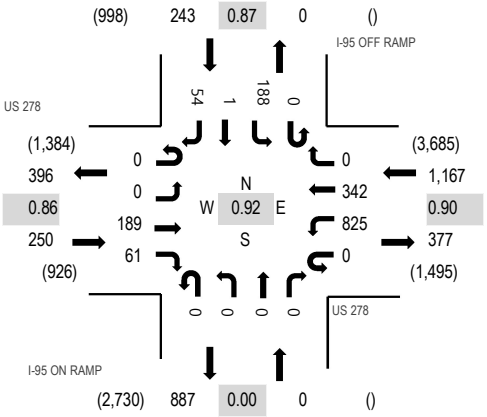
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	9	1	0	12	7	0	0	0	0	0	0	7	1	0	37
Lights	0	0	590	32	0	343	189	0	0	0	0	0	0	398	0	79	1,631
Mediums	0	0	29	1	0	10	14	0	0	0	0	0	0	5	0	2	61
Total	0	0	628	34	0	365	210	0	0	0	0	0	0	410	1	81	1,729

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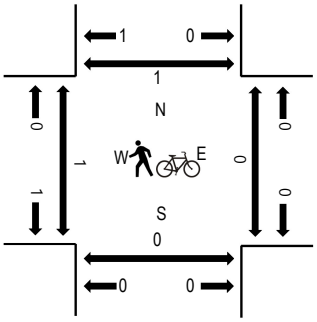
Location: 29 I-95 ON RAMP & US 278 PM
Date: Thursday, December 2, 2021
Peak Hour: 05:00 PM - 06:00 PM
Peak 15-Minutes: 05:15 PM - 05:30 PM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	US 278 Eastbound				US 278 Westbound				I-95 ON RAMP Northbound				I-95 OFF RAMP Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:00 PM	0	0	36	11	0	97	49	0	0	0	0	0	0	48	0	11	252	1,136	0	0	0	0
2:15 PM	0	0	45	13	0	120	54	0	0	0	0	0	0	43	0	18	293	1,168	0	0	0	0
2:30 PM	0	0	53	13	0	94	65	0	0	0	0	0	0	42	0	14	281	1,194	0	0	0	0
2:45 PM	0	0	39	13	0	117	81	0	0	0	0	0	0	52	0	8	310	1,252	0	0	0	0
3:00 PM	0	0	42	9	0	126	61	0	0	0	0	0	0	34	0	12	284	1,311	0	0	0	0
3:15 PM	0	0	42	13	1	145	60	0	0	0	0	0	0	43	0	15	319	1,412	1	0	0	0
3:30 PM	0	0	42	12	0	147	53	0	0	0	0	0	0	69	0	16	339	1,461	1	0	0	0
3:45 PM	0	0	51	7	0	165	78	0	0	0	0	0	0	51	0	17	369	1,513	0	0	0	0
4:00 PM	0	0	58	12	0	145	94	0	0	0	0	0	0	57	1	18	385	1,502	1	0	0	0
4:15 PM	0	0	50	11	0	152	88	0	0	0	0	0	0	51	0	16	368	1,540	0	0	0	0
4:30 PM	1	0	37	15	0	207	74	0	0	0	0	0	0	37	0	20	391	1,621	0	0	0	0
4:45 PM	0	0	41	10	0	188	57	0	0	0	0	0	0	54	0	8	358	1,641	0	0	0	0
5:00 PM	0	0	55	18	0	193	91	0	0	0	0	0	0	53	0	13	423	1,660	0	0	0	0
5:15 PM	0	0	41	23	0	224	99	0	0	0	0	0	0	52	1	9	449		0	0	0	0
5:30 PM	0	0	42	8	0	225	78	0	0	0	0	0	0	43	0	15	411		1	0	0	1
5:45 PM	0	0	51	12	0	183	74	0	0	0	0	0	0	40	0	17	377		0	0	0	0

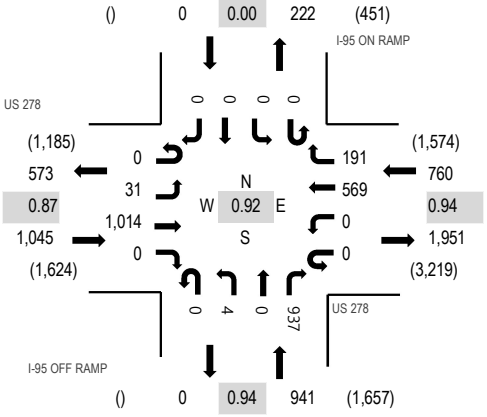
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	5	1	0	22	9	0	0	0	0	0	0	6	1	1	45
Lights	0	0	179	59	0	780	327	0	0	0	0	0	0	182	0	51	1,578
Mediums	0	0	5	1	0	23	6	0	0	0	0	0	0	0	0	2	37
Total	0	0	189	61	0	825	342	0	0	0	0	0	0	188	1	54	1,660

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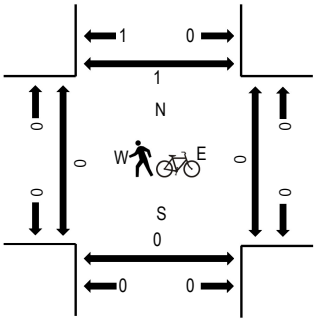
Location: 30 I-95 OFF RAMP & US 278 AM
Date: Thursday, December 2, 2021
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:30 AM - 07:45 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	US 278 Eastbound				US 278 Westbound				I-95 OFF RAMP Northbound				I-95 ON RAMP Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	0	7	227	0	0	0	123	33	0	0	0	241	0	0	0	0	631	2,746	0	0	0	0
7:15 AM	0	9	292	0	0	0	152	43	0	1	0	203	0	0	0	0	700	2,696	0	0	0	1
7:30 AM	0	10	267	0	0	0	166	53	0	1	0	248	0	0	0	0	745	2,552	0	0	0	0
7:45 AM	0	5	228	0	0	0	128	62	0	2	0	245	0	0	0	0	670	2,307	0	0	0	0
8:00 AM	0	4	172	0	0	0	153	51	0	3	0	198	0	0	0	0	581	2,109	0	0	0	0
8:15 AM	0	5	163	0	0	0	160	53	0	2	0	173	0	0	0	0	556		0	0	0	0
8:30 AM	0	3	109	0	0	0	139	62	0	2	0	185	0	0	0	0	500		0	0	0	1
8:45 AM	0	6	117	0	0	0	151	45	0	2	0	151	0	0	0	0	472		0	0	0	0

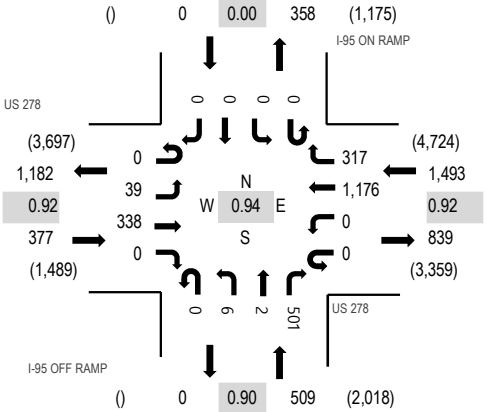
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	16	0	0	0	20	11	0	0	0	22	0	0	0	0	69
Lights	0	28	967	0	0	0	525	176	0	4	0	889	0	0	0	0	2,589
Mediums	0	3	31	0	0	0	24	4	0	0	0	26	0	0	0	0	88
Total	0	31	1,014	0	0	0	569	191	0	4	0	937	0	0	0	0	2,746

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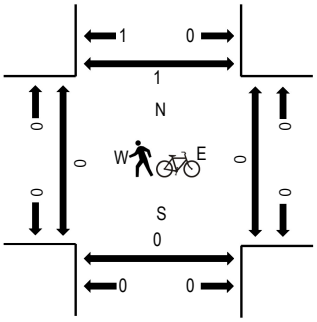
Location: 30 I-95 OFF RAMP & US 278 PM
Date: Thursday, December 2, 2021
Peak Hour: 05:00 PM - 06:00 PM
Peak 15-Minutes: 05:00 PM - 05:15 PM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	US 278 Eastbound				US 278 Westbound				I-95 OFF RAMP Northbound				I-95 ON RAMP Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
2:00 PM	0	3	85	0	0	0	149	64	0	3	0	111	0	0	0	0	415	1,724	0	1	0	0
2:15 PM	0	6	85	0	0	0	171	47	0	2	1	123	0	0	0	0	435	1,753	0	0	0	0
2:30 PM	0	6	90	0	0	0	159	49	0	5	0	121	0	0	0	0	430	1,772	0	0	0	0
2:45 PM	0	5	86	0	0	0	186	57	0	3	0	107	0	0	0	0	444	1,827	0	0	0	0
3:00 PM	0	9	65	0	0	0	186	56	0	3	0	125	0	0	0	0	444	1,941	0	0	0	0
3:15 PM	0	3	86	0	0	0	188	58	0	5	0	114	0	0	0	0	454	2,060	0	0	0	0
3:30 PM	0	4	104	0	0	0	197	57	0	3	0	120	0	0	0	0	485	2,173	0	0	0	0
3:45 PM	0	7	98	0	0	0	254	64	0	0	0	135	0	0	0	0	558	2,222	0	0	0	0
4:00 PM	0	2	113	0	0	0	231	84	0	1	0	132	0	0	0	0	563	2,187	0	0	0	0
4:15 PM	0	5	90	0	0	0	253	84	0	1	0	134	0	0	0	0	567	2,254	0	0	0	0
4:30 PM	0	8	71	0	0	0	264	72	0	3	0	116	0	0	0	0	534	2,309	0	0	0	0
4:45 PM	0	10	71	0	0	0	245	56	0	3	0	138	0	0	0	0	523	2,347	0	0	0	1
5:00 PM	0	11	96	0	0	0	289	81	0	4	2	147	0	0	0	0	630	2,379	0	0	0	0
5:15 PM	0	6	89	0	0	0	322	82	0	2	0	121	0	0	0	0	622		0	0	0	0
5:30 PM	0	8	74	0	0	0	295	85	0	0	0	110	0	0	0	0	572		0	0	0	1
5:45 PM	0	14	79	0	0	0	270	69	0	0	0	123	0	0	0	0	555		0	0	0	0

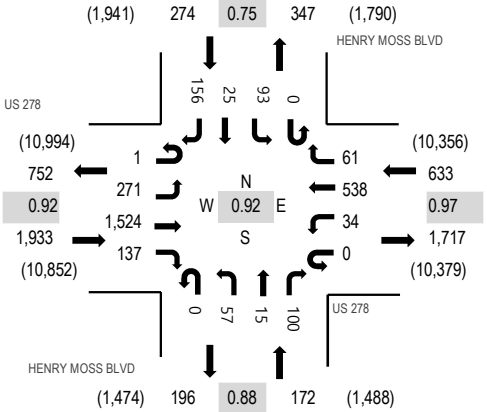
Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	1	11	0	0	0	28	9	0	1	1	22	0	0	0	0	73
Lights	0	38	322	0	0	0	1,119	307	0	5	1	470	0	0	0	0	2,262
Mediums	0	0	5	0	0	0	29	1	0	0	0	9	0	0	0	0	44
Total	0	39	338	0	0	0	1,176	317	0	6	2	501	0	0	0	0	2,379

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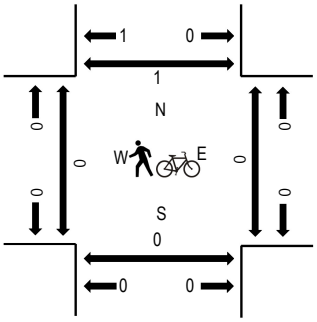
Location: 33 HENRY MOSS BLVD & US 278 AM
Date: Thursday, December 2, 2021
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:30 AM - 07:45 AM

Peak Hour - Motorized Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles in Crosswalk



Traffic Counts - Motorized Vehicles

Interval Start Time	US 278 Eastbound				US 278 Westbound				HENRY MOSS BLVD Northbound				HENRY MOSS BLVD Southbound					Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total		West	East	South	North
7:00 AM	1	73	325	36	0	9	108	18	0	12	1	22	0	29	5	36	675	3,012	0	0	0	0
7:15 AM	0	69	392	28	0	11	134	12	0	14	8	23	0	25	6	48	770	2,982	0	0	0	1
7:30 AM	0	61	430	35	0	5	148	10	0	15	3	28	0	24	11	46	816	2,836	0	0	0	0
7:45 AM	0	68	377	38	0	9	148	21	0	16	3	27	0	15	3	26	751	2,576	0	0	0	0
8:00 AM	0	37	277	33	0	16	131	16	0	24	3	27	0	21	5	55	645	2,352	0	0	0	0
8:15 AM	0	46	277	24	0	10	152	20	0	21	1	19	0	16	4	34	624	2,175	0	0	0	0
8:30 AM	0	31	230	29	1	18	141	19	0	21	1	18	0	14	6	27	556	2,026	0	0	0	0
8:45 AM	0	13	223	33	0	10	167	14	0	15	3	24	0	9	6	10	527	1,908	0	0	0	0
9:00 AM	0	10	196	17	0	9	151	7	0	23	5	24	0	12	2	12	468	1,817	0	0	0	0
9:15 AM	1	10	188	20	0	17	163	10	0	18	1	23	0	6	5	13	475	1,787	0	0	0	0
9:30 AM	0	7	167	22	0	15	164	12	0	17	4	12	0	9	0	9	438	1,717	0	0	0	1
9:45 AM	0	4	167	21	0	13	152	12	0	24	0	17	0	11	4	11	436	1,690	0	0	0	0
10:00 AM	1	4	152	21	0	7	173	13	0	20	1	20	0	16	2	8	438	1,629	0	0	0	0
10:15 AM	0	9	144	11	0	13	172	8	0	15	2	10	0	13	1	7	405	1,639	0	0	0	0
10:30 AM	0	11	151	13	0	13	162	13	0	16	0	8	0	9	3	12	411	1,677	0	0	0	0
10:45 AM	0	9	126	8	0	10	149	12	0	17	1	13	0	11	6	13	375	1,718	0	0	0	0
11:00 AM	0	8	173	25	0	8	163	14	0	13	1	16	0	7	6	14	448	1,736	0	0	0	0
11:15 AM	2	8	196	13	0	13	146	7	0	19	2	12	0	11	2	12	443	1,724	0	0	0	0
11:30 AM	0	8	163	19	1	14	176	9	0	16	6	9	0	16	4	11	452	1,689	0	0	0	0
11:45 AM	0	8	166	20	0	15	133	8	0	13	1	10	0	8	1	10	393	1,703	0	0	0	0
12:00 PM	0	9	169	12	0	9	153	21	0	13	3	22	0	11	1	13	436	1,772	0	0	0	1
12:15 PM	0	13	150	11	1	7	155	15	0	13	3	11	0	16	2	11	408	1,787	0	0	0	0
12:30 PM	0	11	175	19	0	16	176	17	0	12	5	11	0	10	4	10	466	1,822	2	0	0	0
12:45 PM	0	17	158	16	0	15	162	25	0	20	6	11	0	16	4	12	462	1,791	0	0	0	0
1:00 PM	0	14	151	28	0	10	173	13	0	18	2	8	0	13	4	17	451	1,787	0	0	0	1
1:15 PM	0	17	142	10	0	13	173	18	0	18	7	16	0	14	1	14	443	1,783	0	0	0	0
1:30 PM	0	20	144	13	0	6	175	16	0	22	0	8	0	14	0	17	435	1,785	0	1	0	0
1:45 PM	1	23	150	15	0	6	181	20	0	8	4	9	0	14	5	22	458	1,830	0	0	0	0
2:00 PM	0	21	151	12	0	12	174	14	0	11	6	12	0	16	3	15	447	1,850	0	0	0	0
2:15 PM	0	10	178	10	0	6	179	15	0	14	0	10	0	13	0	10	445	1,878	0	0	0	0
2:30 PM	0	30	172	12	0	10	170	14	0	10	1	8	0	13	3	37	480	1,924	0	0	0	0
2:45 PM	0	14	147	12	0	12	163	25	0	10	1	9	0	25	3	57	478	1,985	0	0	0	0
3:00 PM	0	19	163	11	0	3	185	12	0	13	1	19	0	13	4	32	475	2,087	0	0	0	1
3:15 PM	0	14	166	13	0	10	203	15	0	16	1	11	0	18	5	19	491	2,223	0	0	0	0
3:30 PM	0	22	182	15	0	9	219	13	0	9	3	7	0	36	1	25	541	2,331	0	0	0	0

3:45 PM	0	26	178	10	0	12	252	14	0	15	1	5	0	18	5	44	580	2,362	0	0	0	0
4:00 PM	0	34	175	21	0	6	234	12	0	9	4	14	0	34	7	61	611	2,327	0	0	0	0
4:15 PM	0	27	191	7	0	6	254	11	0	15	1	13	0	23	5	46	599	2,370	0	0	0	0
4:30 PM	0	11	163	13	0	13	288	9	0	12	1	9	0	22	2	29	572	2,405	0	0	0	0
4:45 PM	0	16	167	15	0	11	263	8	0	18	3	8	0	18	1	17	545	2,429	0	0	0	0
5:00 PM	1	20	185	15	0	10	340	9	0	12	0	8	0	27	1	26	654	2,454	0	0	0	1
5:15 PM	0	32	162	11	0	4	348	12	0	18	2	12	0	11	3	19	634	2,345	0	0	0	1
5:30 PM	0	24	147	9	0	15	336	7	0	10	3	7	0	16	5	17	596	2,234	0	0	0	0
5:45 PM	0	17	161	11	0	5	308	13	0	18	3	7	0	12	3	12	570	2,048	0	0	0	0
6:00 PM	0	20	147	12	0	9	297	6	0	15	2	11	0	6	2	18	545	1,814	0	0	0	0
6:15 PM	0	19	157	11	0	4	266	16	0	12	3	9	0	11	1	14	523		0	0	0	0
6:30 PM	0	21	129	6	0	7	205	13	0	8	1	9	0	2	0	9	410		0	0	0	0
6:45 PM	0	15	110	9	0	10	152	7	0	6	1	3	0	13	1	9	336		0	0	0	0

Peak Rolling Hour Flow Rates

	Eastbound				Westbound				Northbound				Southbound				
Vehicle Type	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total
Articulated Trucks	0	0	35	0	0	0	22	0	0	0	0	0	0	0	0	0	57
Lights	1	266	1,436	136	0	33	493	61	0	56	15	99	0	92	25	152	2,865
Mediums	0	5	53	1	0	1	23	0	0	1	0	1	0	1	0	4	90
Total	1	271	1,524	137	0	34	538	61	0	57	15	100	0	93	25	156	3,012

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
11/30/21	66	5	39	110
00:15	46	7	50	103
00:30	62	4	36	102
00:45	42	4	48	94
	216	20	173	409
01:00	38	3	42	83
01:15	42	0	48	90
01:30	38	5	34	77
01:45	35	2	46	83
	153	10	170	333
02:00	42	2	34	78
02:15	33	3	37	73
02:30	19	3	44	66
02:45	28	4	53	85
	122	12	168	302
03:00	31	1	53	85
03:15	38	3	43	84
03:30	28	5	39	72
03:45	37	3	38	78
	134	12	173	319
04:00	35	2	55	92
04:15	45	7	44	96
04:30	58	2	42	102
04:45	85	5	64	154
	223	16	205	444
05:00	68	10	45	123
05:15	82	8	53	143
05:30	137	4	60	201
05:45	159	6	64	229
	446	28	222	696
06:00	156	9	62	227
06:15	211	10	70	291
06:30	303	9	64	376
06:45	301	15	71	387
	971	43	267	1281
07:00	331	12	74	417
07:15	340	12	82	434
07:30	337	13	89	439
07:45	316	11	66	393
	1324	48	311	1683
08:00	268	22	64	354
08:15	315	24	85	424
08:30	330	23	112	465
08:45	271	19	90	380
	1184	88	351	1623
09:00	253	26	111	390
09:15	264	21	106	391
09:30	269	14	101	384
09:45	249	25	107	381
	1035	86	425	1546
10:00	289	12	127	428
10:15	301	18	119	438
10:30	313	24	108	445
10:45	308	17	112	437
	1211	71	466	1748
11:00	322	13	107	442
11:15	317	14	102	433
11:30	322	11	123	456
11:45	362	10	100	472
	1323	48	432	1803
Total	8342	482	3363	12187
Percent	68.4%	4.0%	27.6%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12 PM	320	10	121	451
12:15	282	10	94	386
12:30	254	5	96	355
12:45	498	13	136	647
	1354	38	447	1839
13:00	432	13	122	567
13:15	360	10	127	497
13:30	411	21	103	535
13:45	340	10	98	448
	1543	54	450	2047
14:00	358	15	96	469
14:15	378	9	102	489
14:30	351	16	117	484
14:45	324	15	123	462
	1411	55	438	1904
15:00	373	20	124	517
15:15	317	11	114	442
15:30	344	22	115	481
15:45	338	8	122	468
	1372	61	475	1908
16:00	318	9	113	440
16:15	322	18	128	468
16:30	349	8	119	476
16:45	274	9	122	405
	1263	44	482	1789
17:00	315	8	125	448
17:15	273	11	115	399
17:30	308	9	122	439
17:45	247	9	106	362
	1143	37	468	1648
18:00	251	7	109	367
18:15	259	9	106	374
18:30	234	8	83	325
18:45	199	3	92	294
	943	27	390	1360
19:00	182	5	103	290
19:15	154	11	102	267
19:30	148	12	77	237
19:45	129	8	82	219
	613	36	364	1013
20:00	135	6	89	230
20:15	103	8	64	175
20:30	109	7	64	180
20:45	98	3	83	184
	445	24	300	769
21:00	130	8	67	205
21:15	126	3	91	220
21:30	96	12	58	166
21:45	94	10	57	161
	446	33	273	752
22:00	71	6	68	145
22:15	67	5	56	128
22:30	82	5	65	152
22:45	81	8	74	163
	301	24	263	588
23:00	66	3	50	119
23:15	47	6	51	104
23:30	47	3	52	102
23:45	69	5	41	115
	229	17	194	440
Total	11063	450	4544	16057
Percent	68.9%	2.8%	28.3%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12/01/21	61	4	52	117
00:15	60	5	33	98
00:30	38	8	42	88
00:45	45	4	48	97
	204	21	175	400
01:00	33	2	33	68
01:15	34	5	35	74
01:30	26	3	37	66
01:45	26	2	54	82
	119	12	159	290
02:00	29	2	44	75
02:15	40	1	34	75
02:30	37	2	30	69
02:45	35	2	43	80
	141	7	151	299
03:00	24	3	37	64
03:15	33	1	40	74
03:30	32	5	53	90
03:45	31	1	39	71
	120	10	169	299
04:00	50	3	62	115
04:15	35	8	40	83
04:30	61	7	37	105
04:45	54	5	44	103
	200	23	183	406
05:00	68	11	42	121
05:15	89	2	62	153
05:30	100	7	63	170
05:45	131	8	63	202
	388	28	230	646
06:00	169	6	53	228
06:15	235	8	59	302
06:30	299	8	58	365
06:45	264	7	73	344
	967	29	243	1239
07:00	341	8	75	424
07:15	310	18	77	405
07:30	327	9	61	397
07:45	313	20	84	417
	1291	55	297	1643
08:00	284	9	96	389
08:15	344	24	78	446
08:30	303	18	95	416
08:45	257	28	88	373
	1188	79	357	1624
09:00	256	28	92	376
09:15	245	32	99	376
09:30	271	21	99	391
09:45	269	24	112	405
	1041	105	402	1548
10:00	236	30	97	363
10:15	275	14	90	379
10:30	269	15	124	408
10:45	324	13	128	465
	1104	72	439	1615
11:00	292	11	117	420
11:15	315	18	106	439
11:30	311	16	101	428
11:45	335	15	122	472
	1253	60	446	1759
Total	8016	501	3251	11768
Percent	68.1%	4.3%	27.6%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12 PM	290	14	97	401
12:15	297	19	92	408
12:30	304	17	109	430
12:45	324	15	92	431
	1215	65	390	1670
13:00	298	19	100	417
13:15	308	19	99	426
13:30	283	15	116	414
13:45	304	16	110	430
	1193	69	425	1687
14:00	326	19	102	447
14:15	321	19	117	457
14:30	303	23	118	444
14:45	330	25	115	470
	1280	86	452	1818
15:00	302	20	102	424
15:15	312	15	108	435
15:30	282	19	96	397
15:45	327	12	91	430
	1223	66	397	1686
16:00	304	17	124	445
16:15	323	25	120	468
16:30	297	8	95	400
16:45	313	9	113	435
	1237	59	452	1748
17:00	302	10	106	418
17:15	263	9	95	367
17:30	291	13	93	397
17:45	297	10	81	388
	1153	42	375	1570
18:00	238	13	101	352
18:15	243	12	85	340
18:30	226	11	105	342
18:45	205	8	71	284
	912	44	362	1318
19:00	190	8	70	268
19:15	185	9	62	256
19:30	163	8	60	231
19:45	140	14	78	232
	678	39	270	987
20:00	143	9	82	234
20:15	125	5	58	188
20:30	117	10	72	199
20:45	120	13	67	200
	505	37	279	821
21:00	109	6	74	189
21:15	111	9	63	183
21:30	88	4	70	162
21:45	82	8	64	154
	390	27	271	688
22:00	103	6	54	163
22:15	90	3	51	144
22:30	101	6	47	154
22:45	92	5	44	141
	386	20	196	602
23:00	92	4	37	133
23:15	84	5	48	137
23:30	68	4	44	116
23:45	57	2	48	107
	301	15	177	493
Total	10473	569	4046	15088
Percent	69.4%	3.8%	26.8%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12/02/21	47	1	41	89
00:15	59	3	34	96
00:30	49	0	49	98
00:45	31	2	37	70
	186	6	161	353
01:00	46	1	31	78
01:15	35	4	34	73
01:30	29	1	41	71
01:45	41	2	36	79
	151	8	142	301
02:00	39	2	30	71
02:15	25	2	21	48
02:30	35	2	44	81
02:45	41	3	44	88
	140	9	139	288
03:00	34	3	44	81
03:15	27	0	41	68
03:30	46	8	44	98
03:45	37	7	55	99
	144	18	184	346
04:00	54	8	36	98
04:15	37	2	34	73
04:30	54	5	57	116
04:45	60	8	49	117
	205	23	176	404
05:00	75	9	48	132
05:15	88	6	48	142
05:30	118	12	50	180
05:45	142	2	65	209
	423	29	211	663
06:00	171	4	63	238
06:15	229	10	59	298
06:30	279	13	70	362
06:45	298	11	58	367
	977	38	250	1265
07:00	320	11	54	385
07:15	325	16	75	416
07:30	333	15	61	409
07:45	321	17	78	416
	1299	59	268	1626
08:00	288	24	97	409
08:15	266	12	78	356
08:30	308	9	74	391
08:45	246	23	74	343
	1108	68	323	1499
09:00	243	20	90	353
09:15	253	22	88	363
09:30	242	36	113	391
09:45	264	20	104	388
	1002	98	395	1495
10:00	274	22	96	392
10:15	283	18	140	441
10:30	290	15	113	418
10:45	302	22	99	423
	1149	77	448	1674
11:00	348	22	122	492
11:15	345	21	106	472
11:30	336	13	111	460
11:45	339	23	99	461
	1368	79	438	1885
Total	8152	512	3135	11799
Percent	69.1%	4.3%	26.6%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12 PM	283	11	110	404
12:15	328	15	92	435
12:30	322	10	98	430
12:45	336	14	119	469
	1269	50	419	1738
13:00	338	26	83	447
13:15	317	13	125	455
13:30	329	13	88	430
13:45	346	11	115	472
	1330	63	411	1804
14:00	332	23	112	467
14:15	389	6	106	501
14:30	368	14	91	473
14:45	320	17	91	428
	1409	60	400	1869
15:00	358	16	102	476
15:15	337	16	95	448
15:30	328	12	106	446
15:45	326	12	97	435
	1349	56	400	1805
16:00	336	11	88	435
16:15	322	12	88	422
16:30	301	18	95	414
16:45	314	9	94	417
	1273	50	365	1688
17:00	296	12	93	401
17:15	277	9	89	375
17:30	264	16	72	352
17:45	275	16	74	365
	1112	53	328	1493
18:00	255	9	86	350
18:15	274	8	69	351
18:30	256	11	85	352
18:45	218	10	80	308
	1003	38	320	1361
19:00	214	11	70	295
19:15	198	6	74	278
19:30	187	10	54	251
19:45	167	6	53	226
	766	33	251	1050
20:00	180	9	59	248
20:15	143	7	71	221
20:30	165	11	64	240
20:45	162	9	75	246
	650	36	269	955
21:00	141	7	55	203
21:15	128	6	67	201
21:30	109	8	61	178
21:45	102	8	50	160
	480	29	233	742
22:00	92	4	45	141
22:15	110	4	54	168
22:30	81	5	43	129
22:45	88	6	49	143
	371	19	191	581
23:00	72	7	44	123
23:15	78	6	43	127
23:30	73	3	45	121
23:45	61	6	33	100
	284	22	165	471
Total	11296	509	3752	15557
Percent	72.6%	3.3%	24.1%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12/03/21	71	5	26	102
00:15	77	1	27	105
00:30	62	2	44	108
00:45	43	5	30	78
	253	13	127	393
01:00	49	1	39	89
01:15	31	3	28	62
01:30	43	4	22	69
01:45	37	1	33	71
	160	9	122	291
02:00	41	1	30	72
02:15	38	2	38	78
02:30	52	2	34	88
02:45	49	0	39	88
	180	5	141	326
03:00	35	1	46	82
03:15	29	3	23	55
03:30	66	6	62	134
03:45	40	2	49	91
	170	12	180	362
04:00	49	2	49	100
04:15	48	1	37	86
04:30	70	10	36	116
04:45	68	6	47	121
	235	19	169	423
05:00	64	9	32	105
05:15	81	5	39	125
05:30	110	8	52	170
05:45	141	7	46	194
	396	29	169	594
06:00	148	8	40	196
06:15	221	9	44	274
06:30	299	14	61	374
06:45	289	11	67	367
	957	42	212	1211
07:00	330	10	73	413
07:15	350	18	72	440
07:30	336	19	63	418
07:45	334	12	73	419
	1350	59	281	1690
08:00	333	23	69	425
08:15	281	16	67	364
08:30	303	14	70	387
08:45	297	13	89	399
	1214	66	295	1575
09:00	278	17	78	373
09:15	287	17	63	367
09:30	304	17	81	402
09:45	313	13	81	407
	1182	64	303	1549
10:00	321	17	93	431
10:15	371	11	81	463
10:30	350	11	77	438
10:45	337	16	101	454
	1379	55	352	1786
11:00	402	12	95	509
11:15	368	9	98	475
11:30	396	17	82	495
11:45	410	10	84	504
	1576	48	359	1983
Total	9052	421	2710	12183
Percent	74.3%	3.5%	22.2%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12 PM	406	13	85	504
12:15	421	12	99	532
12:30	410	11	84	505
12:45	422	11	99	532
	1659	47	367	2073
13:00	392	15	91	498
13:15	450	11	105	566
13:30	426	13	104	543
13:45	384	9	80	473
	1652	48	380	2080
14:00	388	10	71	469
14:15	421	12	83	516
14:30	407	9	90	506
14:45	402	11	72	485
	1618	42	316	1976
15:00	444	9	73	526
15:15	444	12	59	515
15:30	389	13	82	484
15:45	412	6	76	494
	1689	40	290	2019
16:00	424	7	86	517
16:15	406	16	79	501
16:30	419	15	76	510
16:45	384	11	79	474
	1633	49	320	2002
17:00	396	4	75	475
17:15	399	20	71	490
17:30	370	8	45	423
17:45	357	5	69	431
	1522	37	260	1819
18:00	363	13	64	440
18:15	354	8	63	425
18:30	330	4	57	391
18:45	277	7	67	351
	1324	32	251	1607
19:00	268	11	58	337
19:15	227	8	49	284
19:30	234	13	52	299
19:45	193	7	48	248
	922	39	207	1168
20:00	185	5	44	234
20:15	144	3	37	184
20:30	164	7	42	213
20:45	244	6	46	296
	737	21	169	927
21:00	215	11	66	292
21:15	179	4	58	241
21:30	178	6	43	227
21:45	185	2	42	229
	757	23	209	989
22:00	147	5	50	202
22:15	132	3	45	180
22:30	120	2	48	170
22:45	108	2	54	164
	507	12	197	716
23:00	97	3	37	137
23:15	71	3	30	104
23:30	82	2	38	122
23:45	82	2	32	116
	332	10	137	479
Total	14352	400	3103	17855
Percent	80.4%	2.2%	17.4%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12/04/21	79	3	23	105
00:15	80	2	38	120
00:30	75	2	30	107
00:45	47	3	36	86
	281	10	127	418
01:00	46	3	36	85
01:15	60	4	27	91
01:30	43	1	27	71
01:45	46	1	22	69
	195	9	112	316
02:00	53	3	14	70
02:15	40	3	28	71
02:30	41	1	28	70
02:45	47	1	32	80
	181	8	102	291
03:00	56	6	25	87
03:15	43	1	39	83
03:30	29	2	31	62
03:45	50	2	34	86
	178	11	129	318
04:00	42	4	23	69
04:15	30	5	33	68
04:30	59	1	31	91
04:45	53	4	18	75
	184	14	105	303
05:00	65	4	29	98
05:15	72	5	41	118
05:30	91	5	26	122
05:45	88	2	25	115
	316	16	121	453
06:00	83	5	28	116
06:15	119	3	37	159
06:30	147	3	31	181
06:45	170	5	31	206
	519	16	127	662
07:00	165	10	37	212
07:15	174	12	23	209
07:30	237	4	35	276
07:45	240	5	51	296
	816	31	146	993
08:00	245	10	53	308
08:15	246	5	39	290
08:30	301	10	45	356
08:45	283	8	47	338
	1075	33	184	1292
09:00	330	11	50	391
09:15	355	13	59	427
09:30	353	6	68	427
09:45	398	10	54	462
	1436	40	231	1707
10:00	349	12	59	420
10:15	412	9	63	484
10:30	411	8	61	480
10:45	429	10	54	493
	1601	39	237	1877
11:00	441	7	46	494
11:15	421	7	51	479
11:30	458	4	53	515
11:45	457	10	59	526
	1777	28	209	2014
Total	8559	255	1830	10644
Percent	80.4%	2.4%	17.2%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12 PM	384	12	58	454
12:15	420	9	51	480
12:30	457	7	47	511
12:45	431	10	51	492
	1692	38	207	1937
13:00	444	10	52	506
13:15	430	11	56	497
13:30	451	8	48	507
13:45	458	13	69	540
	1783	42	225	2050
14:00	473	11	54	538
14:15	479	9	49	537
14:30	476	19	42	537
14:45	479	15	50	544
	1907	54	195	2156
15:00	436	4	54	494
15:15	405	10	52	467
15:30	411	10	41	462
15:45	429	16	53	498
	1681	40	200	1921
16:00	415	11	40	466
16:15	420	12	46	478
16:30	376	6	60	442
16:45	337	13	59	409
	1548	42	205	1795
17:00	331	6	39	376
17:15	333	9	49	391
17:30	278	4	48	330
17:45	270	6	42	318
	1212	25	178	1415
18:00	260	9	46	315
18:15	234	7	37	278
18:30	270	6	38	314
18:45	197	7	43	247
	961	29	164	1154
19:00	203	5	32	240
19:15	214	7	42	263
19:30	163	5	36	204
19:45	197	8	31	236
	777	25	141	943
20:00	171	4	27	202
20:15	192	3	33	228
20:30	149	7	31	187
20:45	162	7	29	198
	674	21	120	815
21:00	178	6	27	211
21:15	141	4	33	178
21:30	129	7	32	168
21:45	96	4	21	121
	544	21	113	678
22:00	115	2	30	147
22:15	103	9	15	127
22:30	82	3	27	112
22:45	92	5	20	117
	392	19	92	503
23:00	76	3	16	95
23:15	96	1	22	119
23:30	73	3	23	99
23:45	72	4	20	96
	317	11	81	409
Total	13488	367	1921	15776
Percent	85.5%	2.3%	12.2%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12/05/21	56	7	13	76
00:15	60	6	8	74
00:30	51	9	13	73
00:45	69	4	18	91
	236	26	52	314
01:00	41	4	11	56
01:15	50	3	12	65
01:30	30	1	21	52
01:45	45	3	11	59
	166	11	55	232
02:00	40	1	16	57
02:15	40	1	14	55
02:30	42	3	15	60
02:45	37	1	13	51
	159	6	58	223
03:00	33	1	14	48
03:15	28	2	18	48
03:30	42	1	16	59
03:45	41	3	13	57
	144	7	61	212
04:00	33	1	12	46
04:15	38	4	8	50
04:30	48	2	24	74
04:45	41	2	10	53
	160	9	54	223
05:00	51	0	20	71
05:15	36	2	19	57
05:30	60	3	12	75
05:45	51	7	19	77
	198	12	70	280
06:00	75	3	9	87
06:15	85	3	15	103
06:30	113	2	25	140
06:45	112	5	21	138
	385	13	70	468
07:00	106	2	21	129
07:15	124	4	21	149
07:30	136	1	24	161
07:45	136	5	23	164
	502	12	89	603
08:00	158	4	25	187
08:15	180	4	16	200
08:30	189	7	32	228
08:45	224	6	32	262
	751	21	105	877
09:00	241	11	30	282
09:15	236	12	32	280
09:30	285	9	32	326
09:45	310	6	22	338
	1072	38	116	1226
10:00	322	13	33	368
10:15	357	14	38	409
10:30	383	9	42	434
10:45	418	7	41	466
	1480	43	154	1677
11:00	423	10	33	466
11:15	461	9	36	506
11:30	423	4	31	458
11:45	384	10	37	431
	1691	33	137	1861
Total	6944	231	1021	8196
Percent	84.7%	2.8%	12.5%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12 PM	463	15	33	511
12:15	485	3	36	524
12:30	427	7	43	477
12:45	451	7	37	495
	1826	32	149	2007
13:00	444	11	38	493
13:15	481	2	49	532
13:30	469	8	22	499
13:45	494	8	36	538
	1888	29	145	2062
14:00	476	5	55	536
14:15	441	7	40	488
14:30	471	6	34	511
14:45	502	9	41	552
	1890	27	170	2087
15:00	486	6	35	527
15:15	480	9	46	535
15:30	452	8	32	492
15:45	451	7	39	497
	1869	30	152	2051
16:00	404	5	41	450
16:15	422	4	45	471
16:30	410	9	58	477
16:45	422	7	49	478
	1658	25	193	1876
17:00	348	5	39	392
17:15	386	12	41	439
17:30	400	9	38	447
17:45	369	7	41	417
	1503	33	159	1695
18:00	315	15	31	361
18:15	322	10	36	368
18:30	322	5	21	348
18:45	268	6	28	302
	1227	36	116	1379
19:00	262	8	40	310
19:15	279	12	27	318
19:30	219	6	30	255
19:45	234	10	32	276
	994	36	129	1159
20:00	205	6	18	229
20:15	211	6	25	242
20:30	220	4	41	265
20:45	161	7	36	204
	797	23	120	940
21:00	161	4	25	190
21:15	159	10	24	193
21:30	141	5	18	164
21:45	161	4	22	187
	622	23	89	734
22:00	121	4	24	149
22:15	116	5	17	138
22:30	122	7	14	143
22:45	95	4	16	115
	454	20	71	545
23:00	71	9	16	96
23:15	77	3	8	88
23:30	57	4	17	78
23:45	65	1	12	78
	270	17	53	340
Total	14998	331	1546	16875
Percent	88.9%	2.0%	9.2%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12/06/21	58	2	25	85
00:15	65	0	22	87
00:30	76	2	12	90
00:45	48	1	15	64
	247	5	74	326
01:00	53	2	15	70
01:15	36	1	19	56
01:30	26	0	13	39
01:45	23	1	13	37
	138	4	60	202
02:00	37	0	19	56
02:15	38	1	19	58
02:30	28	1	21	50
02:45	42	2	15	59
	145	4	74	223
03:00	31	1	24	56
03:15	37	3	21	61
03:30	34	2	24	60
03:45	44	2	28	74
	146	8	97	251
04:00	42	1	37	80
04:15	50	3	25	78
04:30	59	0	31	90
04:45	67	4	35	106
	218	8	128	354
05:00	83	3	23	109
05:15	101	3	28	132
05:30	140	3	37	180
05:45	162	4	43	209
	486	13	131	630
06:00	178	3	42	223
06:15	249	1	48	298
06:30	288	8	46	342
06:45	324	7	42	373
	1039	19	178	1236
07:00	340	11	46	397
07:15	361	10	38	409
07:30	312	5	52	369
07:45	311	12	63	386
	1324	38	199	1561
08:00	289	9	53	351
08:15	281	5	47	333
08:30	317	14	65	396
08:45	308	10	68	386
	1195	38	233	1466
09:00	274	11	63	348
09:15	277	10	69	356
09:30	269	12	77	358
09:45	255	9	63	327
	1075	42	272	1389
10:00	261	11	89	361
10:15	270	16	67	353
10:30	307	14	86	407
10:45	330	8	67	405
	1168	49	309	1526
11:00	373	14	74	461
11:15	337	12	89	438
11:30	325	6	94	425
11:45	354	11	75	440
	1389	43	332	1764
Total	8570	271	2087	10928
Percent	78.4%	2.5%	19.1%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

NB

Start Time	Lights	Mediums	Trucks	Total
12 PM	343	12	97	452
12:15	322	8	83	413
12:30	330	13	84	427
12:45	318	10	85	413
	1313	43	349	1705
13:00	349	14	89	452
13:15	204	10	65	279
13:30	174	5	53	232
13:45	175	4	43	222
	902	33	250	1185
14:00	258	5	76	339
14:15	362	8	111	481
14:30	337	9	109	455
14:45	324	9	109	442
	1281	31	405	1717
15:00	470	9	133	612
15:15	310	4	102	416
15:30	362	10	104	476
15:45	337	3	102	442
	1479	26	441	1946
16:00	313	6	102	421
16:15	308	11	103	422
16:30	318	10	119	447
16:45	318	13	101	432
	1257	40	425	1722
17:00	280	8	113	401
17:15	322	12	92	426
17:30	269	5	77	351
17:45	287	6	92	385
	1158	31	374	1563
18:00	276	11	90	377
18:15	236	3	84	323
18:30	207	4	98	309
18:45	184	0	101	285
	903	18	373	1294
19:00	182	6	110	298
19:15	151	6	80	237
19:30	122	0	69	191
19:45	152	4	56	212
	607	16	315	938
20:00	105	1	66	172
20:15	127	0	67	194
20:30	106	2	69	177
20:45	128	4	89	221
	466	7	291	764
21:00	111	1	68	180
21:15	93	5	69	167
21:30	100	2	53	155
21:45	65	5	60	130
	369	13	250	632
22:00	71	3	62	136
22:15	92	0	91	183
22:30	91	5	101	197
22:45	79	6	57	142
	333	14	311	658
23:00	64	5	53	122
23:15	67	2	47	116
23:30	61	2	43	106
23:45	64	7	41	112
	256	16	184	456
Total	10324	288	3968	14580
Percent	70.8%	2.0%	27.2%	100.0%
Grand Total	143629	5587	40277	189493
Percent	75.8%	2.9%	21.3%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
11/30/21	59	4	32	95
00:15	47	2	35	84
00:30	54	2	34	90
00:45	41	1	29	71
	201	9	130	340
01:00	39	2	27	68
01:15	48	2	39	89
01:30	35	2	27	64
01:45	34	2	22	58
	156	8	115	279
02:00	34	4	30	68
02:15	41	1	28	70
02:30	46	2	31	79
02:45	44	1	42	87
	165	8	131	304
03:00	44	3	36	83
03:15	62	1	34	97
03:30	61	1	40	102
03:45	55	1	33	89
	222	6	143	371
04:00	59	2	30	91
04:15	72	2	32	106
04:30	99	3	37	139
04:45	75	1	44	120
	305	8	143	456
05:00	89	4	59	152
05:15	127	2	45	174
05:30	158	5	52	215
05:45	115	2	53	170
	489	13	209	711
06:00	141	6	49	196
06:15	135	8	53	196
06:30	161	8	57	226
06:45	182	4	82	268
	619	26	241	886
07:00	281	11	68	360
07:15	265	13	57	335
07:30	264	13	74	351
07:45	284	10	62	356
	1094	47	261	1402
08:00	256	10	59	325
08:15	285	13	47	345
08:30	271	17	58	346
08:45	328	21	62	411
	1140	61	226	1427
09:00	279	4	60	343
09:15	188	3	21	212
09:30	195	3	29	227
09:45	336	10	58	404
	998	20	168	1186
10:00	363	16	58	437
10:15	413	6	87	506
10:30	458	18	95	571
10:45	500	24	101	625
	1734	64	341	2139
11:00	553	18	127	698
11:15	502	9	115	626
11:30	413	13	92	518
11:45	444	9	116	569
	1912	49	450	2411
Total	9035	319	2558	11912
Percent	75.8%	2.7%	21.5%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12 PM	411	20	94	525
12:15	371	8	49	428
12:30	384	14	66	464
12:45	399	20	70	489
	1565	62	279	1906
13:00	431	18	95	544
13:15	447	14	87	548
13:30	382	15	95	492
13:45	378	21	109	508
	1638	68	386	2092
14:00	422	20	129	571
14:15	460	19	117	596
14:30	461	16	115	592
14:45	483	19	132	634
	1826	74	493	2393
15:00	408	16	110	534
15:15	427	21	120	568
15:30	436	16	106	558
15:45	443	15	145	603
	1714	68	481	2263
16:00	459	19	128	606
16:15	499	13	138	650
16:30	457	18	131	606
16:45	447	8	117	572
	1862	58	514	2434
17:00	451	12	108	571
17:15	569	20	102	691
17:30	547	20	116	683
17:45	465	18	105	588
	2032	70	431	2533
18:00	404	20	94	518
18:15	340	13	76	429
18:30	288	17	105	410
18:45	243	10	99	352
	1275	60	374	1709
19:00	226	5	90	321
19:15	220	15	88	323
19:30	195	9	77	281
19:45	166	9	68	243
	807	38	323	1168
20:00	170	4	55	229
20:15	136	5	70	211
20:30	125	8	71	204
20:45	159	6	66	231
	590	23	262	875
21:00	120	6	63	189
21:15	141	2	47	190
21:30	108	5	52	165
21:45	108	5	61	174
	477	18	223	718
22:00	106	3	52	161
22:15	79	5	58	142
22:30	78	1	50	129
22:45	101	2	47	150
	364	11	207	582
23:00	59	1	51	111
23:15	58	3	42	103
23:30	54	2	43	99
23:45	47	3	36	86
	218	9	172	399
Total	14368	559	4145	19072
Percent	75.3%	2.9%	21.7%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12/01/21	46	0	37	83
00:15	55	0	43	98
00:30	50	0	30	80
00:45	51	3	44	98
	202	3	154	359
01:00	36	3	38	77
01:15	36	3	46	85
01:30	30	1	28	59
01:45	32	1	36	69
	134	8	148	290
02:00	37	4	25	66
02:15	46	5	33	84
02:30	38	4	27	69
02:45	25	2	44	71
	146	15	129	290
03:00	28	3	44	75
03:15	40	4	43	87
03:30	54	5	38	97
03:45	48	5	57	110
	170	17	182	369
04:00	37	0	41	78
04:15	68	1	40	109
04:30	80	5	47	132
04:45	89	2	51	142
	274	8	179	461
05:00	96	7	46	149
05:15	98	7	65	170
05:30	126	8	60	194
05:45	114	7	45	166
	434	29	216	679
06:00	41	4	32	77
06:15	0	0	0	0
06:30	92	8	42	142
06:45	145	11	69	225
	278	23	143	444
07:00	248	13	79	340
07:15	322	14	97	433
07:30	285	12	70	367
07:45	272	13	58	343
	1127	52	304	1483
08:00	269	14	89	372
08:15	345	24	75	444
08:30	337	16	57	410
08:45	307	10	86	403
	1258	64	307	1629
09:00	353	19	74	446
09:15	382	10	82	474
09:30	387	17	72	476
09:45	358	23	83	464
	1480	69	311	1860
10:00	402	11	77	490
10:15	416	16	80	512
10:30	414	14	98	526
10:45	402	18	82	502
	1634	59	337	2030
11:00	371	20	84	475
11:15	372	19	89	480
11:30	212	13	46	271
11:45	171	10	37	218
	1126	62	256	1444
Total	8263	409	2666	11338
Percent	72.9%	3.6%	23.5%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12 PM	341	14	72	427
12:15	442	17	83	542
12:30	437	18	114	569
12:45	486	20	124	630
	1706	69	393	2168
13:00	447	17	116	580
13:15	405	15	85	505
13:30	408	13	112	533
13:45	397	20	96	513
	1657	65	409	2131
14:00	384	19	105	508
14:15	424	14	107	545
14:30	415	20	106	541
14:45	400	17	113	530
	1623	70	431	2124
15:00	396	12	120	528
15:15	488	18	113	619
15:30	415	15	120	550
15:45	375	17	110	502
	1674	62	463	2199
16:00	402	23	111	536
16:15	484	18	134	636
16:30	499	20	105	624
16:45	497	15	112	624
	1882	76	462	2420
17:00	432	19	97	548
17:15	533	18	86	637
17:30	474	23	87	584
17:45	395	7	84	486
	1834	67	354	2255
18:00	326	12	78	416
18:15	350	20	65	435
18:30	286	12	95	393
18:45	222	8	68	298
	1184	52	306	1542
19:00	198	10	84	292
19:15	204	5	72	281
19:30	190	4	62	256
19:45	166	8	65	239
	758	27	283	1068
20:00	160	4	47	211
20:15	155	3	59	217
20:30	145	4	38	187
20:45	120	5	31	156
	580	16	175	771
21:00	134	6	37	177
21:15	133	4	38	175
21:30	130	2	49	181
21:45	130	4	48	182
	527	16	172	715
22:00	119	2	48	169
22:15	105	3	38	146
22:30	95	8	36	139
22:45	85	2	38	125
	404	15	160	579
23:00	100	3	36	139
23:15	78	3	42	123
23:30	64	7	32	103
23:45	72	2	33	107
	314	15	143	472
Total	14143	550	3751	18444
Percent	76.7%	3.0%	20.3%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12/02/21	63	2	31	96
00:15	40	0	32	72
00:30	48	1	48	97
00:45	32	0	32	64
	183	3	143	329
01:00	40	3	40	83
01:15	29	5	36	70
01:30	37	6	36	79
01:45	34	3	33	70
	140	17	145	302
02:00	43	3	44	90
02:15	33	1	31	65
02:30	19	1	9	29
02:45	1	0	0	1
	96	5	84	185
03:00	16	1	13	30
03:15	55	4	72	131
03:30	52	8	56	116
03:45	70	4	69	143
	193	17	210	420
04:00	46	1	33	80
04:15	63	2	39	104
04:30	85	0	43	128
04:45	83	3	52	138
	277	6	167	450
05:00	91	5	69	165
05:15	108	3	39	150
05:30	140	8	48	196
05:45	111	4	59	174
	450	20	215	685
06:00	136	7	77	220
06:15	177	7	72	256
06:30	197	11	47	255
06:45	197	12	63	272
	707	37	259	1003
07:00	232	11	79	322
07:15	221	7	64	292
07:30	268	10	89	367
07:45	283	8	72	363
	1004	36	304	1344
08:00	274	12	73	359
08:15	297	16	75	388
08:30	292	8	69	369
08:45	346	12	76	434
	1209	48	293	1550
09:00	330	13	83	426
09:15	323	9	77	409
09:30	384	8	84	476
09:45	392	15	90	497
	1429	45	334	1808
10:00	396	8	70	474
10:15	423	18	90	531
10:30	417	12	87	516
10:45	404	23	89	516
	1640	61	336	2037
11:00	381	11	93	485
11:15	407	13	89	509
11:30	401	11	76	488
11:45	445	13	98	556
	1634	48	356	2038
Total	8962	343	2846	12151
Percent	73.8%	2.8%	23.4%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12 PM	426	16	106	548
12:15	381	12	88	481
12:30	415	17	104	536
12:45	424	10	98	532
	1646	55	396	2097
13:00	403	20	84	507
13:15	410	14	91	515
13:30	448	11	100	559
13:45	418	13	100	531
	1679	58	375	2112
14:00	408	13	96	517
14:15	410	15	113	538
14:30	421	13	83	517
14:45	385	13	102	500
	1624	54	394	2072
15:00	387	10	91	488
15:15	425	10	112	547
15:30	422	15	107	544
15:45	470	10	110	590
	1704	45	420	2169
16:00	424	12	119	555
16:15	440	11	98	549
16:30	483	16	93	592
16:45	555	18	85	658
	1902	57	395	2354
17:00	464	14	98	576
17:15	529	14	91	634
17:30	522	12	76	610
17:45	469	14	97	580
	1984	54	362	2400
18:00	459	12	92	563
18:15	407	3	87	497
18:30	342	5	92	439
18:45	282	5	76	363
	1490	25	347	1862
19:00	259	4	103	366
19:15	234	2	82	318
19:30	267	4	81	352
19:45	211	2	88	301
	971	12	354	1337
20:00	201	6	62	269
20:15	211	3	57	271
20:30	181	5	53	239
20:45	170	8	65	243
	763	22	237	1022
21:00	178	4	41	223
21:15	130	4	34	168
21:30	114	3	39	156
21:45	92	3	43	138
	514	14	157	685
22:00	62	2	10	74
22:15	108	1	14	123
22:30	103	1	37	141
22:45	119	2	50	171
	392	6	111	509
23:00	131	1	53	185
23:15	117	5	66	188
23:30	91	3	48	142
23:45	83	1	26	110
	422	10	193	625
Total	15091	412	3741	19244
Percent	78.4%	2.1%	19.4%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12/03/21	73	1	37	111
00:15	78	0	26	104
00:30	57	2	30	89
00:45	55	0	36	91
	263	3	129	395
01:00	47	0	39	86
01:15	55	2	32	89
01:30	36	0	42	78
01:45	36	1	35	72
	174	3	148	325
02:00	56	2	31	89
02:15	66	1	22	89
02:30	48	3	45	96
02:45	41	2	36	79
	211	8	134	353
03:00	43	0	35	78
03:15	45	1	26	72
03:30	84	0	30	114
03:45	70	4	42	116
	242	5	133	380
04:00	56	0	47	103
04:15	90	4	37	131
04:30	85	4	35	124
04:45	87	3	48	138
	318	11	167	496
05:00	89	5	42	136
05:15	129	2	48	179
05:30	143	6	49	198
05:45	137	2	41	180
	498	15	180	693
06:00	119	10	52	181
06:15	200	5	67	272
06:30	220	11	56	287
06:45	217	9	55	281
	756	35	230	1021
07:00	203	9	51	263
07:15	244	8	60	312
07:30	247	2	57	306
07:45	311	8	68	387
	1005	27	236	1268
08:00	262	8	69	339
08:15	343	14	72	429
08:30	325	10	66	401
08:45	346	7	67	420
	1276	39	274	1589
09:00	383	6	75	464
09:15	346	3	63	412
09:30	418	8	66	492
09:45	446	15	69	530
	1593	32	273	1898
10:00	396	12	73	481
10:15	434	11	69	514
10:30	478	15	75	568
10:45	531	19	79	629
	1839	57	296	2192
11:00	481	11	70	562
11:15	474	5	89	568
11:30	513	14	65	592
11:45	502	14	74	590
	1970	44	298	2312
Total	10145	279	2498	12922
Percent	78.5%	2.2%	19.3%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12 PM	514	14	85	613
12:15	493	11	63	567
12:30	491	12	78	581
12:45	513	11	69	593
	2011	48	295	2354
13:00	526	9	76	611
13:15	511	13	83	607
13:30	457	16	67	540
13:45	488	10	87	585
	1982	48	313	2343
14:00	510	6	73	589
14:15	506	14	84	604
14:30	516	9	77	602
14:45	514	13	79	606
	2046	42	313	2401
15:00	518	13	97	628
15:15	515	16	78	609
15:30	510	11	94	615
15:45	520	13	87	620
	2063	53	356	2472
16:00	529	9	83	621
16:15	519	10	88	617
16:30	521	17	75	613
16:45	530	12	76	618
	2099	48	322	2469
17:00	525	8	78	611
17:15	520	15	80	615
17:30	514	10	63	587
17:45	478	5	76	559
	2037	38	297	2372
18:00	436	6	58	500
18:15	427	6	61	494
18:30	416	4	63	483
18:45	378	10	53	441
	1657	26	235	1918
19:00	341	5	52	398
19:15	318	7	49	374
19:30	281	6	51	338
19:45	262	2	53	317
	1202	20	205	1427
20:00	235	6	49	290
20:15	223	2	41	266
20:30	165	4	46	215
20:45	238	7	32	277
	861	19	168	1048
21:00	219	5	28	252
21:15	185	2	33	220
21:30	176	1	27	204
21:45	183	2	38	223
	763	10	126	899
22:00	159	5	39	203
22:15	139	1	28	168
22:30	140	2	38	180
22:45	138	3	30	171
	576	11	135	722
23:00	110	2	38	150
23:15	115	1	30	146
23:30	113	1	36	150
23:45	91	1	30	122
	429	5	134	568
Total	17726	368	2899	20993
Percent	84.4%	1.8%	13.8%	100.0%

All Traffic Data Services

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Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12/04/21	47	5	30	82
00:15	81	1	30	112
00:30	72	2	12	86
00:45	75	1	16	92
	275	9	88	372
01:00	51	2	23	76
01:15	52	2	21	75
01:30	52	1	35	88
01:45	54	3	15	72
	209	8	94	311
02:00	46	2	26	74
02:15	81	2	26	109
02:30	59	2	23	84
02:45	63	1	26	90
	249	7	101	357
03:00	68	2	24	94
03:15	64	2	25	91
03:30	84	2	25	111
03:45	61	2	29	92
	277	8	103	388
04:00	53	2	38	93
04:15	66	2	25	93
04:30	78	0	25	103
04:45	91	4	30	125
	288	8	118	414
05:00	100	3	26	129
05:15	112	2	23	137
05:30	107	5	33	145
05:45	136	2	29	167
	455	12	111	578
06:00	118	5	28	151
06:15	153	3	28	184
06:30	151	3	44	198
06:45	189	3	38	230
	611	14	138	763
07:00	226	4	40	270
07:15	230	4	35	269
07:30	254	6	34	294
07:45	281	4	42	327
	991	18	151	1160
08:00	289	10	39	338
08:15	328	8	46	382
08:30	334	1	56	391
08:45	344	6	63	413
	1295	25	204	1524
09:00	387	12	53	452
09:15	437	12	57	506
09:30	468	10	43	521
09:45	437	7	48	492
	1729	41	201	1971
10:00	415	13	47	475
10:15	504	5	61	570
10:30	490	6	68	564
10:45	562	9	52	623
	1971	33	228	2232
11:00	513	10	57	580
11:15	544	9	50	603
11:30	454	11	46	511
11:45	436	7	75	518
	1947	37	228	2212
Total	10297	220	1765	12282
Percent	83.8%	1.8%	14.4%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12 PM	511	8	61	580
12:15	450	16	55	521
12:30	487	14	53	554
12:45	510	7	46	563
	1958	45	215	2218
13:00	416	7	67	490
13:15	450	13	62	525
13:30	444	11	56	511
13:45	459	6	55	520
	1769	37	240	2046
14:00	450	10	60	520
14:15	442	7	65	514
14:30	401	14	59	474
14:45	457	14	48	519
	1750	45	232	2027
15:00	417	10	74	501
15:15	498	10	85	593
15:30	405	6	51	462
15:45	442	9	66	517
	1762	35	276	2073
16:00	394	7	54	455
16:15	407	6	56	469
16:30	406	5	58	469
16:45	350	9	52	411
	1557	27	220	1804
17:00	327	1	42	370
17:15	325	4	50	379
17:30	285	5	50	340
17:45	336	10	45	391
	1273	20	187	1480
18:00	303	4	45	352
18:15	276	5	51	332
18:30	314	4	44	362
18:45	277	5	42	324
	1170	18	182	1370
19:00	235	6	40	281
19:15	252	6	43	301
19:30	237	5	50	292
19:45	230	1	29	260
	954	18	162	1134
20:00	198	3	28	229
20:15	188	2	31	221
20:30	158	5	22	185
20:45	162	3	36	201
	706	13	117	836
21:00	157	1	27	185
21:15	155	4	24	183
21:30	130	1	24	155
21:45	139	5	37	181
	581	11	112	704
22:00	173	2	26	201
22:15	159	5	19	183
22:30	123	3	27	153
22:45	97	3	31	131
	552	13	103	668
23:00	89	1	23	113
23:15	98	3	24	125
23:30	89	0	16	105
23:45	90	1	12	103
	366	5	75	446
Total	14398	287	2121	16806
Percent	85.7%	1.7%	12.6%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12/05/21	64	3	17	84
00:15	50	2	26	78
00:30	53	3	9	65
00:45	29	1	20	50
	196	9	72	277
01:00	43	2	8	53
01:15	35	4	11	50
01:30	37	1	10	48
01:45	43	1	11	55
	158	8	40	206
02:00	39	1	15	55
02:15	45	1	17	63
02:30	37	0	16	53
02:45	33	0	25	58
	154	2	73	229
03:00	38	1	19	58
03:15	35	0	17	52
03:30	52	0	8	60
03:45	51	0	18	69
	176	1	62	239
04:00	59	0	18	77
04:15	45	1	21	67
04:30	46	0	12	58
04:45	50	0	16	66
	200	1	67	268
05:00	67	1	17	85
05:15	69	1	14	84
05:30	91	3	21	115
05:45	85	3	22	110
	312	8	74	394
06:00	99	5	26	130
06:15	95	1	20	116
06:30	95	1	23	119
06:45	124	1	14	139
	413	8	83	504
07:00	137	4	29	170
07:15	133	3	43	179
07:30	185	5	31	221
07:45	178	2	27	207
	633	14	130	777
08:00	205	7	36	248
08:15	269	4	38	311
08:30	241	5	33	279
08:45	313	5	47	365
	1028	21	154	1203
09:00	296	10	45	351
09:15	346	6	50	402
09:30	418	5	44	467
09:45	417	4	44	465
	1477	25	183	1685
10:00	444	8	51	503
10:15	416	8	61	485
10:30	505	7	60	572
10:45	571	6	72	649
	1936	29	244	2209
11:00	528	4	46	578
11:15	439	6	56	501
11:30	515	9	52	576
11:45	529	15	52	596
	2011	34	206	2251
Total	8694	160	1388	10242
Percent	84.9%	1.6%	13.6%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12 PM	526	9	45	580
12:15	500	14	76	590
12:30	517	7	63	587
12:45	541	10	57	608
	2084	40	241	2365
13:00	526	9	68	603
13:15	531	5	62	598
13:30	532	13	74	619
13:45	485	8	75	568
	2074	35	279	2388
14:00	515	5	67	587
14:15	453	2	61	516
14:30	499	11	80	590
14:45	549	12	65	626
	2016	30	273	2319
15:00	498	20	72	590
15:15	501	8	76	585
15:30	487	8	63	558
15:45	482	15	71	568
	1968	51	282	2301
16:00	430	11	72	513
16:15	467	11	65	543
16:30	447	13	50	510
16:45	448	12	66	526
	1792	47	253	2092
17:00	372	7	45	424
17:15	367	7	55	429
17:30	463	9	64	536
17:45	421	10	70	501
	1623	33	234	1890
18:00	317	6	51	374
18:15	319	9	54	382
18:30	248	7	37	292
18:45	274	9	42	325
	1158	31	184	1373
19:00	248	9	53	310
19:15	246	6	37	289
19:30	248	3	42	293
19:45	270	3	55	328
	1012	21	187	1220
20:00	235	7	64	306
20:15	220	6	54	280
20:30	230	5	52	287
20:45	188	2	26	216
	873	20	196	1089
21:00	169	3	54	226
21:15	153	5	20	178
21:30	143	4	22	169
21:45	132	0	38	170
	597	12	134	743
22:00	125	6	32	163
22:15	103	1	36	140
22:30	103	6	36	145
22:45	86	3	27	116
	417	16	131	564
23:00	85	6	28	119
23:15	83	0	19	102
23:30	88	5	25	118
23:45	77	2	19	98
	333	13	91	437
Total	15947	349	2485	18781
Percent	84.9%	1.9%	13.2%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12/06/21	70	1	27	98
00:15	47	3	23	73
00:30	39	1	19	59
00:45	49	0	24	73
	205	5	93	303
01:00	42	1	23	66
01:15	41	2	15	58
01:30	42	3	18	63
01:45	34	2	18	54
	159	8	74	241
02:00	41	2	23	66
02:15	33	2	16	51
02:30	37	3	24	64
02:45	28	3	19	50
	139	10	82	231
03:00	45	3	21	69
03:15	34	2	26	62
03:30	58	3	19	80
03:45	49	1	28	78
	186	9	94	289
04:00	50	4	29	83
04:15	67	1	22	90
04:30	96	2	20	118
04:45	101	2	32	135
	314	9	103	426
05:00	106	1	31	138
05:15	117	1	32	150
05:30	152	3	32	187
05:45	142	4	37	183
	517	9	132	658
06:00	130	3	29	162
06:15	199	7	44	250
06:30	209	5	44	258
06:45	183	4	43	230
	721	19	160	900
07:00	201	11	44	256
07:15	260	6	49	315
07:30	267	8	54	329
07:45	247	6	41	294
	975	31	188	1194
08:00	269	9	49	327
08:15	261	7	54	322
08:30	266	8	58	332
08:45	286	8	62	356
	1082	32	223	1337
09:00	295	4	41	340
09:15	300	11	60	371
09:30	319	7	59	385
09:45	326	7	64	397
	1240	29	224	1493
10:00	363	10	66	439
10:15	395	11	63	469
10:30	396	10	55	461
10:45	346	5	55	406
	1500	36	239	1775
11:00	384	8	61	453
11:15	428	11	60	499
11:30	376	7	60	443
11:45	385	7	78	470
	1573	33	259	1865
Total	8611	230	1871	10712
Percent	80.4%	2.1%	17.5%	100.0%

All Traffic Data Services

www.alltrafficdata.net

Site Code: 1
Station ID: 1
I-95 OVER RAILROAD

Latitude: 0' 0.0000 Undefined
Longitude: 0' 0.0000 Undefined

SB

Start Time	Lights	Mediums	Trucks	Total
12 PM	392	6	74	472
12:15	368	16	75	459
12:30	362	14	53	429
12:45	421	9	78	508
	1543	45	280	1868
13:00	347	8	78	433
13:15	424	11	67	502
13:30	355	12	75	442
13:45	349	8	72	429
	1475	39	292	1806
14:00	351	5	84	440
14:15	354	14	77	445
14:30	371	11	83	465
14:45	381	11	77	469
	1457	41	321	1819
15:00	357	14	83	454
15:15	387	12	91	490
15:30	376	10	57	443
15:45	409	7	84	500
	1529	43	315	1887
16:00	358	10	73	441
16:15	433	5	83	521
16:30	453	7	77	537
16:45	423	2	90	515
	1667	24	323	2014
17:00	470	6	84	560
17:15	490	3	81	574
17:30	458	5	66	529
17:45	424	1	76	501
	1842	15	307	2164
18:00	375	0	67	442
18:15	344	4	64	412
18:30	293	0	64	357
18:45	247	4	60	311
	1259	8	255	1522
19:00	172	7	52	231
19:15	205	3	52	260
19:30	197	2	56	255
19:45	170	0	73	243
	744	12	233	989
20:00	162	4	58	224
20:15	130	5	50	185
20:30	126	2	38	166
20:45	131	2	34	167
	549	13	180	742
21:00	107	4	44	155
21:15	92	2	45	139
21:30	78	3	43	124
21:45	94	1	44	139
	371	10	176	557
22:00	67	2	42	111
22:15	75	2	26	103
22:30	73	3	42	118
22:45	60	1	38	99
	275	8	148	431
23:00	53	2	32	87
23:15	50	2	47	99
23:30	53	2	34	89
23:45	55	3	35	93
	211	9	148	368
Total	12922	267	2978	16167
Percent	79.9%	1.7%	18.4%	100.0%
Grand Total	168602	4752	37712	211066
Percent	79.9%	2.3%	17.9%	100.0%

Volume Development Worksheets

US 17 and US 278

TRAFFIC CONTROL: Unsignalized

DATE COUNTED: December 2, 2021

	US 17								US 278							
AM PEAK HOUR	**NBL**	**NBT**	**NBR**	**NBR**	**SBL**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBR**	**WBL**	**WBL**	**WBT**	**WBR**	**WBR**
2022 Raw Counts	0	77	487		133		93	0	0	0	0	223		0	39	
2022 Separated Counts	-		437	50	118	15	-			-		152	71	-	25	14
2022 UNBALANCED VOLUMES	**0**	**77**	**437**	**50**	**118**	**15**	**93**	**0**	**0**	**0**	**0**	**152**	**71**	**0**	**25**	**14**
Balancing																
2022 BALANCED + ROUNDED VOLUMES	**0**	**80**	**440**	**50**	**120**	**15**	**95**	**0**	**0**	**0**	**0**	**155**	**75**	**0**	**25**	**15**
Years To Buildout (8)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate	-	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	-		-		2.0%	1.0%	-	2.0%	1.0%
Background Traffic Growth	0	6	35	4	10	1	8	0	0	0	0	25	6	0	4	1
2030 ROUNDED VOLUMES	**0**	**90**	**475**	**55**	**130**	**20**	**105**	**0**	**0**	**0**	**0**	**180**	**85**	**0**	**30**	**20**
2030 Development Volumes		2	60	0		5	8					200	0			10
Balancing																
2030 BALANCED VOLUMES	**0**	**95**	**535**	**55**	**130**	**25**	**115**	**0**	**0**	**0**	**0**	**380**	**85**	**0**	**30**	**30**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate	-	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	-		-		2.0%	1.0%	-	2.0%	1.0%
Background Traffic Growth	0	22	123	14	34	4	27	0	0	0	0	87	21	0	14	4
2050 ROUNDED VOLUMES	**0**	**105**	**565**	**65**	**155**	**20**	**125**	**0**	**0**	**0**	**0**	**245**	**100**	**0**	**40**	**20**
2050 Development Volumes		2	60	5		15	8					200	0			20
Balancing																
2050 BALANCED VOLUMES	**0**	**110**	**625**	**70**	**155**	**35**	**135**	**0**	**0**	**0**	**0**	**445**	**100**	**0**	**40**	**40**

Note: **Traffic to I-95**

Traffic from I-95

	US 17								US 278							
PM PEAK HOUR	**NBL**	**NBT**	**NBR**	**NBR**	**SBL**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBR**	**WBL**	**WBL**	**WBT**	**WBR**	**WBR**
2022 Raw Traffic Counts	0	102	120		58		61	0	0	0	0	209		0	112	
2022 Separated Traffic Counts	-		53	67	25	33	-			-		170	39	-	91	21
2022 UNBALANCED VOLUMES	**0**	**102**	**53**	**67**	**25**	**33**	**61**	**0**	**0**	**0**	**0**	**170**	**39**	**0**	**91**	**21**
Balancing													5			
2022 BALANCED + ROUNDED VOLUMES	**0**	**105**	**55**	**70**	**25**	**35**	**65**	**0**	**0**	**0**	**0**	**170**	**45**	**0**	**95**	**25**
Years To Buildout (2030)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate	-	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	-		-		2.0%	1.0%	-	2.0%	1.0%
Background Traffic Growth	0	8	4	6	2	3	5	0	0	0	0	27	4	0	15	2
2030 ROUNDED VOLUMES	**0**	**115**	**60**	**80**	**30**	**40**	**70**	**0**	**0**	**0**	**0**	**200**	**50**	**0**	**110**	**30**
2030 Development Volumes		7	191	0		15	3					71	0			15
Balancing			5													
2030 BALANCED VOLUMES	**0**	**125**	**260**	**80**	**30**	**55**	**75**	**0**	**0**	**0**	**0**	**275**	**50**	**0**	**110**	**45**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate	-	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	-		-		2.0%	1.0%	-	2.0%	1.0%
Background Traffic Growth	0	29	15	20	7	10	18	0	0	0	0	95	13	0	53	7
2050 ROUNDED VOLUMES	**0**	**135**	**70**	**90**	**35**	**45**	**85**	**0**	**0**	**0**	**0**	**265**	**60**	**0**	**150**	**35**
2050 Development Volumes		7	191	15		20	3					71	10			0
Balancing																
2050 BALANCED VOLUMES	**0**	**145**	**265**	**105**	**35**	**65**	**90**	**0**	**0**	**0**	**0**	**340**	**70**	**0**	**150**	**35**

Note: **Traffic to I-95**

Traffic from I-95

I-95 SB Ramps and US 278

TRAFFIC CONTROL: Signalized
DATE COUNTED: December 2, 2021

	I-95 SB Ramp						US 278							
AM PEAK HOUR	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBT**	**EBR**	**WBL**	**WBT**	**WBT**	**WBR**
2022 Raw Counts	0	0	0	410	0	81	0	628		34	365	210		0
2022 Separated Counts		-			-		-	597	31	-	-	206	4	-
2022 UNBALANCED VOLUMES	**0**	**0**	**0**	**410**	**0**	**81**	**0**	**597**	**31**	**34**	**365**	**206**	**4**	**0**
Balancing								5						
2022 BALANCED + ROUNDED VOLUMES	**0**	**0**	**0**	**410**	**0**	**85**	**0**	**605**	**35**	**35**	**365**	**210**	**5**	**0**
Years To Buildout (2030)	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate		-		2.0%	-	1.0%	-	1.0%	1.0%	1.0%	2.0%	2.0%	1.0%	-
Background Traffic Growth	0	0	0	66	0	7	0	48	3	3	58	34	0.4	0
2030 ROUNDED VOLUMES	**0**	**0**	**0**	**480**	**0**	**95**	**0**	**655**	**40**	**40**	**425**	**245**	**5**	**0**
2030 Development Volumes						52		37		28	300	148	10	
Balancing								5						
2030 BALANCED VOLUMES	**0**	**0**	**0**	**480**	**0**	**150**	**0**	**700**	**40**	**70**	**725**	**395**	**15**	**0**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate		-		2.0%	-	1.0%	-	1.0%	1.0%	1.0%	2.0%	2.0%	1.0%	-
Background Traffic Growth	0	0	0	230	0	24	0	169	10	10	204	118	1	0
2050 ROUNDED VOLUMES	**0**	**0**	**0**	**640**	**0**	**110**	**0**	**775**	**45**	**45**	**570**	**330**	**10**	**0**
2050 Development Volumes						52		37		43	370	148	20	
Balancing								5						
2050 BALANCED VOLUMES	**0**	**0**	**0**	**640**	**0**	**165**	**0**	**820**	**45**	**90**	**940**	**480**	**30**	**0**

Note: **Traffic to I-95**
Traffic from I-95

	I-95 SB Ramp						US 278							
PM PEAK HOUR	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBT**	**EBR**	**WBL**	**WBT**	**WBT**	**WBR**
2022 Raw Counts	0	0	0	188	0	54	0	189		61	825	342		0
2022 Separated Counts		-			-		-	150	39	-	-	336	6	
2022 UNBALANCED VOLUMES	**0**	**0**	**0**	**188**	**0**	**54**	**0**	**150**	**39**	**61**	**825**	**336**	**6**	**0**
Balancing												15		
2022 BALANCED + ROUNDED VOLUMES	**0**	**0**	**0**	**190**	**0**	**55**	**0**	**150**	**40**	**65**	**825**	**355**	**10**	**0**
Years To Buildout (2030)	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate		-		2.0%	-	1.0%	-	1.0%	1.0%	1.0%	2.0%	2.0%	1.0%	-
Background Traffic Growth	0	0	0	30	0	4	0	12	3	5	132	57	0.8	0
2030 ROUNDED VOLUMES	**0**	**0**	**0**	**220**	**0**	**60**	**0**	**165**	**45**	**75**	**960**	**415**	**10**	**0**
2030 Development Volumes						18		117		89	265	53	15	
Balancing												5		
2030 BALANCED VOLUMES	**0**	**0**	**0**	**220**	**0**	**80**	**0**	**285**	**45**	**165**	**1,225**	**475**	**25**	**0**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate		-		2.0%	-	1.0%	-	1.0%	1.0%	1.0%	2.0%	2.0%	1.0%	-
Background Traffic Growth	0	0	0	106	0	15	0	42	11	18	462	199	3	0
2050 ROUNDED VOLUMES	**0**	**0**	**0**	**300**	**0**	**75**	**0**	**195**	**55**	**85**	**1,290**	**555**	**15**	**0**
2050 Development Volumes						18		117		109	215	53	10	
Balancing														
2050 BALANCED VOLUMES	**0**	**0**	**0**	**300**	**0**	**95**	**0**	**315**	**55**	**195**	**1,505**	**610**	**25**	**0**

Note: **Traffic to I-95**
Traffic from I-95

I-95 NB Ramps and US 278

TRAFFIC CONTROL: Unsignalized
DATE COUNTED: December 2, 2021

	I-95 NB Ramp						US 278							
AM PEAK HOUR	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBT**	**EBR**	**WBL**	**WBT**	**WBT**	**WBR**
2022 Raw Counts	4	0	937	0	0	0	31	1014		0	0	569		191
2022 Separated Counts		-			-		-	604	410	-	-	204	365	-
2022 UNBALANCED VOLUMES	**4**	**0**	**937**	**0**	**0**	**0**	**31**	**604**	**410**	**0**	**0**	**204**	**365**	**191**
Balancing													5	
2022 BALANCED + ROUNDED VOLUMES	**5**	**0**	**940**	**0**	**0**	**0**	**35**	**605**	**410**	**0**	**0**	**205**	**370**	**195**
Years To Buildout (2030)	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate	1.0%	-	2.0%		-		1.0%	1.0%	2.0%	-	-	2.0%	2.0%	2.0%
Background Traffic Growth	0.4	0	150	0	0	0	3	48	66	0	0	33	59	31
2030 ROUNDED VOLUMES	**5**	**0**	**1,095**	**0**	**0**	**0**	**40**	**655**	**480**	**0**	**0**	**240**	**430**	**225**
2030 Development Volumes	88		95				16	21				70	300	
Balancing														
2030 BALANCED VOLUMES	**95**	**0**	**1,190**	**0**	**0**	**0**	**60**	**680**	**480**	**0**	**0**	**310**	**730**	**225**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate	1.0%	-	2.0%		-		1.0%	1.0%	2.0%	-	-	2.0%	2.0%	2.0%
Background Traffic Growth	1	0	526	0	0	0	10	169	230	0	0	115	207	109
2050 ROUNDED VOLUMES	**10**	**0**	**1,470**	**0**	**0**	**0**	**45**	**775**	**640**	**0**	**0**	**320**	**580**	**305**
2050 Development Volumes	98		155				16	21				70	370	
Balancing														
2050 BALANCED VOLUMES	**110**	**0**	**1,625**	**0**	**0**	**0**	**65**	**800**	**640**	**0**	**0**	**390**	**950**	**305**

Note: **Traffic to I-95**
Traffic from I-95

	I-95 NB Ramp						US 278							
PM PEAK HOUR	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBT**	**EBR**	**WBL**	**WBT**	**WBT**	**WBR**
2022 Raw Counts	6	0	501	0	0	0	39	338		0	0	1176		317
2022 Separated Counts		-			-		-	150	188	-	-	351	825	-
2022 UNBALANCED VOLUMES	**6**	**0**	**501**	**0**	**0**	**0**	**39**	**150**	**188**	**0**	**0**	**351**	**825**	**317**
Balancing														
2022 BALANCED + ROUNDED VOLUMES	**10**	**0**	**505**	**0**	**0**	**0**	**40**	**150**	**190**	**0**	**0**	**355**	**825**	**320**
Years To Buildout (2030)	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate	1.0%	-	2.0%		-		1.0%	1.0%	2.0%	-	-	2.0%	2.0%	2.0%
Background Traffic Growth	1	0	81	0	0	0	3	12	30	0	0	57	132	51
2030 ROUNDED VOLUMES	**15**	**0**	**590**	**0**	**0**	**0**	**45**	**165**	**220**	**0**	**0**	**415**	**960**	**375**
2030 Development Volumes	43		425				50	67				25	265	
Balancing														
2030 BALANCED VOLUMES	**60**	**0**	**1,015**	**0**	**0**	**0**	**95**	**235**	**220**	**0**	**0**	**440**	**1,225**	**375**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate	1.0%	-	2.0%		-		1.0%	1.0%	2.0%	-	-	2.0%	2.0%	2.0%
Background Traffic Growth	3	0	283	0	0	0	11	42	106	0	0	199	462	179
2050 ROUNDED VOLUMES	**15**	**0**	**790**	**0**	**0**	**0**	**55**	**195**	**300**	**0**	**0**	**555**	**1,290**	**500**
2050 Development Volumes	38		630				50	67				25	215	
Balancing														
2050 BALANCED VOLUMES	**55**	**0**	**1,420**	**0**	**0**	**0**	**105**	**265**	**300**	**0**	**0**	**580**	**1,505**	**500**

Note: **Traffic to I-95**
Traffic from I-95

Henry Moss Blvd and US 278

TRAFFIC CONTROL: Signalized
DATE COUNTED: December 2, 2021

	Henry Moss Blvd								US 278									
AM PEAK HOUR	**NBL**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**SBR**	**EBL**	**EBL**	**EBT**	**EBT**	**EBR**	**EBR**	**WBL**	**WBT**	**WBT**	**WBR**
2022 Raw Traffic Counts	57		15	100	93	25	156		271		1524		137		34	538		61
2022 Separated Traffic Counts	14	43	-		-		40	116	83	188	460	1064	42	95	-	141	397	-
2022 UNBALANCED VOLUMES	**14**	**43**	**15**	**100**	**93**	**25**	**40**	**116**	**83**	**188**	**460**	**1064**	**42**	**95**	**34**	**141**	**397**	**61**
Balancing																5		
2022 BALANCED + ROUNDED VOLUMES	**15**	**45**	**15**	**100**	**95**	**25**	**40**	**120**	**85**	**190**	**460**	**1065**	**45**	**95**	**35**	**150**	**400**	**65**
Years To Buildout (2030)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.0%	2.0%	1.0%	2.0%	1.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Background Traffic Growth	2	7	2	16	15	4	6	19	7	30	37	170	4	15	6	24	64	10
2030 ROUNDED VOLUMES	**20**	**55**	**20**	**120**	**110**	**30**	**50**	**140**	**95**	**225**	**500**	**1,240**	**50**	**115**	**45**	**175**	**465**	**75**
2030 Development Volumes											21	95				70	300	
Balancing											5							
2030 BALANCED VOLUMES	**20**	**55**	**20**	**120**	**110**	**30**	**50**	**140**	**95**	**225**	**530**	**1,335**	**50**	**115**	**45**	**245**	**765**	**75**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.0%	2.0%	1.0%	2.0%	1.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Background Traffic Growth	8	25	8	56	53	14	22	67	24	106	129	596	13	53	20	84	224	36
2050 ROUNDED VOLUMES	**25**	**75**	**25**	**160**	**150**	**40**	**65**	**190**	**110**	**300**	**590**	**1,665**	**60**	**150**	**55**	**235**	**625**	**105**
2050 Development Volumes											21	155				70	370	
Balancing		10									10							
2050 BALANCED VOLUMES	**25**	**85**	**25**	**160**	**150**	**40**	**65**	**190**	**110**	**300**	**625**	**1,820**	**60**	**150**	**55**	**305**	**995**	**105**

Note: **Traffic to I-95**
Traffic from I-95

	Henry Moss Blvd								US 278									
PM PEAK HOUR	**NBL**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**SBR**	**EBL**	**EBL**	**EBT**	**EBT**	**EBR**	**EBR**	**WBL**	**WBT**	**WBT**	**WBR**
2022 Raw Traffic Counts	58		8	34	66	12	74		93		655		46		34	1332		41
2022 Separated Traffic Counts	14	44	-		-		15	59	13	80	85	570	7	39	-	293	1039	-
2022 UNBALANCED VOLUMES	**14**	**44**	**8**	**34**	**66**	**12**	**15**	**59**	**13**	**80**	**85**	**570**	**7**	**39**	**34**	**293**	**1039**	**41**
Balancing																		
2022 BALANCED + ROUNDED VOLUMES	**15**	**45**	**10**	**35**	**70**	**15**	**15**	**60**	**15**	**80**	**85**	**570**	**10**	**40**	**35**	**295**	**1040**	**45**
Years To Buildout (2030)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Yearly Growth Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.0%	2.0%	1.0%	2.0%	1.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Background Traffic Growth	2	7	2	6	11	2	2	10	1	13	7	91	1	6	6	47	166	7
2030 ROUNDED VOLUMES	**20**	**55**	**15**	**45**	**85**	**20**	**20**	**70**	**20**	**95**	**95**	**665**	**15**	**50**	**45**	**340**	**1,210**	**55**
2030 Development Volumes											67	425				25	265	
Balancing																		
2030 BALANCED VOLUMES	**20**	**55**	**15**	**45**	**85**	**20**	**20**	**70**	**20**	**95**	**165**	**1,090**	**15**	**50**	**45**	**365**	**1,475**	**55**
Years To Buildout (2050)	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Yearly Growth Rate	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.0%	2.0%	1.0%	2.0%	1.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Background Traffic Growth	8	25	6	20	39	8	8	34	4	45	24	319	3	22	20	165	582	25
2050 ROUNDED VOLUMES	**25**	**75**	**20**	**55**	**110**	**25**	**25**	**95**	**20**	**125**	**110**	**890**	**15**	**65**	**55**	**460**	**1,625**	**70**
2050 Development Volumes											67	630				25	215	
Balancing																		
2050 BALANCED VOLUMES	**25**	**75**	**20**	**55**	**110**	**25**	**25**	**95**	**20**	**125**	**180**	**1,520**	**15**	**65**	**55**	**485**	**1,840**	**70**

Note: **Traffic to I-95**
Traffic from I-95

Traffic Impact Analysis

95 Logistics Center
Jasper County, SC

Prepared for:
SL Hardeeville Industrial Park LLC

Bihl Engineering, LLC 2022

BIHL ENGINEERING

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1.0 Executive Summary

The 95 Logistics Center development is proposed to be located on US 17 in Jasper County, SC. The development is planned to consist of a maximum of 2.6 million square feet of industrial warehousing, and it is planned to have two new full access driveways on US 17. For the purposes of this traffic impact analysis (TIA), the proposed development is assumed to be complete by 2026.

This report presents the trip generation, distribution, traffic analyses, and any recommendations for transportation improvements required to meet anticipated traffic demands.

The study area for the TIA included the following intersections:

- US 17 at US 278 (unsignalized)
- US 278 at I-95 SB On-Ramp/Off-Ramp (signalized)
- US 278 at I-95 NB On-Ramp/Off Ramp (unsignalized)
- US 17 at John Smith Road (unsignalized)
- US 17 at Site Driveway #1 (unsignalized) (2026 Build conditions only)
- US 17 at Site Driveway #2 (unsignalized) (2026 Build conditions only)

Due to the COVID-19 pandemic, traffic volumes and travel patterns have been impacted. All turning movements were adjusted using AM and PM adjustment factors as recommended by South Carolina Department of Transportation (SCDOT) District 6. These adjusted traffic volumes were used in the Existing conditions analysis.

Three 2026 Build conditions were studied: 2026 Build with no Improvements, 2026 Build with Improvements, and 2026 Build with improvements with the I-95 NB On-Ramp/Off-Ramp intersection signalized.

Based on the results of the analysis, the unsignalized intersection of US 17 at US 278 currently operates acceptably and is projected to continue to operate acceptably in the 2026 No Build and 2026 Build conditions.

The signalized intersection of US 278 at I-95 SB On-Ramp/Off-Ramp currently operates acceptably. In the 2026 No Build conditions, the intersection is projected to continue to operate acceptably. In the 2026 Build conditions, the intersection is projected to operate acceptably during the AM peak hour and with elevated delay during the PM peak hour. When coordinated with the US 278 at I-95 NB On-Ramp/Off-Ramp intersection in the 2026 Build with improvements with I-95 NB Off-Ramp Signalized conditions, the intersection is projected to operate acceptably.

The unsignalized intersection of US 278 at I-95 NB On-Ramp/Off-Ramp currently operates acceptably and is projected to continue to operate acceptably in the 2026 No Build conditions. In the 2026 Build conditions, the intersection is projected to operate with elevated delay during the AM and PM peak hours. It is recommended that a detailed traffic signal warrant analysis be performed at this intersection when traffic volumes are realized. Based on the analysis, the intersection is projected to operate

acceptably when signalized and coordinated with the intersection of US 278 at I-95 SB On-Ramp/Off-Ramp.

The unsignalized intersection of US 17 at John Smith Road currently operates with elevated delay during the AM peak hour and acceptably during the PM peak hour. In the 2026 No Build and 2026 Build conditions, the intersection is projected to operate with elevated delay during the AM and PM peak hour conditions. An exclusive northbound right-turn lane is recommended in the 2026 Build with Improvements conditions. With the exclusive northbound right-turn lane, the intersection is projected to improve but continue to operate with elevated delay in the 2026 Build with Improvements conditions.

The site driveways are projected to operate acceptably in the 2026 Build conditions with implementation of the recommended southbound left-turn lane improvements at both driveways.

Based on results of the analysis the following transportation related improvements are recommended.

- US 17 at US 278 o Refresh all pavement markings and striping on all approaches of the intersection
- US 278 at I-95 SB On-Ramp/Off-Ramp o Optimize traffic signal timings
- US 278 at I-95 NB On-Ramp/Off Ramp o Monitor intersection traffic volumes and perform traffic signal warrant analysis yearly or at a schedule requested by Jasper County and/or SCDOT
    - Signalize intersection once traffic signal warrants are met and coordinate signal timings with the US 278 at I-95 SB On-Ramp/Off-Ramp intersection
- US 17 at John Smith Road o Installation of an exclusive northbound right-turn lane on US 17
- US 17 at Site Driveway #1 o Installation of an exclusive southbound left-turn lane on US 17
    - Installation of exclusive left- and right-turn exiting lanes on Site Driveway #1 o Location and design details to be coordinated with the SCDOT and Jasper County
- US 17 at Site Driveway #2 o Installation of an exclusive southbound left-turn lane on US 17 o Installation of exclusive left- and right-turn exiting lanes on Site Driveway #2 o Location and design details to be coordinated with SCDOT and Jasper County

Results in this report are based solely on traffic studies and are considered input into final design considerations. The final design will be determined by the project engineer after other design elements (such as, but not limited to, utilities, stormwater, etc.) are taken into consideration.

2.0 Introduction

The 95 Logistics Center development is proposed to be located on US 17 in Jasper County, SC. The development is planned to consist of a maximum of 2.6 million square feet of industrial warehousing, and it is planned to have two new full access driveways on US 17. For the purposes of this TIA, the proposed development is assumed to be complete by 2026.

3.0 Inventory

3.1 Study Area

The study area for the TIA includes the following existing intersections:

- US 17 at US 278
- US 278 at I-95 SB On-Ramp/Off-Ramp
- US 278 at I-95 NB On-Ramp/Off Ramp
- US 17 at John Smith Road

Figure 1 (Appendix) shows the site location and **Figure 2 (Appendix)** shows the project conceptual site plan.

3.2 Existing Conditions

Roadways in the project vicinity include I-95, US 17, US 278, and John Smith Road.

I-95 is a four-lane, divided interstate with a posted speed limit of 70 miles per hour (mph) in the vicinity of the US 278 access ramps. Per SCDOT counts, I-95 has a 2019 annual average daily traffic (AADT) of 56,300 vehicles per day (vpd) north of US 278 and 62,700 vpd south of US 278. There is a diamond interchange at the US 278 exit.

US 278 (Independence Boulevard) is a five-lane roadway with a two-way, left-turn lane (TWLTL) and a posted speed limit of 45 mph from US 17 to Medical Center Drive. US 278 is designated as a principal arterial roadway east of I-95 and a minor arterial west of I-95. US 278 transitions to a four-lane, divided principal arterial roadway with a landscaped median and a 60 mph speed limit east of Medical Center Drive. Per SCDOT counts, US 278 has a 2019 AADT of 30,000 vpd east of I-95 and 4,100 vpd west of I-95. It is recommended that the pavement markings and striping in the vicinity of the intersections be refreshed.

US 17 (Whyte Hardee Boulevard) is a two-lane, undivided, major collector roadway with a posted speed limit of 55 mph just north of John Smith Road and is 45 mph for the remainder of the study area. Per SCDOT counts, US 17 has a 2019 AADT of 2,600 vpd north of US 278 and 4,200 vpd south of US 278. The proposed development has two planned full access driveways (Site Driveway #1 and Site Driveway

#2) on US 17. A masterplan for the Whyte-Hardee Boulevard has recently been developed. A summary of the masterplan is discussed in the following section.

John Smith Road (S-141) is a two-lane, undivided, major collector roadway with a posted speed limit of 55 mph east of Royal Live Oaks Academy Driveway and 35 mph west of Royal Live Oaks Academy Driveway. Per SCDOT counts, John Smith Road has a 2019 AADT of 5,700 vpd in the vicinity of the site. **Figure 3 (Appendix)** shows the existing roadway laneage in the study area.

3.3 Whyte-Hardee Masterplan

A masterplan was recently completed for the US 17 Corridor adjacent to the site – Whyte-Hardee Boulevard Master Plan. The area the corridor is located on is called, "The Business Park District." The primary improvements contemplated in this area are Streetscape improvements from Garr Road to Best Street and sidepath improvements from Garr Road to US 278. Based on the report, estimated costs for the streetscape are $510,000 and $1,120,000 for the sidepath. An illustrative scenario was created at the intersection of Whyte-Hardee at John Smith Road with the following conceptual components.

- "Streetscape improvements including street trees, sidepath (east side), and bioretention
- Sidepath that would serve as the East Coast Greenway as well as another side path on the north side of John Smith Road connecting the new Recreation Center and Royal Live Oaks Academy
- Parking area of existing businesses can be screened from Whyte-Hardee and John Smith while continuing to operate
- New development with a consistent setback and limited up-front parking can create a more harmonious streetscape
- Limited curb cuts and cross access helps to minimize pedestrian vehicle conflicts. Even if certain existing conditions force parking in the right-of-way, there are opportunities for it to be formalized with better design while accommodating through-traffic"

4.0 Traffic Generation

The trip generation of the proposed development was determined using trip generation rates published in the Institute of Transportation Engineers' (ITE) *Trip Generation, 10th Edition* (2017).

Table 1 summarizes the AM and PM peak hour trips associated with the proposed site.

As shown in **Table 1**, the proposed development is projected to generate 337 new trips during the AM peak hour (259 entering and 78 exiting) and 340 trips during the PM peak hour (92 entering and 248 exiting).

Table 1: Trip Generation							
Land Use and Intensity	**ITE Land Use Code**	**AM Peak Hour**			**PM Peak Hour**		
		Total	**In**	**Out**	**Total**	**In**	**Out**
2,600,000 square feet of Industrial Warehousing	150	337	259	78	340	92	248
New Trips		**337**	**259**	**78**	**340**	**92**	**248**

Source: ITE *Trip Generation, 10th Edition*

5.0 Site Traffic Distribution

The proposed project traffic was assigned to the surrounding roadway network. The directional distribution and assignment were based on qualitative knowledge of the project area, quantitative application of existing traffic patterns, and expected trip length.

The following general trip distribution was applied to the project trips associated with the proposed development:

- 20% to/from the north on I-95
- 3% to/from the north on US 17
- 30% to/from the south on I-95
- 20% to/from the south on US 17
- 27% to/from the east on US 278

Figure 4 (Appendix) shows the traffic distribution for the site in the study area.

6.0 Traffic Volumes

6.1 Existing Traffic

Peak hour intersection turning movement counts including vehicular, pedestrian, and heavy vehicle traffic were performed in March 2021 from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM at the following intersection:

- US 17 at John Smith Road

Due to the COVID-19 pandemic, traffic volumes and travel patterns have been impacted. All turning movement counts performed in March 2021 were adjusted using AM and PM peak hour adjustment factors of 1.15 and 1.02 for the AM and PM peak hours, respectively, as stated in the SCDOT District 6 *Traffic Impact Analyses during COVID-19 Pandemic (Update)* memorandum (February 5, 2021). These adjusted traffic volumes were used in the Existing conditions analysis.

Historic peak hour intersection turning movement counts including vehicular, pedestrian, and heavy vehicle traffic collected in July 2020 from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM were used for the intersection of US 17 at US 278. Due to the COVID-19 pandemic, turning movement counts performed in July 2020 were adjusted using AM and PM peak hour adjustment factors of 1.16 and 1.11 for the AM and PM peak hours, respectively, as stated in the SCDOT District 6 *Traffic Impact Analyses during COVID-19 Pandemic* memorandum (April 23. 2020). The counts were then grown to the Year 2021 by applying an overall growth rate of 4.0% per year (based on historic growth trends) for use in the Existing conditions analysis.

Historic peak hour intersection turning movement counts including vehicular, pedestrian, and heavy vehicle traffic collected in August 2019 from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM were used for the intersections of US 278 at I-95 NB On-Ramp/Off-Ramp and US 278 at I-95 SB On-Ramp/Off-Ramp. The counts were grown to the Year 2021 by applying an overall growth rate of 4.0% per year (based on historic growth trends) for use in the Existing conditions analysis.

The grown Existing peak hour intersection turning movement volumes are shown on **Figure 5 (Appendix)**. The turning movement count data is included in the **Appendix.**

6.2 2026 No Build Traffic

Historic growth is the increase in existing traffic volumes due to usage increases and non-specific growth throughout the area. An overall growth rate of 4.0% was applied to the study area in the analysis. In addition to this non-specific growth, projected traffic associated with the Inspired Living at Hardeeville development, which is currently in the planning process, was also included in the background traffic.

The 2026 No Build traffic volumes include existing traffic grown to the buildout year. **Figure 6 (Appendix)** and **Figure 7 (Appendix)** show the 2026 No Build AM and PM peak hour traffic volumes, respectively.

6.3 Project Traffic

The AM peak hour and PM peak hour projected project trips were assigned based on the trip distribution discussed in **Section 5.**

6.4 2026 Build Traffic

The 2026 total traffic volumes include the 2026 background traffic and the proposed development traffic at buildout. The 2026 AM and PM peak hour total traffic volumes are shown in **Figure 6 (Appendix)** and **Figure 7 (Appendix)**, respectively.

Three 2026 Build conditions were studied: 2026 Build with no Improvements, 2026 Build with Improvements, and 2026 Build with improvements with the I-95 NB On-Ramp/Off-Ramp intersection signalized.

Intersection volume development worksheets are included in the **Appendix**.

7.0 Capacity Analysis

Capacity analyses were performed for the AM and PM peak hours in the Existing, 2026 No Build, and 2026 Build conditions (no improvements, improvements, improvements with signalization of US 278 at I-95 NB On-Ramp/Off Ramp) using the Synchro, Version 10, software to determine the operating characteristics of the adjacent roadway network and the impacts of the proposed project. The analyses were conducted with methodologies contained in the *Highway Capacity Manual, 6th Edition* (HCM 6) (Transportation Research Board, 2016). The Synchro analysis worksheets are provided in the **Appendix**.

Capacity of an intersection is defined as the maximum number of vehicles that can pass through an intersection during a specified time, typically an hour. Capacity is described by level of service (LOS) for the operating characteristics of an intersection. LOS is a qualitative measure that describes operational conditions and motorist perceptions within a traffic stream. HCM 6 defines six levels of service, LOS A through LOS F, with A being the best and F being the worst.

LOS for signalized intersections is determined by the overall intersection operations and is reflected in average delay per vehicle. LOS D or better is typically considered acceptable for signalized intersections.

LOS for a two-way stop-controlled (TWSC) intersection is determined by the delay of the poorest performing minor approach, as LOS is not defined for TWSC intersections as a whole. It is typical for minor stop-controlled side streets and driveways on major streets to experience longer delays at LOS E and LOS F during peak hours while the majority of the traffic moving through the corridor typically experiences little or no delay.

Capacity analyses were performed for the Existing, 2026 No Build, 2026 Build, 2026 Build with Improvements, and 2026 Build with Improvements with Signalization of US 278 at I-95 NB On-Ramp/Off Ramp AM and PM peak hour traffic conditions for the following intersections:

- US 17 at US 278 (unsignalized)
- US 278 at I-95 SB On-Ramp/Off-Ramp (signalized)

- US 278 at I-95 NB On-Ramp/Off Ramp (unsignalized)
- US 17 at John Smith Road (unsignalized)
- US 17 at Site Driveway #1 (unsignalized) (All 2026 Build conditions only)
- US 17 at Site Driveway #2 (unsignalized) (All 2026 Build conditions only)

Any peak hour factors (PHF) above 0.95 were adjusted to 0.95 in all conditions for the purposes of the analysis.

Any heavy vehicle percentages (HV%) below 2.0% were adjusted to 2.0% in all conditions for the purposes of the analysis. Due to the industrial nature of the development, a HV% of 20% was assumed at Site Driveway #1 and Site Driveway #2. The HV% was adjusted in the 2026 Build conditions at the study area intersections to reflect the higher percentage of expected heavy vehicle traffic due to the projected site traffic.

Table 2 summarizes LOS and control delay (average seconds of delay per vehicle) for the projected Existing, 2026 No Build, 2026 Build, 2026 Build with Improvements, and 2026 Build with Improvements with Signalization of US 278 at I-95 NB On-Ramp/Off Ramp AM and PM peak hour conditions at the study area intersections.

7.1 US 17 at US 278

As shown in **Table 2**, the unsignalized intersection of US 17 at US 278 currently operates acceptably at LOS B during the AM and PM peak hours. In the 2026 No Build conditions, the intersection is projected to continue to operate at LOS B during the AM and PM peak hour conditions. In the 2026 Build conditions, the intersection is projected to operate acceptably at LOS D during the AM peak hour and at LOS B during the PM peak hour.

7.2 US 278 at I-95 SB On-Ramp/Off-Ramp

This intersection is fully actuated and operates in free mode. To reflect the free operation, the cycle length and splits were optimized for the Existing, 2026 No Build, and 2026 Build AM and PM peak hour conditions. As shown in **Table 2**, the signalized intersection of US 278 at I-95 SB On-Ramp/Off-Ramp currently operates acceptably at LOS B during the AM peak hour and at LOS C during the PM peak hour. In the 2026 No Build conditions, the intersection is projected to operate acceptably at LOS C during the AM peak hour and at LOS D during the PM peak hour. In the 2026 Build conditions and 2026 Build with Improvements conditions, the intersection is projected to operate acceptably at LOS D during the AM peak hour and with elevated delay at LOS E during the PM peak hour.

In the 2026 Build with Improvements with Signalization of US 278 at I-95 NB On-Ramp/Off Ramp conditions, the intersection was updated to actuated coordinated conditions and coordinated with the I-95 NB On-Ramp/Off Ramp intersection. As shown in **Table 2**, the signalized intersection is projected to operate at LOS C in the AM peak hour and LOS D in the PM peak hour conditions.

Table 2:
Level of Service and Delay (average seconds per vehicle)

Intersection	Traffic Control [1]	Existing Conditions		2026 No Build Conditions		2026 Build Conditions		2026 Build with Improvements Conditions		2026 Build with Improv. with I-95 NB Off- Ramp Signalized Conditions	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
US 17 at US 278	U	B (11.8) – WB	B (10.4) – WB	B (14.2) – WB	B (11.6) – WB	D (32.8) – WB	B (13.4) – WB	Same as Build conditions	Same as Build conditions	Same as Build conditions	Same as Build conditions
US 278 at I-95 SB OnRamp/ Off-Ramp[2,3]	S	B (19.0)	C (21.9)	C (34.6)	D (50.7)	D (35.5)	E (63.5)	Same as Build conditions	Same as Build conditions	C (33.1)	D (52.0)
US 278 at I-95 NB On-Ramp/ Off-Ramp[3]	U	C (21.4) – NB	C (16.7) – NB	D (29.9) – NB	C (22.0) – NB	F (96.1) – NB	E (44.7) – NB	Same as Build conditions	Same as Build conditions	A (6.2)	A (5.4)
US 17 at John Smith Road[4]	U	F (115.8) – WB	D (27.0) – WB	F (**) – WB	F (95.0) – WB	F (**) – WB	F (137.3) – WB	F (**) – WB	F (68.0) – WB	Same as Build conditions w/ Impr.	Same as Build conditions w/ Impr.
US 17 at Site Driveway #1	U	N/A	N/A	N/A	N/A	B (13.1) – WB	B (13.1) – WB	Same as Build conditions	Same as Build conditions	Same as Build conditions	Same as Build conditions
US 17 at Site Driveway #2	U	N/A	N/A	N/A	N/A	B (12.5) – WB	B (11.7) – WB	Same as Build conditions	Same as Build conditions	Same as Build conditions	Same as Build conditions

N/A – Not Applicable

1. S = Signalized, U = Unsignalized
2. AM and PM peak hour cycle lengths and splits were optimized in all scenarios to reflect free, fully actuated operation. Minimum cycle length of 120 seconds assumed.
3. In the 2026 Build with Improvements with I-95 NB Off Ramp Signalized conditions, signalized intersections were coordinated, and cycle length was optimized.
4. (**) indicates delay exceeds 300 seconds

7.3 US 278 at I-95 NB On-Ramp/Off-Ramp

As shown in **Table 2**, the unsignalized intersection of US 278 at I-95 NB On-Ramp/Off-Ramp currently operates acceptably at LOS C during the AM and PM peak hour conditions. In the 2026 No Build conditions, the intersection is projected to operate acceptably at LOS D during the AM peak hour and at LOS C during the PM peak hour. In the 2026 Build conditions, the intersection is projected to operate with elevated delay at LOS F during the AM peak hour and at LOS E during the PM peak hour.

The 95th percentile queue is considered the maximum number of vehicles that will queue while waiting to complete their maneuver at the intersection. The maximum queue on the northbound approach (I-95 OffRamp) is expected to be approximately five vehicles during the AM peak hour.

In the 2026 Build with Improvements with Signalization of US 278 at I-95 NB On-Ramp/Off Ramp conditions, the intersection was updated to actuated coordinated conditions and coordinated with the I-95 SB On-Ramp/Off Ramp intersection. As shown in **Table 2**, the signalized intersection is projected to operate at LOS A in the AM and PM peak hour conditions.

Based on the results of the analysis, it is recommended that the intersection traffic volumes be monitored and perform traffic signal warrant analysis yearly or at a schedule requested by Jasper County and/or SCDOT. Once traffic signal warrants are met, it is recommended that the intersection be signalized intersection. Once traffic signal warrants are met, traffic signal timings with US 278 at I-95 SB On Ramp/Off-Ramp intersection should be optimized.

7.4 US 17 at John Smith Road

As shown in **Table 2**, the unsignalized intersection of US 17 at John Smith Road currently operates with elevated delay at LOS F during the AM peak hour and acceptably at LOS D during the PM peak hour. In the 2026 No Build and Build conditions, the intersection is projected to operate with elevated delay at LOS F during the AM and PM peak hour conditions. Due to the number of projected northbound right turns (background trips) on US 17 in the 2026 Build conditions, an exclusive northbound right-turn lane is recommended and was included in the 2026 Build with Improvements analysis. With the addition of the exclusive northbound right-turn lane, the intersection is projected to continue to operate with elevated delay at LOS F during the AM and PM peak hours in the 2026 Build with Improvements conditions however the delay is reduced.

7.5 US 17 at Site Driveway #1

SCDOT *Roadway Design Manual* (2017) guidelines were reviewed at the unsignalized intersection of US 17 at Site Driveway #1 to determine if criteria were met for the consideration of an exclusive northbound right-turn lane or an exclusive southbound left-turn lane on US 17. Based on a comparison of the projected 2026 Build AM and PM peak hour traffic volumes to the criteria, it was determined that an exclusive southbound left-turn lane on US 17 at Site Driveway #1 "should be considered" for a two-lane roadway and is therefore recommended. It was also determined that an exclusive northbound right-turn

lane on US 17 at Site Driveway #1 "may not be necessary" for a two-lane roadway and is therefore not recommended. The exclusive southbound left-turn lane was included in the 2026 Build analysis and the turn lane analysis charts are included in the **Appendix**.

As shown in **Table 2**, the unsignalized intersection of US 17 at Site Driveway #1 is projected to operate acceptably at LOS B during the AM and PM peak hours in the 2026 Build conditions.

7.6 US 17 at Site Driveway #2

SCDOT *Roadway Design Manual* (2017) guidelines were reviewed at the unsignalized intersection of US 17 at Site Driveway #2 to determine if criteria were met for the consideration of an exclusive northbound right-turn lane or an exclusive southbound left-turn lane on US 17. Based on a comparison of the projected 2026 Build AM and PM peak hour traffic volumes to the criteria, it was determined that an exclusive southbound left-turn lane on US 17 at Site Driveway #2 "should be considered" for a two-lane roadway and is therefore recommended. It was also determined that an exclusive northbound right-turn lane on US 17 at Site Driveway #2 "may not be necessary" for a two-lane roadway and is therefore not recommended. The exclusive southbound left-turn lane was included in the 2026 Build analysis and the turn lane analysis charts are included in the **Appendix**.

As shown in **Table 2**, the unsignalized intersection of US 17 at Site Driveway #2 is projected to operate acceptably at LOS B during the AM and PM peak hours in the 2026 Build conditions.

8.0 Conclusion

The 95 Logistics Center development is proposed to be located on US 17 in Jasper County, SC. The development is planned to consist of a maximum of 2.6 million square feet of industrial warehousing, and it is planned to have two new full access driveways on US 17. For the purposes of this TIA, the proposed development is assumed to be complete by 2026.

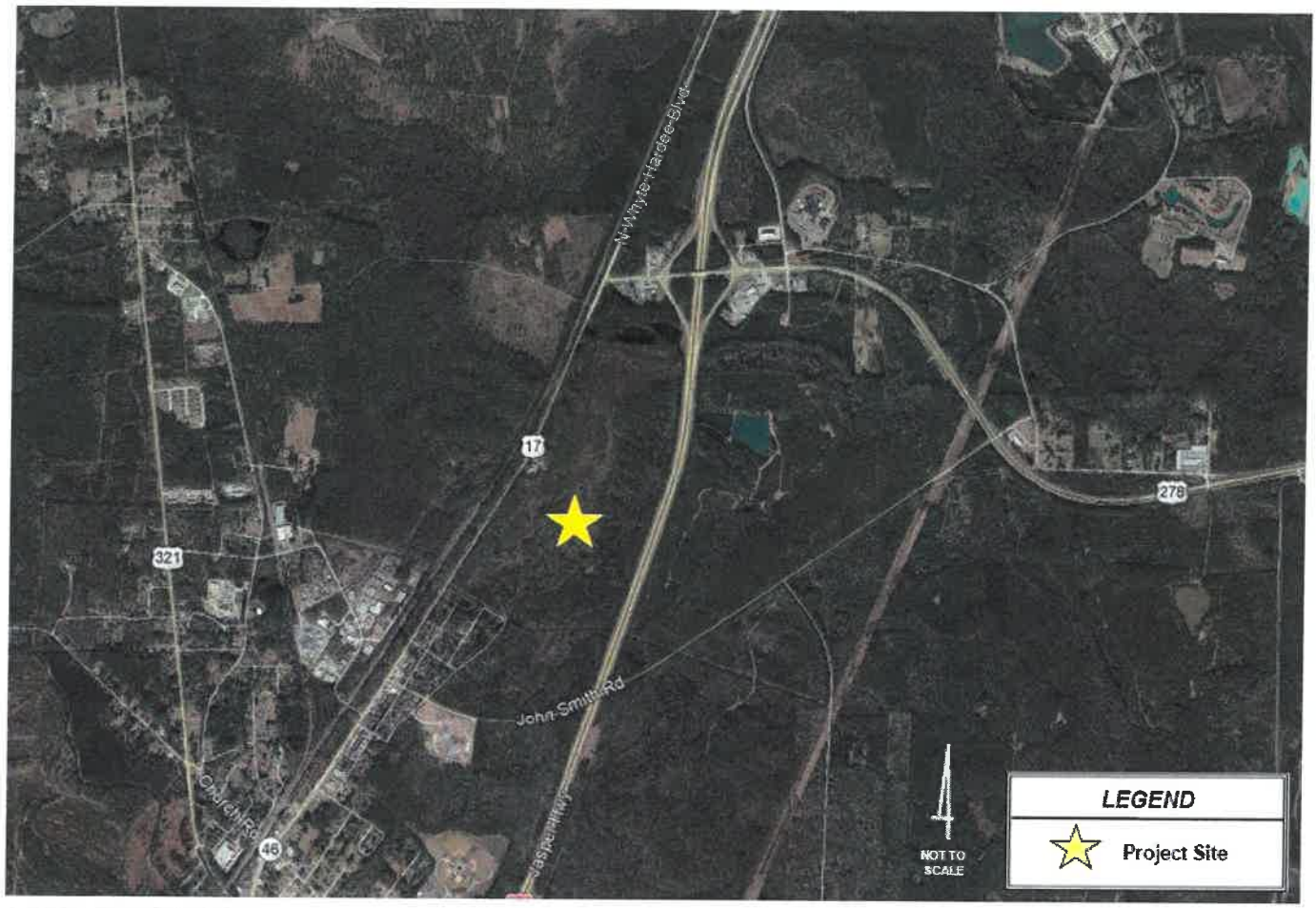
Based on results of the analysis the following transportation related improvements are recommended.

- US 17 at US 278 o Refresh all pavement markings and striping on all approaches of the intersection
- US 278 at I-95 SB On-Ramp/Off-Ramp o Optimize traffic signal timings
- US 278 at I-95 NB On-Ramp/Off Ramp o Monitor intersection traffic volumes and perform traffic signal warrant analysis yearly or at a schedule requested by Jasper County and/or SCDOT
    - o Signalize intersection once traffic signal warrants are met and coordinate signal timings with the US 278 at I-95 SB On-Ramp/Off-Ramp intersection
- US 17 at John Smith Road o Installation of an exclusive northbound right-turn lane on US 17

- US 17 at Site Driveway #1 o Installation of an exclusive southbound left-turn lane on US 17 o Installation of exclusive left- and right-turn exiting lanes on Site Driveway #1 o Location and design details to be coordinated with the SCDOT and Jasper County
- US 17 at Site Driveway #2 o Installation of an exclusive southbound left-turn lane on US 17 o Installation of exclusive left- and right-turn exiting lanes on Site Driveway #2 o Location and design details to be coordinated with SCDOT and Jasper County

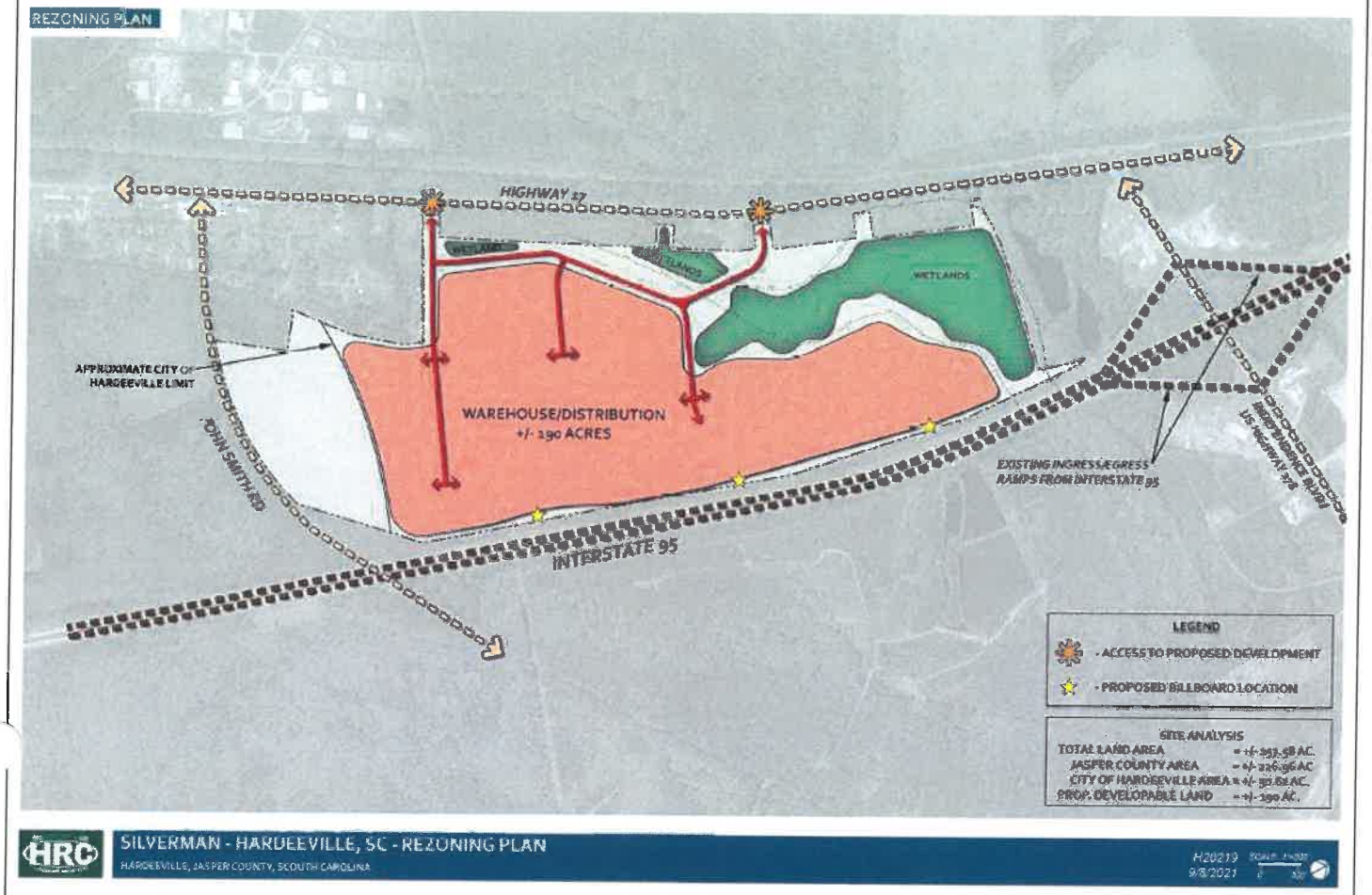
Results in this report are based solely on traffic studies and are considered input into final design considerations. The final design will be determined by the project engineer after other design elements (such as, but not limited to, utilities, stormwater, etc.) are taken into consideration.

Appendix

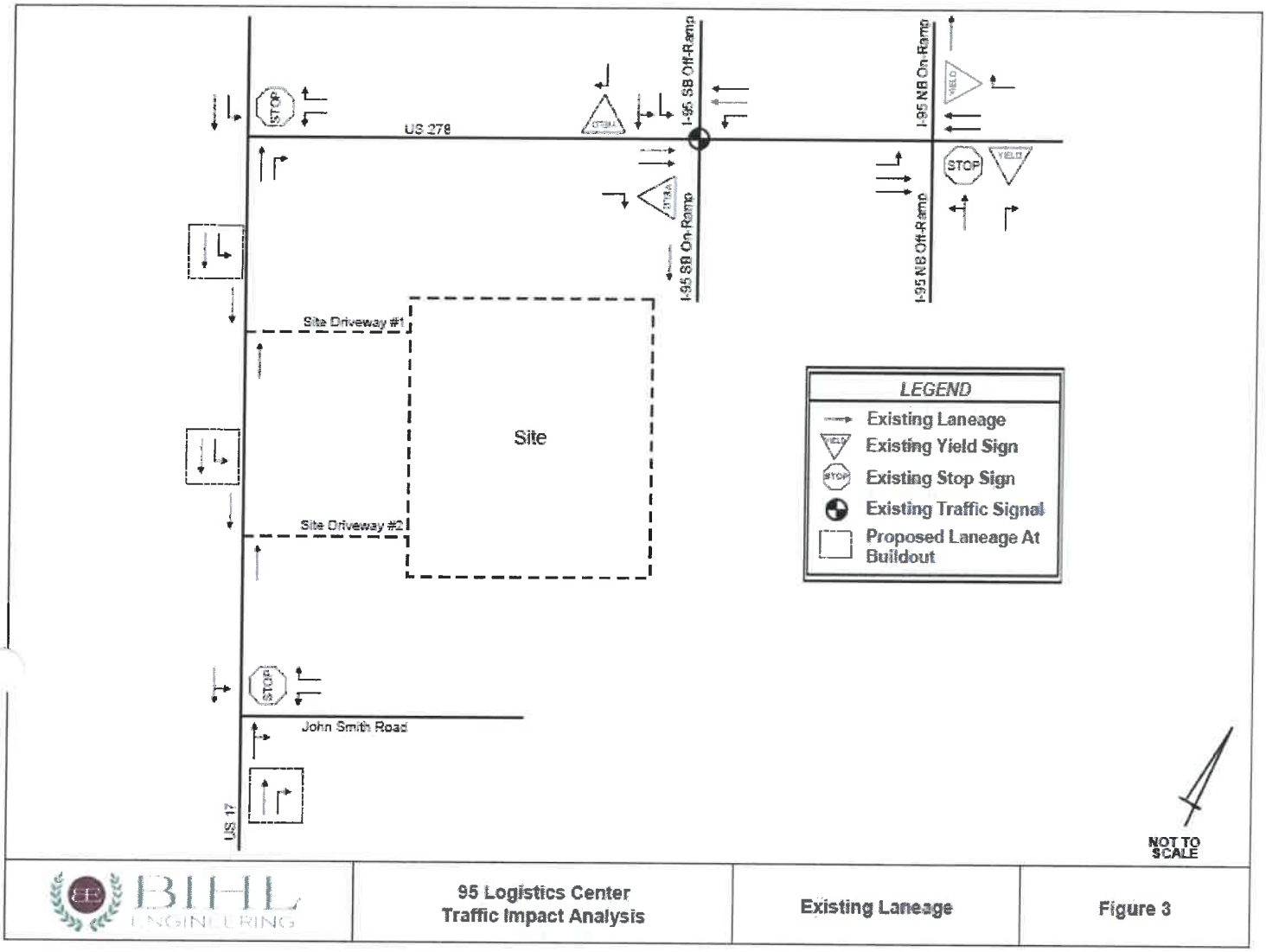


Aerial Source: Google Earth

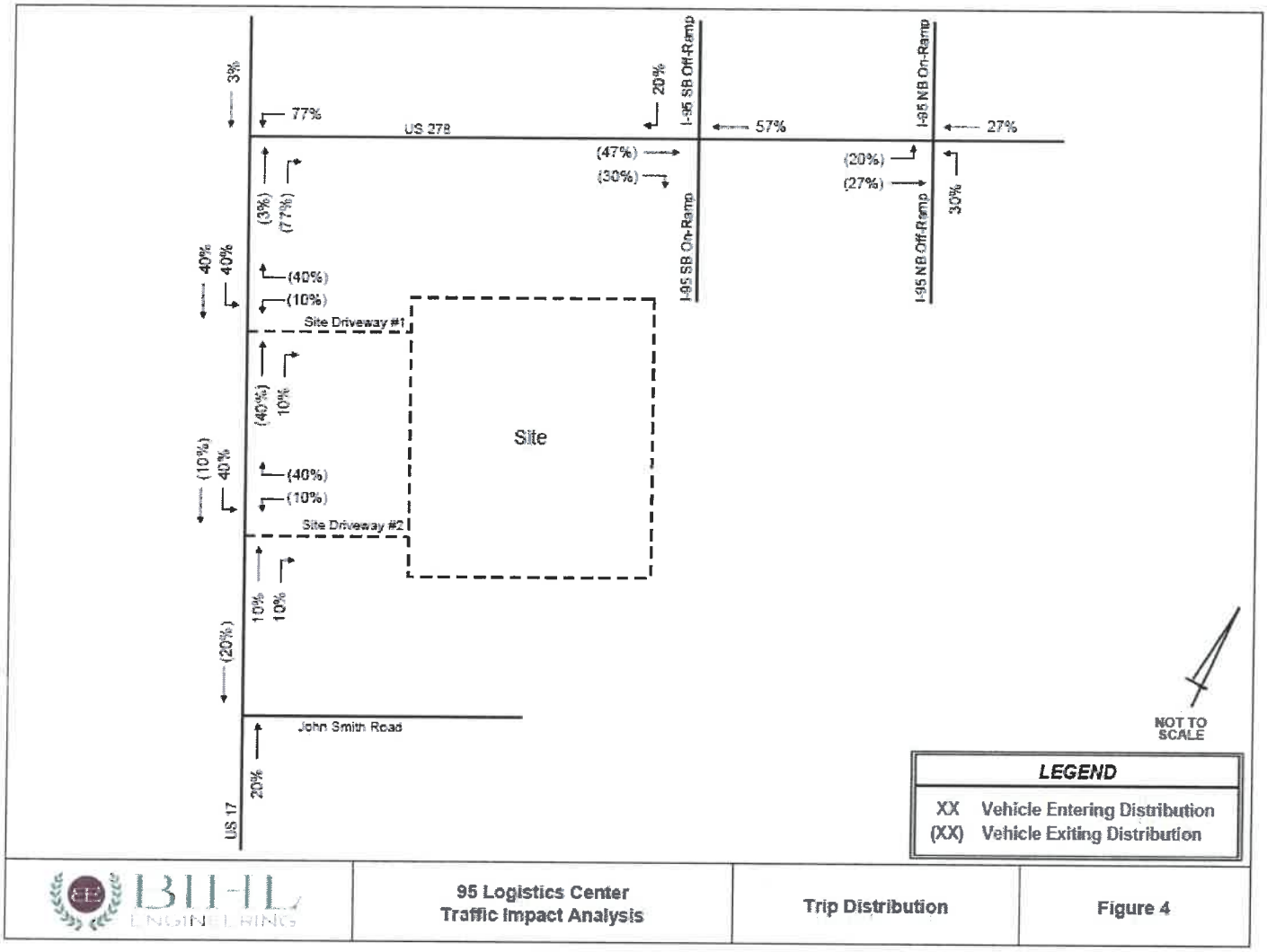
BIHL ENGINEERING	95 Logistics Center Traffic Impact Analysis	Site Location	Figure 1



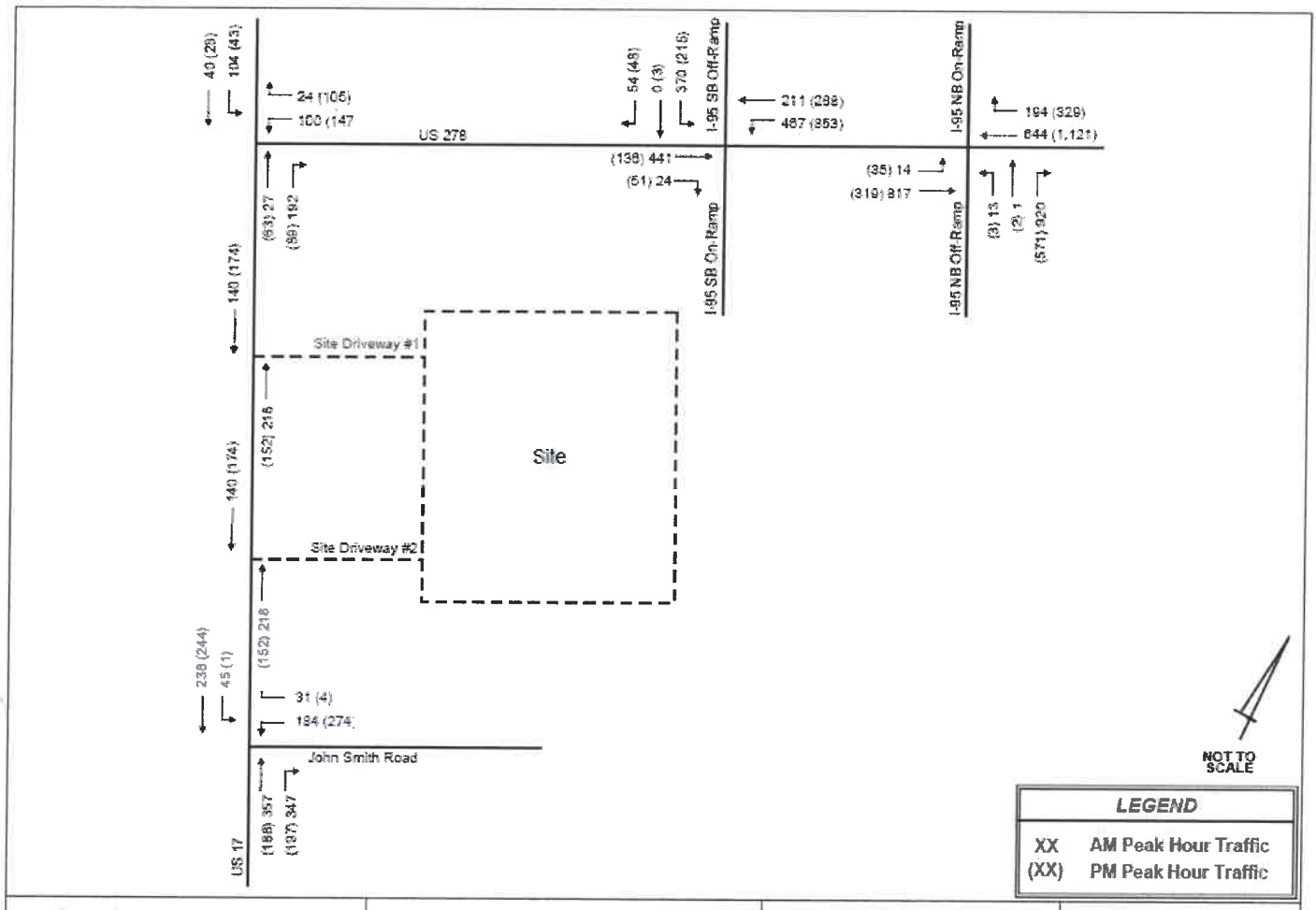
Source: HRC	95 Logistics Center Traffic Impact Analysis	Conceptual Site Plan	Figure 2



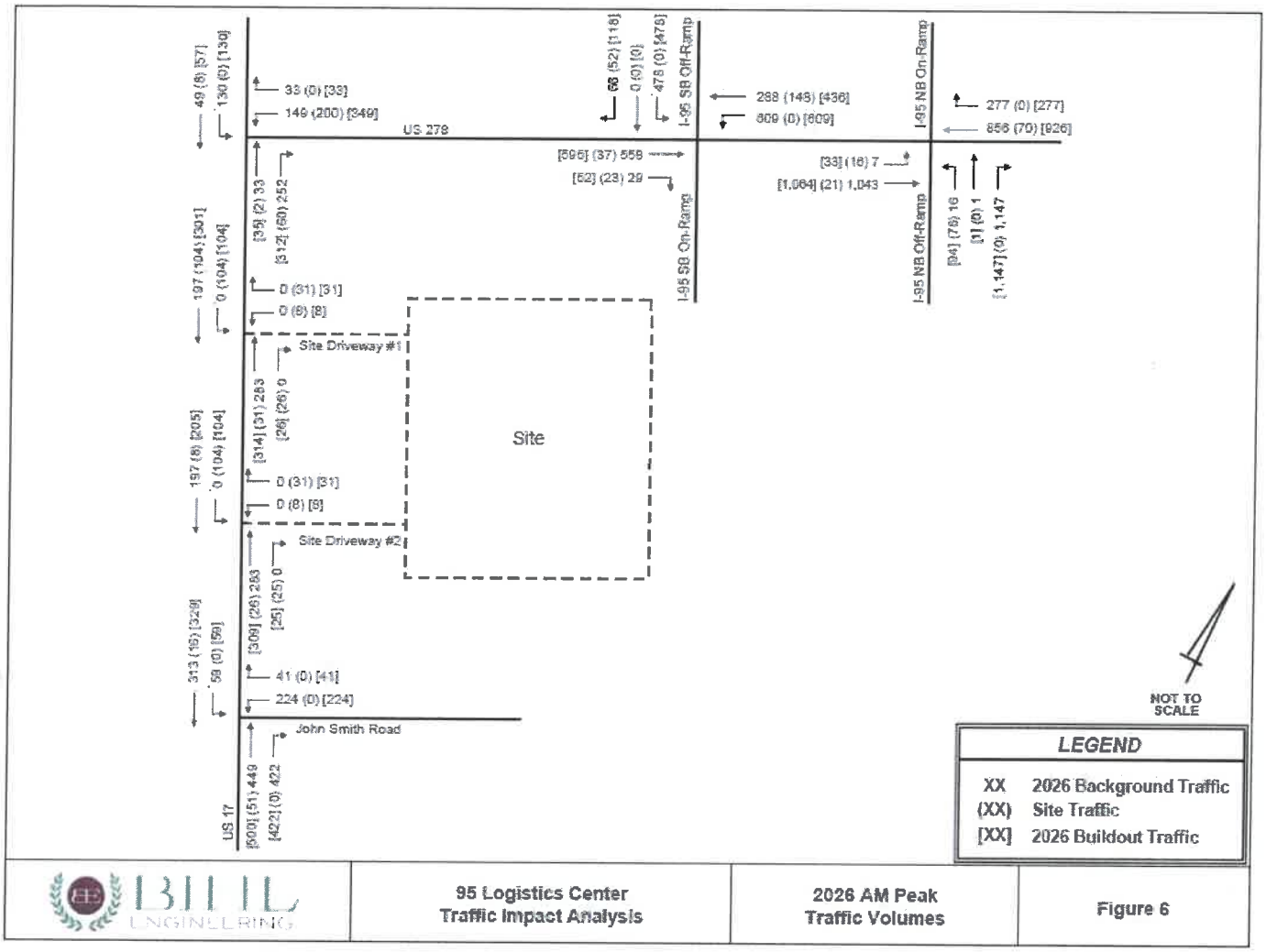
BIHL ENGINEERING	95 Logistics Center Traffic Impact Analysis	Existing Laneage	Figure 3



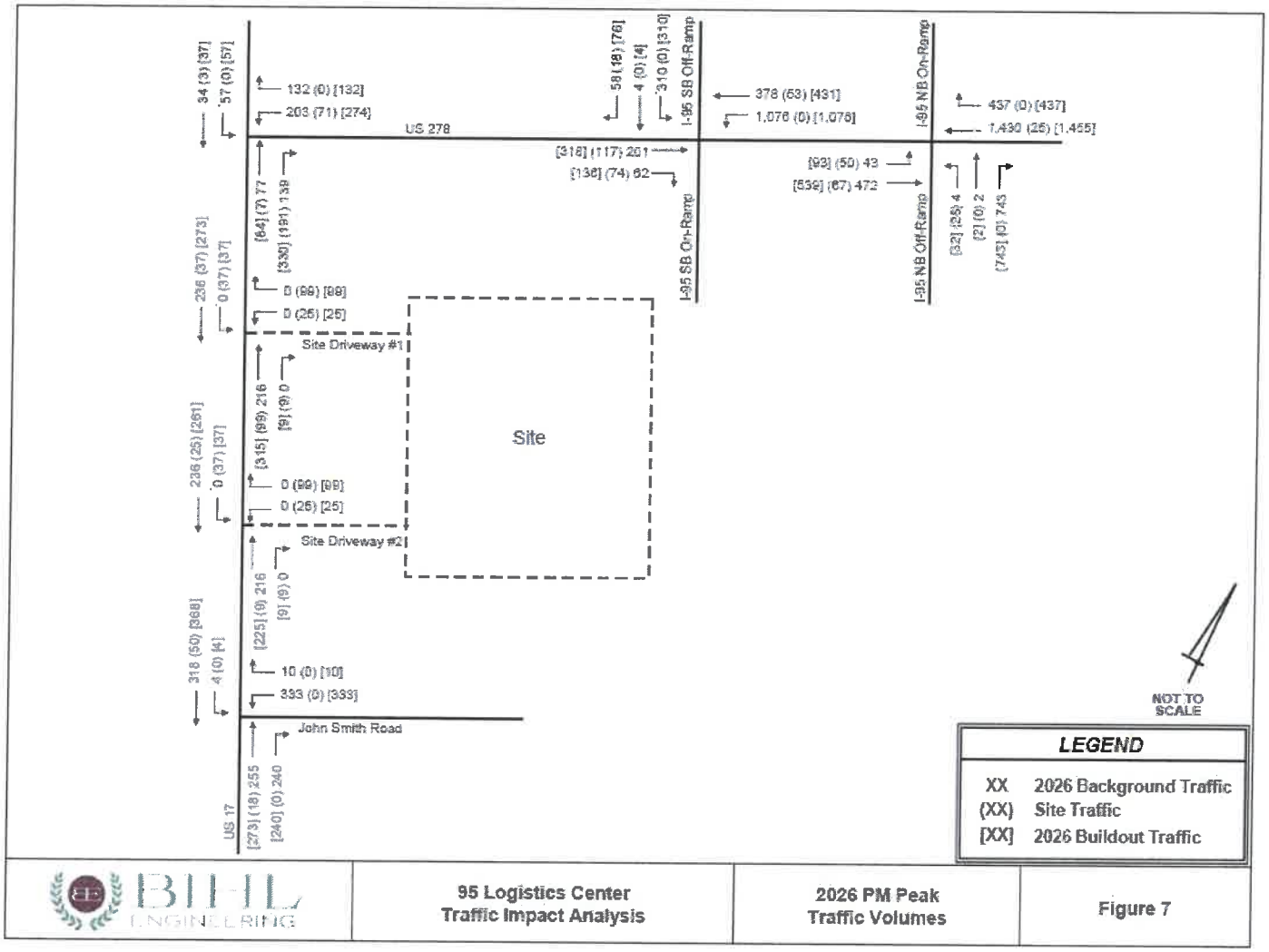
BELL-HL ENGINEERING	95 Logistics Center Traffic Impact Analysis	Trip Distribution	Figure 4



BELL ENGINEERING	95 Logistics Center Traffic Impact Analysis	Existing Traffic Volumes	Figure 5



BHL ENGINEERING	95 Logistics Center Traffic Impact Analysis	2026 AM Peak Traffic Volumes	Figure 6



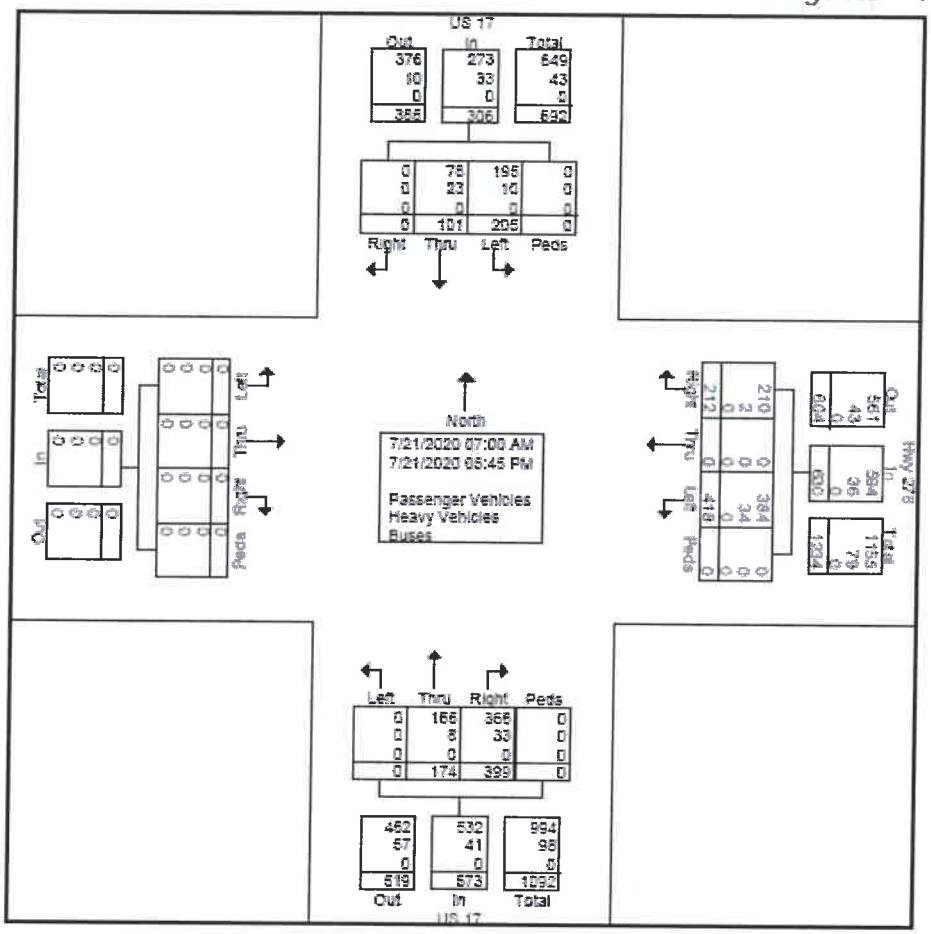
BELL ENGINEERING	95 Logistics Center Traffic Impact Analysis	2026 PM Peak Traffic Volumes	Figure 7

File Name : US 17 @ Hwy 278
Site Code :
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Groups Printed- Passenger Vehicles - Heavy Vehicles - Buses

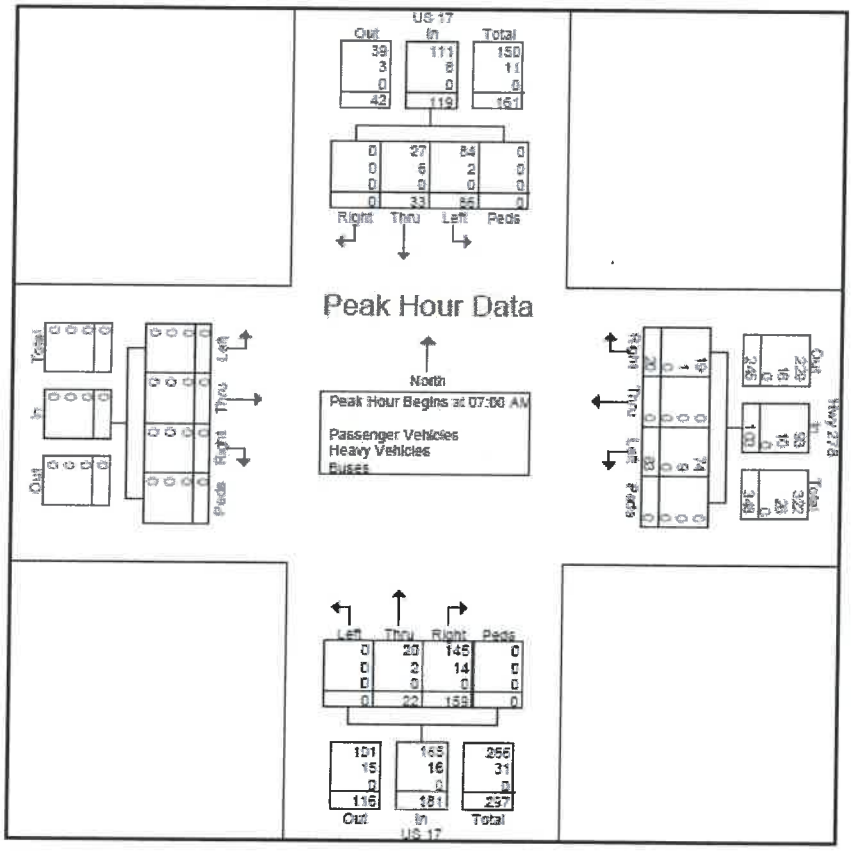
	US 17 From North				Hwy 278 From East				US 17 From South				From West				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
07:00 AM	21	9	0	0	16	0	4	0	0	2	49	0	0	0	0	0	101
07:15 AM	21	5	0	0	20	0	9	0	0	7	42	0	0	0	0	0	104
07:30 AM	27	10	0	0	24	0	4	0	0	6	28	0	0	0	0	0	99
07:45 AM	17	9	0	0	23	0	3	0	0	7	40	0	0	0	0	0	99
Total	86	33	0	0	83	0	20	0	0	22	159	0	0	0	0	0	403
08:00 AM	17	9	0	0	26	0	5	0	0	5	19	0	0	0	0	0	81
08:15 AM	13	9	0	0	24	0	8	0	0	10	19	0	0	0	0	0	83
08:30 AM	16	7	0	0	20	0	6	0	0	9	21	0	0	0	0	0	79
08:45 AM	13	7	0	0	18	0	3	0	0	9	26	0	0	0	0	0	76
Total	59	32	0	0	88	0	22	0	0	33	85	0	0	0	0	0	319
04:00 PM	10	6	0	0	29	0	22	0	0	18	26	0	0	0	0	0	111
04:15 PM	5	8	0	0	26	0	18	0	0	15	18	0	0	0	0	0	90
04:30 PM	13	3	0	0	36	0	18	0	0	11	17	0	0	0	0	0	98
04:45 PM	6	7	0	0	33	0	26	0	0	10	20	0	0	0	0	0	102
Total	34	24	0	0	124	0	84	0	0	54	81	0	0	0	0	0	401
05:00 PM	13	6	0	0	32	0	29	0	0	19	22	0	0	0	0	0	121
05:15 PM	6	3	0	0	26	0	15	0	0	18	18	0	0	0	0	0	86
05:30 PM	1	2	0	0	30	0	21	0	0	18	16	0	0	0	0	0	88
05:45 PM	6	1	0	0	35	0	21	0	0	10	18	0	0	0	0	0	91
Total	26	12	0	0	123	0	86	0	0	65	74	0	0	0	0	0	386
Grand Total	205	101	0	0	418	0	212	0	0	174	399	0	0	0	0	0	1509
Apprch %	67	33	0	0	66.3	0	33.7	0	0	30.4	69.6	0	0	0	0	0	
Total %	13.6	6.7	0	0	27.7	0	14	0	0	11.5	26.4	0	0	0	0	0	
Passenger Vehicles	195	78	0	0	384	0	210	0	0	166	386	0	0	0	0	0	1399
% Passenger Vehicles	95.1	77.2	0	0	91.9	0	99.1	0	0	95.4	91.7	0	0	0	0	0	92.7
Heavy Vehicles	10	23	0	0	34	0	2	0	0	8	33	0	0	0	0	0	110
% Heavy Vehicles	4.9	22.8	0	0	8.1	0	0.9	0	0	4.6	8.3	0	0	0	0	0	7.3
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

File Name : US 17 @ Hwy 278
Site Code :
Start Date : 7/21/2020
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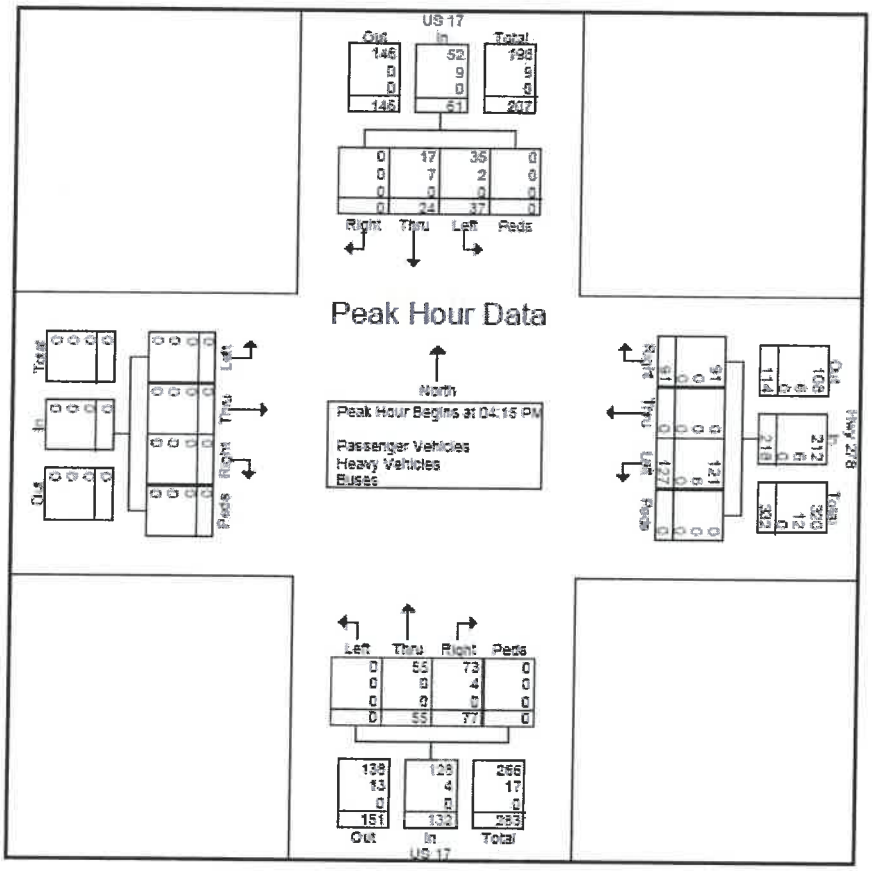
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Site Code :
Start Date : 7/21/2020
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Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	21	9	0	0	30	16	0	4	0	20	0	2	49	0	51	0	0	0	0	0	101
07:15 AM	21	5	0	0	26	20	0	9	0	29	0	7	42	0	49	0	0	0	0	0	104
07:30 AM	27	10	0	0	37	24	0	4	0	28	0	6	28	0	34	0	0	0	0	0	99
07:45 AM	17	9	0	0	26	23	0	3	0	26	0	7	40	0	47	0	0	0	0	0	99
Total Volume	86	33	0	0	119	83	0	20	0	103	0	22	159	0	181	0	0	0	0	0	403
% App. Total	72.3	27.7	0	0		80.6	0	19.4	0		0	12.2	87.8	0		0	0	0	0		
PHF	.796	.825	.000	.000	.804	.865	.000	.556	.000	.888	.000	.786	.811	.000	.887	.000	.000	.000	.000	.000	.969
Passenger Vehicles	84	27	0	0	111	74	0	19	0	93	0	20	145	0	165	0	0	0	0	0	369
% Passenger Vehicles																					
Heavy Vehicles	2	6	0	0	8	9	0	1	0	10	0	2	14	0	16	0	0	0	0	0	34
% Heavy Vehicles	2.3	18.2	0	0	6.7	10.8	0	5.0	0	9.7	0	9.1	8.8	0	8.8	0	0	0	0	0	8.4
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



File Name : US 17 @ Hwy 278
Site Code :
Start Date : 7/21/2020
Page No : 4

	US 17 From North					Hwy 278 From East					US 17 From South					From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	5	8	0	0	13	26	0	18	0	44	0	15	18	0	33	0	0	0	0	0	90
04:30 PM	13	3	0	0	16	36	0	18	0	54	0	11	17	0	28	0	0	0	0	0	98
04:45 PM	6	7	0	0	13	33	0	26	0	59	0	10	20	0	30	0	0	0	0	0	102
05:00 PM	13	6	0	0	19	32	0	29	0	61	0	19	22	0	41	0	0	0	0	0	121
Total Volume	37	24	0	0	61	127	0	91	0	218	0	55	77	0	132	0	0	0	0	0	411
% App. Total	60.7	39.3	0	0		58.3	0	41.7	0		0	41.7	58.3	0		0	0	0	0		
PHF	.712	.750	.000	.000	.803	.882	.000	.784	.000	.893	.000	.724	.875	.000	.805	.000	.000	.000	.000	.000	.849
Passenger Vehicles	35	17	0	0	52	121	0	91	0	212	0	55	73	0	128	0	0	0	0	0	392
% Passenger Vehicles																					
Heavy Vehicles	2	7	0	0	9	6	0	0	0	6	0	0	4	0	4	0	0	0	0	0	19
% Heavy Vehicles	5.4	29.2	0	0	14.8	4.7	0	0	0	2.8	0	0	5.2	0	3.0	0	0	0	0	0	4.6
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

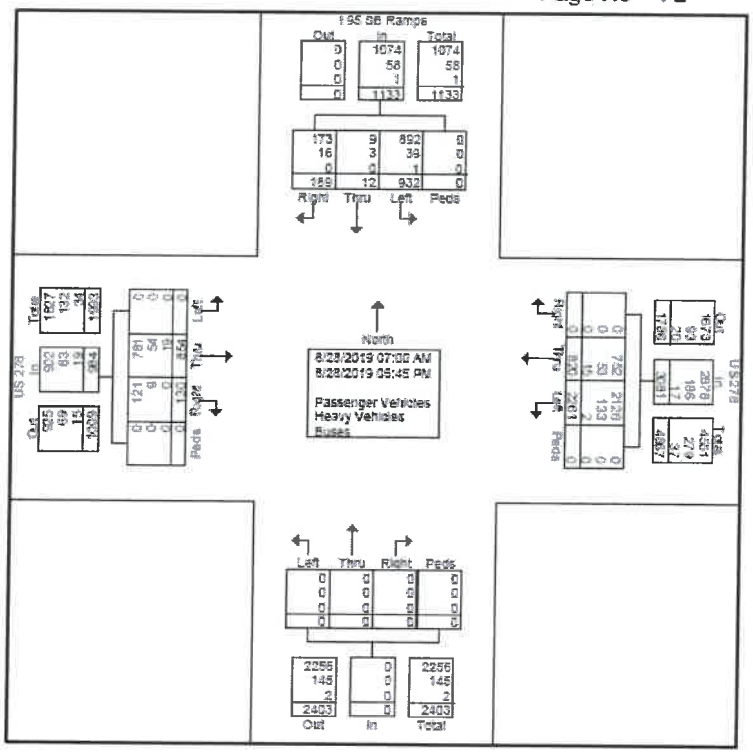


File Name : US 278 @ I 95 SB Ramps
Site Code :
Start Date : 8/28/2019
Page No : 1

Groups Printed- Passenger Vehicles - Heavy Vehicles - Buses

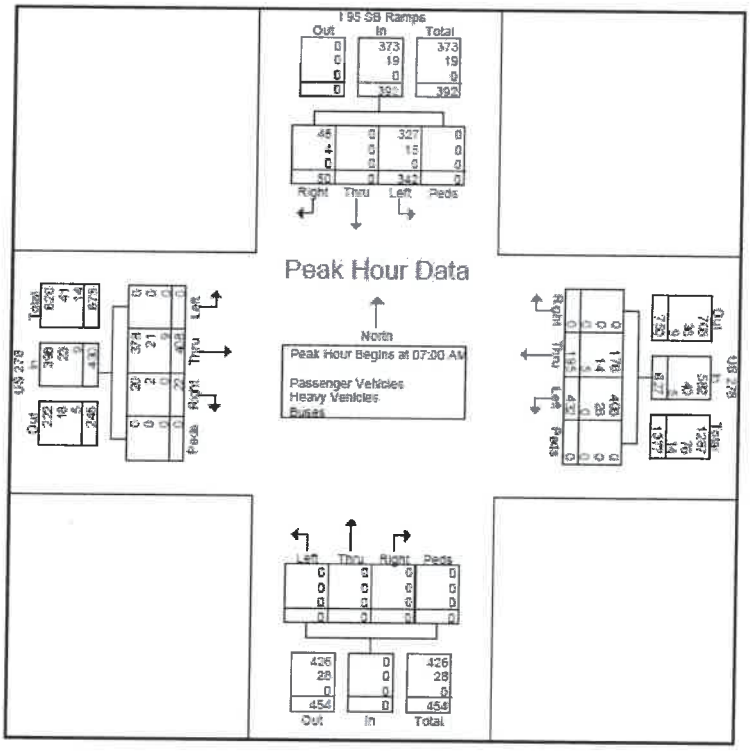
	I 95 SB Ramps From North				US 278 From East				From South				US 278 From West				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
07:00 AM	78	0	17	0	92	45	0	0	0	0	0	0	0	121	8	0	361
07:15 AM	90	0	17	0	112	57	0	0	0	0	0	0	0	111	3	0	390
07:30 AM	99	0	8	0	114	65	0	0	0	0	0	0	0	92	2	0	380
07:45 AM	75	0	8	0	114	28	0	0	0	0	0	0	0	84	9	0	318
Total	342	0	50	0	432	195	0	0	0	0	0	0	0	408	22	0	1449
08:00 AM	68	1	12	0	95	33	0	0	0	0	0	0	0	81	9	0	279
08:15 AM	62	2	11	0	111	28	0	0	0	0	0	0	0	50	4	0	268
08:30 AM	54	0	15	0	108	29	0	0	0	0	0	0	0	51	3	0	260
08:45 AM	41	1	14	0	104	20	0	0	0	0	0	0	0	32	11	0	223
Total	225	4	52	0	418	110	0	0	0	0	0	0	0	194	27	0	1030
04:00 PM	43	2	11	0	146	52	0	0	0	0	0	0	0	33	7	0	294
04:15 PM	50	2	16	0	142	77	0	0	0	0	0	0	0	36	9	0	332
04:30 PM	45	1	9	0	168	63	0	0	0	0	0	0	0	28	11	0	325
04:45 PM	53	0	17	0	160	53	0	0	0	0	0	0	0	42	7	0	332
Total	191	5	53	0	616	245	0	0	0	0	0	0	0	139	34	0	1283
05:00 PM	38	2	9	0	220	80	0	0	0	0	0	0	0	26	13	0	388
05:15 PM	66	0	8	0	217	65	0	0	0	0	0	0	0	27	14	0	397
05:30 PM	42	1	10	0	191	68	0	0	0	0	0	0	0	31	13	0	356
05:45 PM	28	0	7	0	167	57	0	0	0	0	0	0	0	29	7	0	295
Total	174	3	34	0	795	270	0	0	0	0	0	0	0	113	47	0	1436
Grand Total	932	12	189	0	2261	820	0	0	0	0	0	0	0	854	130	0	5198
Apprch %	82.3	1.1	16.7	0	73.4	26.6	0	0	0	0	0	0	0	86.8	13.2	0	
Total %	17.9	0.2	3.6	0	43.5	15.8	0	0	0	0	0	0	0	16.4	2.5	0	
Passenger Vehicles	892	9	173	0	2126	752	0	0	0	0	0	0	0	781	121	0	4854
% Passenger Vehicles	95.7	75	91.5	0	94	91.7	0	0	0	0	0	0	0	91.5	93.1	0	93.4
Heavy Vehicles	39	3	16	0	133	53	0	0	0	0	0	0	0	54	9	0	307
% Heavy Vehicles	4.2	25	8.5	0	5.9	6.5	0	0	0	0	0	0	0	6.3	6.9	0	5.9
Buses	1	0	0	0	2	15	0	0	0	0	0	0	0	19	0	0	37
% Buses	0.1	0	0	0	0.1	1.8	0	0	0	0	0	0	0	2.2	0	0	0.7

File Name : US 278 @ I 95 SB Ramps
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Start Date : 8/28/2019
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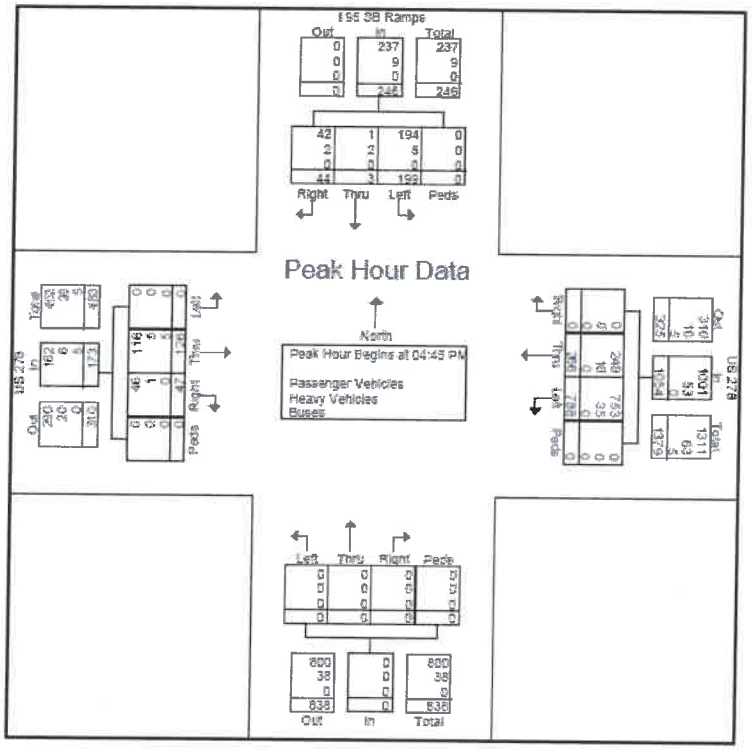
File Name : US 278 @ I 95 SB Ramps
Site Code :
Start Date : 8/28/2019
Page No : 3

	I 95 SB Ramps From North					US 278 From East					From South					US 278 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	78	0	17	0	95	92	45	0	0	137	0	0	0	0	0	0	**121**	8	0	**129**	361
07:15 AM	80	0	17	0	**107**	112	57	0	0	169	0	0	0	0	0	0	111	3	0	114	**390**
07:30 AM	**99**	0	8	0	**107**	**114**	**65**	0	0	**179**	0	0	0	0	0	0	92	2	0	94	380
07:45 AM	75	0	8	0	83	114	28	0	0	142	0	0	0	0	0	0	84	9	0	93	318
Total Volume	342	0	50	0	392	432	195	0	0	627	0	0	0	0	0	0	408	22	0	430	1449
% App. Total	87.2	0	12.8	0		68.9	31.1	0	0		0	0	0	0		0	94.9	5.1	0		
PHF	.864	.000	.735	.000	.916	.947	.750	.000	.000	.878	.000	.000	.000	.000	.000	.000	.843	.611	.000	.833	.929
Passenger Vehicles	327	0	46	0	373	406	176	0	0	582	0	0	0	0	0	0	378	20	0	398	1353
% Passenger Vehicles																					
Heavy Vehicles	15	0	4	0	19	26	14	0	0	40	0	0	0	0	0	0	21	2	0	23	82
% Heavy Vehicles	4.4	0	8.0	0	4.8	6.0	7.2	0	0	6.4	0	0	0	0	0	0	5.1	9.1	0	5.3	5.7
Buses	0	0	0	0	0	0	5	0	0	5	0	0	0	0	0	0	9	0	0	9	14
% Buses	0	0	0	0	0	0	2.6	0	0	0.8	0	0	0	0	0	0	2.2	0	0	2.1	1.0



File Name : US 278 @ I 95 SB Ramps
Site Code :
Start Date : 8/28/2019
Page No : 4

	I 95 SB Ramps From North					US 278 From East					From South					US 278 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	53	0	17	0	70	160	53	0	0	213	0	0	0	0	0	0	42	7	0	49	332
05:00 PM	38	2	9	0	49	220	80	0	0	300	0	0	0	0	0	0	26	13	0	39	388
05:15 PM	66	0	8	0	74	217	65	0	0	282	0	0	0	0	0	0	27	14	0	41	397
05:30 PM	42	1	10	0	53	191	68	0	0	259	0	0	0	0	0	0	31	13	0	44	356
Total Volume	199	3	44	0	246	788	266	0	0	1054	0	0	0	0	0	0	126	47	0	173	1473
% App. Total	80.9	1.2	17.9	0		74.8	25.2	0	0		0	0	0	0		0	72.8	27.2	0		
PHF	.754	.375	.647	.000	.831	.895	.831	.000	.000	.878	.000	.000	.000	.000	.000	.000	.750	.839	.000	.883	.928
Passenger Vehicles	194	1	42	0	237	783	248	0	0	1031	0	0	0	0	0	0	118	46	0	164	1432
% Passenger Vehicles																					
Heavy Vehicles	5	2	2	0	9	35	18	0	0	53	0	0	0	0	0	0	5	1	0	6	68
% Heavy Vehicles	2.5	66.7	4.5	0	3.7	4.4	6.8	0	0	5.0	0	0	0	0	0	0	4.0	2.1	0	3.5	4.6
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5	5
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.0	0	0	2.9	0.3



SHORT COUNTS

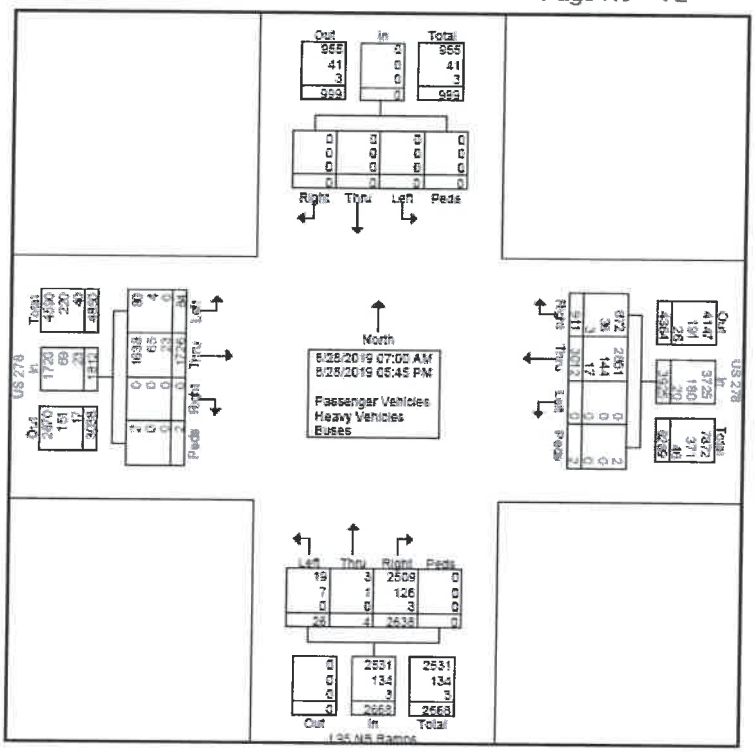
File Name : US 278 @ I 95 NB Ramps
Site Code :
Start Date : 8/28/2019
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Groups Printed- Passenger Vehicles - Heavy Vehicles - Buses

	From North				US 278 From East				I 95 NB Ramps From South				US 278 From West				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
07:00 AM	0	0	0	0	0	128	43	0	1	1	177	0	1	185	0	0	536
07:15 AM	0	0	0	0	0	148	50	0	2	0	226	0	3	223	0	0	652
07:30 AM	0	0	0	0	0	179	56	0	4	0	219	0	4	187	0	0	648
07:45 AM	0	0	0	0	0	140	30	0	5	0	229	0	5	160	0	0	569
Total	0	0	0	0	0	595	179	0	12	1	850	0	13	755	0	0	2405
08:00 AM	0	0	0	0	0	118	32	0	3	0	226	0	4	124	0	0	507
08:15 AM	0	0	0	0	0	133	38	0	1	0	187	0	3	105	0	0	467
08:30 AM	0	0	0	0	0	140	45	0	0	0	205	0	3	111	0	0	504
08:45 AM	0	0	0	0	0	116	43	0	0	0	158	0	1	76	0	0	394
Total	0	0	0	0	0	507	158	0	4	0	776	0	11	416	0	0	1872
04:00 PM	0	0	0	0	0	207	62	0	2	1	108	0	8	61	0	0	445
04:15 PM	0	0	0	0	0	210	69	0	0	0	142	0	11	80	0	0	512
04:30 PM	0	0	0	0	0	222	75	0	3	0	123	0	5	70	0	0	498
04:45 PM	0	0	0	0	0	215	60	0	1	1	147	0	13	89	0	1	527
Total	0	0	0	0	0	854	266	0	6	2	518	0	35	300	0	1	1982
05:00 PM	0	0	0	0	0	281	74	0	1	0	145	0	5	48	0	0	554
05:15 PM	0	0	0	0	0	285	76	2	1	1	129	0	9	86	0	1	590
05:30 PM	0	0	0	0	0	255	94	0	0	0	107	0	5	72	0	0	533
05:45 PM	0	0	0	0	0	235	64	0	2	0	113	0	6	49	0	0	469
Total	0	0	0	0	0	1056	308	2	4	1	494	0	25	255	0	1	2146
Grand Total	0	0	0	0	0	3012	911	2	26	4	2638	0	84	1726	0	2	8405
Apprch %	0	0	0	0	0	76.7	23.2	0.1	1	0.1	98.9	0	4.6	95.3	0	0.1	
Total %	0	0	0	0	0	35.8	10.8	0	0.3	0	31.4	0	1	20.5	0	0	
Passenger Vehicles	0	0	0	0	0	2851	872	2	19	3	2509	0	80	1638	0	2	7976
% Passenger Vehicles	0	0	0	0	0	94.7	95.7	100	73.1	75	95.1	0	95.2	94.9	0	100	94.9
Heavy Vehicles	0	0	0	0	0	144	36	0	7	1	126	0	4	85	0	0	383
% Heavy Vehicles	0	0	0	0	0	4.8	4	0	26.9	25	4.8	0	4.8	3.8	0	0	4.6
Buses	0	0	0	0	0	17	3	0	0	0	3	0	0	23	0	0	46
% Buses	0	0	0	0	0	0.6	0.3	0	0	0	0.1	0	0	1.3	0	0	0.5

SHORT COUNTS

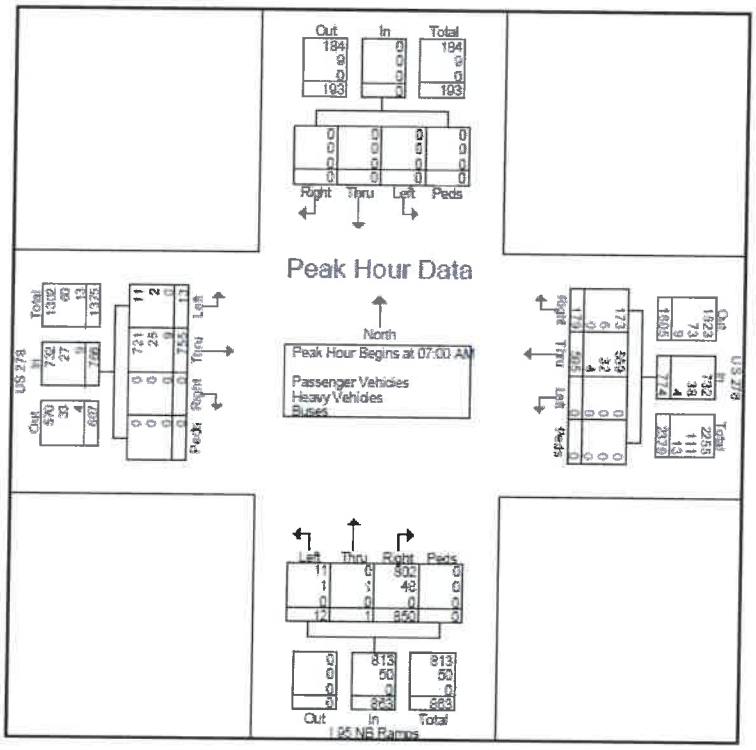
File Name : US 278 @ I 95 NB Ramps
Site Code :
Start Date : 8/28/2019
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SHORT COUNTS

File Name : US 278 @ I 95 NB Ramps
Site Code :
Start Date : 8/28/2019
Page No : 3

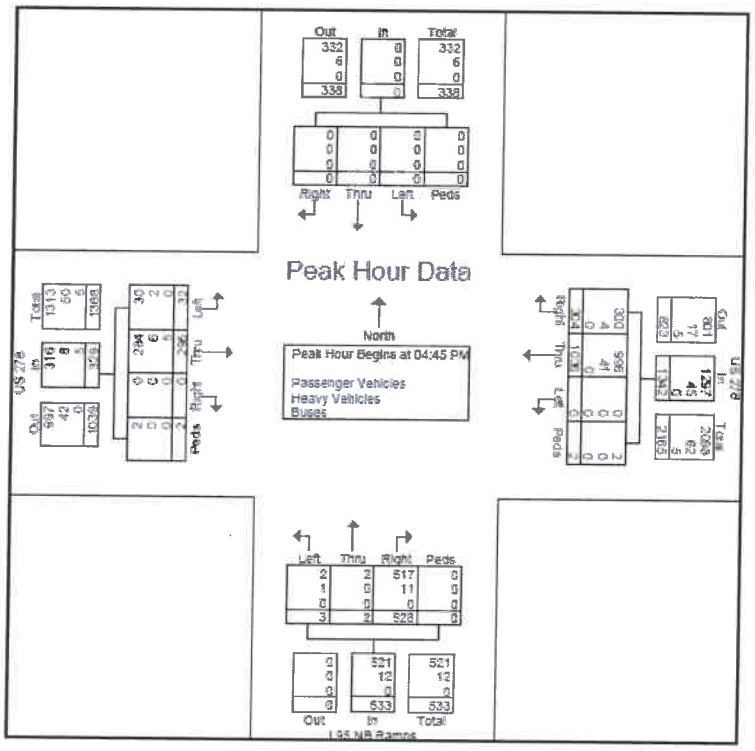
	From North					US 278 From East					I 95 NB Ramps From South					US 278 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	0	0	0	0	0	0	126	43	0	171	1	1	177	0	179	1	185	0	0	186	536
07:15 AM	0	0	0	0	0	0	148	50	0	198	2	0	226	0	228	3	223	0	0	226	652
07:30 AM	0	0	0	0	0	0	179	56	0	235	4	0	218	0	222	4	197	0	0	191	648
07:45 AM	0	0	0	0	0	0	140	30	0	170	5	0	229	0	234	5	160	0	0	165	569
Total Volume	0	0	0	0	0	0	595	179	0	774	12	1	850	0	863	13	755	0	0	768	2405
% App. Total	0	0	0	0		0	76.9	23.1	0		1.4	0.1	98.5	0		1.7	98.3	0	0		
PHF	.000	.000	.000	.000	.000	.000	.831	.799	.000	.823	.600	.250	.926	.000	.922	.650	.846	.000	.000	.850	.922
Passenger Vehicles	0	0	0	0	0	0	569	173	0	739	11	0	813	0	813	11	728	0	0	732	2277
% Passenger Vehicles																					
Heavy Vehicles	0	0	0	0	0	0	32	6	0	38	1	1	48	0	50	2	25	0	0	27	115
% Heavy Vehicles	0	0	0	0	0	0	5.4	3.4	0	4.9	8.3	100	5.6	0	5.8	15.4	3.3	0	0	3.5	4.8
Buses	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	0	9	0	0	9	13
% Buses	0	0	0	0	0	0	0.7	0	0	0.5	0	0	0	0	0	0	1.2	0	0	1.2	0.5



SHORT COUNTS

File Name : US 278 @ I 95 NB Ramps
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	From North					US 278 From East					I 95 NB Ramps From South					US 278 From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	0	0	0	0	0	0	215	60	0	275	1	1	147	0	149	13	89	0	1	103	527
05:00 PM	0	0	0	0	0	0	281	74	0	355	1	0	145	0	146	5	48	0	0	53	554
05:15 PM	0	0	0	0	0	0	285	76	2	363	1	1	129	0	131	9	86	0	1	96	590
05:30 PM	0	0	0	0	0	0	255	94	0	349	0	0	107	0	107	5	72	0	0	77	533
Total Volume	0	0	0	0	0	0	1036	304	2	1342	3	2	528	0	533	32	295	0	2	329	2204
% App. Total	0	0	0	0		0	77.2	22.7	0.1		0.6	0.4	99.1	0		9.7	89.7	0	0.6		
PHF	.000	.000	.000	.000	.000	.000	.909	.809	.250	.924	.750	.500	.898	.000	.894	.615	.829	.000	.500	.799	.934
Passenger Vehicles	0	0	0	0	0	0	995	300	2	1297	3	2	517	0	522	32	284	0	2	318	2139
% Passenger Vehicles																					
Heavy Vehicles	0	0	0	0	0	0	41	4	0	45	1	0	11	0	12	2	8	0	0	8	65
% Heavy Vehicles	0	0	0	0	0	0	4.0	1.3	0	3.4	33.3	0	2.1	0	2.3	6.3	2.0	0	0	2.4	2.9
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5	5
% Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7	0	0	1.6	0.2



SHORT COUNTS

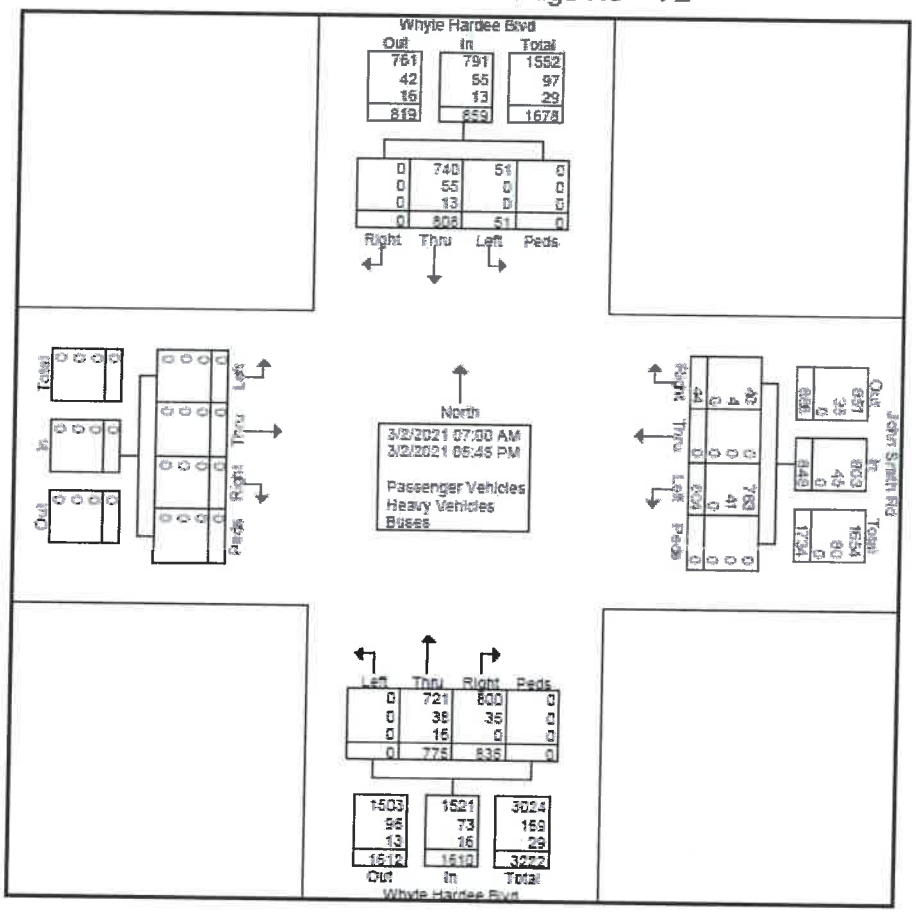
File Name : John Smith Rd @ Whyte Hardee Blvd
Site Code :
Start Date : 3/2/2021
Page No : 1

Groups Printed- Passenger Vehicles - Heavy Vehicles - Buses

	Whyte Hardee Blvd From North				John Smith Rd From East				Whyte Hardee Blvd From South				From West				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
07:00 AM	5	44	0	0	27	0	1	0	0	89	75	0	0	0	0	0	241
07:15 AM	16	55	0	0	20	0	1	0	0	81	76	0	0	0	0	0	249
07:30 AM	7	59	0	0	48	0	16	0	0	75	83	0	0	0	0	0	288
07:45 AM	11	49	0	0	65	0	9	0	0	65	68	0	0	0	0	0	267
Total	39	207	0	0	160	0	27	0	0	310	302	0	0	0	0	0	1045
08:00 AM	3	37	0	0	42	0	3	0	0	43	45	0	0	0	0	0	173
08:15 AM	4	35	0	0	31	0	1	0	0	38	39	0	0	0	0	0	148
08:30 AM	1	22	0	0	26	0	4	0	0	35	57	0	0	0	0	0	145
08:45 AM	2	33	0	0	35	0	2	0	0	27	42	0	0	0	0	0	141
Total	10	127	0	0	134	0	10	0	0	143	183	0	0	0	0	0	607
04:00 PM	1	72	0	0	59	0	0	0	0	33	43	0	0	0	0	0	208
04:15 PM	0	51	0	0	66	0	0	0	0	34	40	0	0	0	0	0	191
04:30 PM	0	67	0	0	71	0	3	0	0	37	39	0	0	0	0	0	217
04:45 PM	1	53	0	0	67	0	0	0	0	44	50	0	0	0	0	0	215
Total	2	243	0	0	263	0	3	0	0	148	172	0	0	0	0	0	831
05:00 PM	0	64	0	0	59	0	1	0	0	55	59	0	0	0	0	0	238
05:15 PM	0	55	0	0	72	0	0	0	0	48	45	0	0	0	0	0	220
05:30 PM	0	59	0	0	66	0	0	0	0	34	36	0	0	0	0	0	195
05:45 PM	0	53	0	0	50	0	3	0	0	37	38	0	0	0	0	0	181
Total	0	231	0	0	247	0	4	0	0	174	178	0	0	0	0	0	834
Grand Total	51	808	0	0	804	0	44	0	0	775	835	0	0	0	0	0	3317
Apprch %	5.9	94.1	0	0	94.8	0	5.2	0	0	48.1	51.9	0	0	0	0	0	
Total %	1.5	24.4	0	0	24.2	0	1.3	0	0	23.4	25.2	0	0	0	0	0	
Passenger Vehicles	51	740	0	0	763	0	40	0	0	721	800	0	0	0	0	0	3115
% Passenger Vehicles	100	91.6	0	0	94.9	0	90.9	0	0	93	95.8	0	0	0	0	0	93.9
Heavy Vehicles	0	55	0	0	41	0	4	0	0	38	35	0	0	0	0	0	173
% Heavy Vehicles	0	6.8	0	0	5.1	0	9.1	0	0	4.9	4.2	0	0	0	0	0	5.2
Buses	0	13	0	0	0	0	0	0	0	16	0	0	0	0	0	0	29
% Buses	0	1.6	0	0	0	0	0	0	0	2.1	0	0	0	0	0	0	0.9

SHORT COUNTS

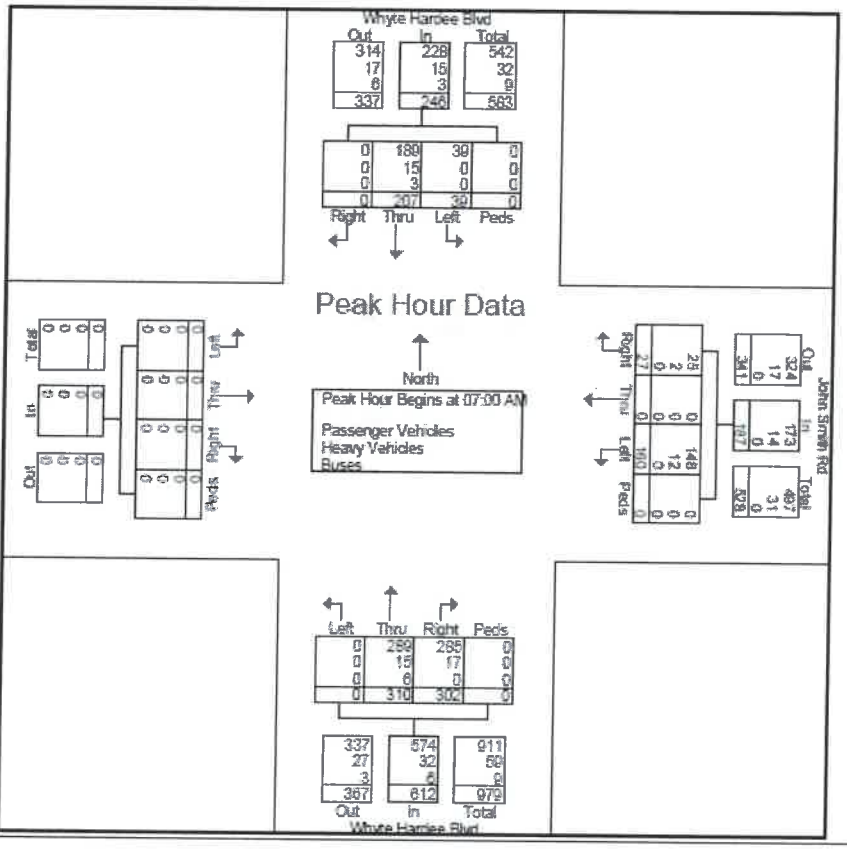
File Name : John Smith Rd @ Whyte Hardee Blvd
Site Code :
Start Date : 3/2/2021
Page No : 2



SHORT COUNTS

File Name : John Smith Rd @ Whyte Hardee Blvd
Site Code :
Start Date : 3/2/2021
Page No : 3

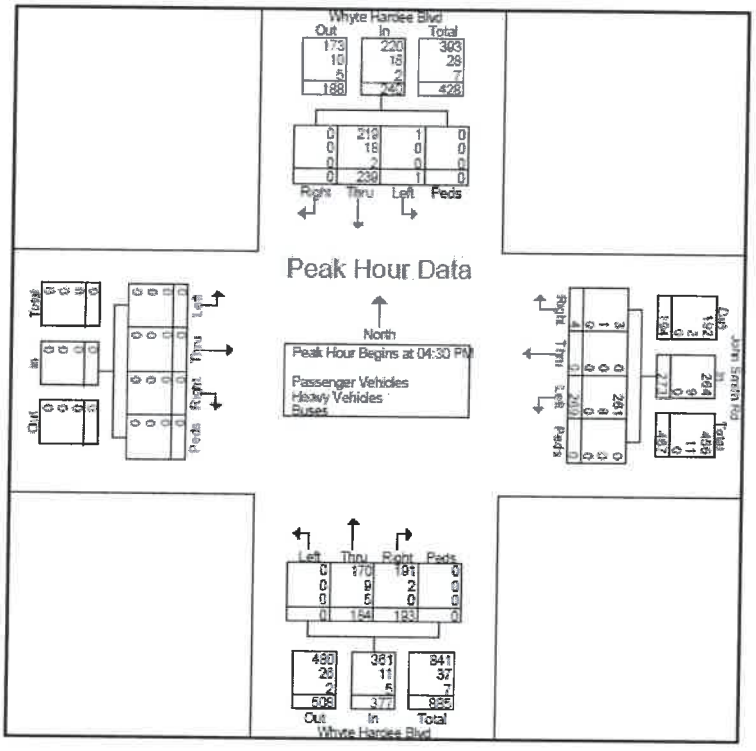
	Whyte Hardee Blvd From North					John Smith Rd From East					Whyte Hardee Blvd From South					From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	5	44	0	0	49	27	0	1	0	28	0	89	75	0	164	0	0	0	0	0	241
07:15 AM	16	55	0	0	71	20	0	1	0	21	0	81	76	0	157	0	0	0	0	0	249
07:30 AM	7	59	0	0	66	48	0	16	0	64	0	75	83	0	158	0	0	0	0	0	288
07:45 AM	11	49	0	0	60	65	0	9	0	74	0	65	68	0	133	0	0	0	0	0	267
Total Volume	39	207	0	0	246	160	0	27	0	187	0	310	302	0	612	0	0	0	0	0	1045
% App. Total	15.9	84.1	0	0		85.6	0	14.4	0		0	50.7	49.3	0		0	0	0	0		
PHF	.609	.877	.000	.000	.866	.615	.000	.422	.000	.632	.000	.871	.910	.000	.933	.000	.000	.000	.000	.000	.907
Passenger Vehicles	38	180	0	0	220	148	0	25	0	173	0	289	285	0	574	0	0	0	0	0	967
% Passenger Vehicles		91.3				92.5		92.6				93.2	94.4								
Heavy Vehicles	0	15	0	0	15	12	0	2	0	14	0	15	17	0	32	0	0	0	0	0	61
% Heavy Vehicles	0	7.2	0	0	6.1	7.5	0	7.4	0	7.5	0	4.8	5.6	0	5.2	0	0	0	0	0	5.8
Buses	0	3	0	0	3	0	0	0	0	0	0	6	0	0	6	0	0	0	0	0	9
% Buses	0	1.4	0	0	1.2	0	0	0	0	0	0	1.9	0	0	1.0	0	0	0	0	0	0.9



SHORT COUNTS

File Name : John Smith Rd @ Whyte Hardee Blvd
Site Code :
Start Date : 3/2/2021
Page No : 4

	Whyte Hardee Blvd From North					John Smith Rd From East					Whyte Hardee Blvd From South					From West					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	0	67	0	0	67	71	0	3	0	74	0	37	39	0	76	0	0	0	0	0	217
04:45 PM	1	53	0	0	54	67	0	0	0	67	0	44	50	0	94	0	0	0	0	0	215
05:00 PM	0	64	0	0	64	59	0	1	0	60	0	55	59	0	114	0	0	0	0	0	238
05:15 PM	0	55	0	0	55	72	0	0	0	72	0	48	45	0	93	0	0	0	0	0	220
Total Volume	1	239	0	0	240	269	0	4	0	273	0	184	193	0	377	0	0	0	0	0	890
% App. Total	0.4	99.6	0	0		98.5	0	1.5	0		0	48.8	51.2	0		0	0	0	0		
PHF	.250	.892	.000	.000	.896	.934	.000	.333	.000	.922	.000	.836	.818	.000	.827	.000	.000	.000	.000	.000	.935
Passenger Vehicles	1	219	0	0	220	261	0	3	0	264	0	170	191	0	361	0	0	0	0	0	845
% Passenger Vehicles		91.6				97.0		75.0				92.4	99.0								
Heavy Vehicles	0	18	0	0	18	8	0	1	0	9	0	9	2	0	11	0	0	0	0	0	38
% Heavy Vehicles	0	7.5	0	0	7.5	3.0	0	25.0	0	3.3	0	4.9	1.0	0	2.9	0	0	0	0	0	4.3
Buses	0	2	0	0	2	0	0	0	0	0	0	5	0	0	5	0	0	0	0	0	7
% Buses	0	0.8	0	0	0.8	0	0	0	0	0	0	2.7	0	0	1.3	0	0	0	0	0	0.8



INTERSECTION VOLUME DEVELOPMENT
95 Logistics Center
US 17 at US 278
AM PEAK HOUR (7:00 AM to 8:00 AM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			US 278 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2020 AM Volumes	0	22	159	86	33	0	0	0	0	83	0	20
Grown Existing 2021 Traffic Count Volumes with 1.16 COVID Adjustment Factor Applied[1]	0	27	192	104	40	0	0	0	0	100	0	24
Pedestrians		0			0			0			0	
Heavy Vehicle %		8.8%			6.7%			0.0%			9.7%	
Peak Hour Factor		0.89			0.80			0.00			0.89	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	0	18	3	0	0	0	0	0	27	0	4
2026 Background Traffic	0	33	252	130	49	0	0	0	0	149	0	33
Trip Distribution												
New Trips IN					3%					77%		
New Trips OUT		3%	77%									
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	2	60	0	8	0	0	0	0	200	0	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	2	60	0	8	0	0	0	0	200	0	0
2026 Buildout Total	**0**	**35**	**312**	**130**	**57**	**0**	**0**	**0**	**0**	**349**	**0**	**33**

1. Traffic counts collected in July 2020 and adjusted by 1.16 COVID factor based on SCDOT guidance and 4% per year growth rate

PM PEAK HOUR (4:15 PM to 5:15 PM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			US 278 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2020 PM Volumes	0	55	77	37	24	0	0	0	0	127	0	91
Grown Existing 2021 Traffic Count Volumes with 1.11 COVID Adjustment Factor Applied[1]	0	63	89	43	28	0	0	0	0	147	0	105
Pedestrians		0			0			0			0	
Heavy Vehicle %		3% (9.5%)			14.8%			0.0%			2.8% (4.7%)	
Peak Hour Factor		0.81			0.80			0.00			0.89	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	0	31	5	0	0	0	0	0	24	0	4
2026 Background Traffic	0	77	139	57	34	0	0	0	0	203	0	132
Trip Distribution												
New Trips IN					3%					77%		
New Trips OUT		3%	77%									
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	7	191	0	3	0	0	0	0	71	0	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	7	191	0	3	0	0	0	0	71	0	0
2026 Buildout Total	**0**	**84**	**330**	**57**	**37**	**0**	**0**	**0**	**0**	**274**	**0**	**132**

1. Traffic counts collected in July 2020 and adjusted by 1.11 COVID factor based on SCDOT guidance and 4% per year growth rate

INTERSECTION VOLUME DEVELOPMENT
95 Logistics Center
US 278 at I-95 Southbound Ramp
AM PEAK HOUR (7:00 AM to 8:00 AM)

Description	- Northbound			I-95 Southbound Ramp Southbound			US 278 Eastbound			US 278 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2019 AM Volumes	0	0	0	342	0	50	0	408	22	432	195	0
Grown Existing 2021 AM Volumes	0	0	0	370	0	54	0	441	24	467	211	0
Pedestrians		0			0			0			0	
Heavy Vehicle %		0.0%			4.8%			7.4% (8.3%)			7.2%	
Peak Hour Factor		0.00			0.92			0.83			0.88	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	0	0	28	0	0	0	21	0	41	31	0
2026 Background Traffic	0	0	0	478	0	66	0	558	29	609	288	0
Trip Distribution												
New Trips IN						20%					57%	
New Trips OUT								47%	30%			
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	0	0	0	0	52	0	37	23	0	148	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	0	0	0	0	52	0	37	23	0	148	0
2026 Buildout Total	**0**	**0**	**0**	**478**	**0**	**118**	**0**	**595**	**52**	**609**	**436**	**0**

PM PEAK HOUR (4:45 PM to 5:45 PM)

Description	- Northbound			I-95 Southbound Ramp Southbound			US 278 Eastbound			US 278 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2019 PM Volumes	0	0	0	199	3	44	0	126	47	788	266	0
Grown Existing 2021 PM Volumes	0	0	0	215	3	48	0	136	51	853	288	0
Pedestrians		0			0			0			0	
Heavy Vehicle %		0.0%			3.7%			6.4% (10.9%)			5.0%	
Peak Hour Factor		0.00			0.83			0.88			0.88	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	0	0	48	0	0	0	36	0	38	28	0
2026 Background Traffic	0	0	0	310	4	58	0	201	62	1,076	378	0
Trip Distribution												
New Trips IN						20%					57%	
New Trips OUT								47%	30%			
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	0	0	0	0	18	0	117	74	0	53	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	0	0	0	0	18	0	117	74	0	53	0
2026 Buildout Total	**0**	**0**	**0**	**310**	**4**	**76**	**0**	**318**	**136**	**1,076**	**431**	**0**

INTERSECTION VOLUME DEVELOPMENT
95 Logistics Center
US 278 at I-95 Northbound Ramp
AM PEAK HOUR (7:00 AM to 8:00 AM)

Description	I-95 Northbound Ramp Northbound			- Southbound			US 278 Eastbound			US 278 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2019 AM Volumes	12	1	850	0	0	0	13	755	0	0	595	179
Grown Existing 2021 AM Volumes	13	1	920	0	0	0	14	817	0	0	644	194
Pedestrians		0			0			0			0	
Heavy Vehicle %		5.8%			0.0%			4.7%			5.4%	
Peak Hour Factor		0.92			0.00			0.85			0.82	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	0	28	0	0	0	0	49	0	0	72	41
2026 Background Traffic	16	1	1,147	0	0	0	17	1,043	0	0	856	277
Trip Distribution												
New Trips IN	30%										27%	
New Trips OUT							20%	27%				
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	78	0	0	0	0	0	16	21	0	0	70	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	78	0	0	0	0	0	16	21	0	0	70	0
2026 Buildout Total	94	1	1,147	0	0	0	33	1,064	0	0	926	277

PM PEAK HOUR (4:45 PM to 5:45 PM)

Description	I-95 Northbound Ramp Northbound			- Southbound			US 278 Eastbound			US 278 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2019 PM Volumes	3	2	528	0	0	0	32	295	0	0	1036	304
Grown Existing 2021 PM Volumes	3	2	571	0	0	0	35	319	0	0	1,121	329
Pedestrians		0			0			2			2	
Heavy Vehicle %		2.3%			0.0%			3.9%			3.4%	
Peak Hour Factor		0.89			0.00			0.80			0.92	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	0	48	0	0	0	0	84	0	0	66	37
2026 Background Traffic	4	2	743	0	0	0	43	472	0	0	1,430	437
Trip Distribution												
New Trips IN	30%										27%	
New Trips OUT							20%	27%				
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	28	0	0	0	0	0	50	67	0	0	25	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	28	0	0	0	0	0	50	67	0	0	25	0
2026 Buildout Total	32	2	743	0	0	0	93	539	0	0	1,455	437

INTERSECTION VOLUME DEVELOPMENT
95 Logistics Center
US 17 at John Smith Road
AM PEAK HOUR (7:00 AM to 8:00 AM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			John Smith Road Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw March 2021 Traffic Count Volumes	0	310	302	39	207	0	0	0	0	160	0	27
Existing 2021 Traffic Count Volumes with 1.15 COVID Adjustment Factor Applied[1]	0	357	347	45	238	0	0	0	0	184	0	31
Pedestrians		0			0			0			0	
Heavy Vehicle %		6.2% (7.8%)			7.3%			0.0%			7.5%	
Peak Hour Factor		0.93			0.87			0.00			0.63	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	15	0	4	23	0	0	0	0	0	0	3
2026 Background Traffic	0	449	422	59	313	0	0	0	0	224	0	41
Trip Distribution												
New Trips IN		20%										
New Trips OUT					20%							
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	51	0	0	16	0	0	0	0	0	0	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	51	0	0	16	0	0	0	0	0	0	0
2026 Buildout Total	**0**	**500**	**422**	**59**	**329**	**0**	**0**	**0**	**0**	**224**	**0**	**41**

1. Traffic counts collected in March 2021 and adjusted by 1.15 COVID factor based on SCDOT guidance

PM PEAK HOUR (4:30 PM to 5:30 PM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			John Smith Road Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw March 2021 Traffic Count Volumes	0	184	193	1	239	0	0	0	0	269	0	4
Existing 2021 Traffic Count Volumes with 1.02 COVID Adjustment Factor Applied[1]	0	188	197	1	244	0	0	0	0	274	0	4
Pedestrians		0			0			0			0	
Heavy Vehicle %		4.2% (5.6%)			8.3%			0.0%			3.3%	
Peak Hour Factor		0.83			0.90			0.00			0.92	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	26	0	3	21	0	0	0	0	0	0	5
2026 Background Traffic	0	255	240	4	318	0	0	0	0	333	0	10
Trip Distribution												
New Trips IN		20%										
New Trips OUT					20%							
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	18	0	0	50	0	0	0	0	0	0	0
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	18	0	0	50	0	0	0	0	0	0	0
2026 Buildout Total	**0**	**273**	**240**	**4**	**368**	**0**	**0**	**0**	**0**	**333**	**0**	**10**

1. Traffic counts collected in March 2021 and adjusted by 1.02 COVID factor based on SCDOT guidance

INTERSECTION VOLUME DEVELOPMENT
95 Logistics Center
US 17 at Site Driveway #1
AM PEAK HOUR (7:00 AM to 8:00 AM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			Site Driveway #1 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2020 AM Volumes	0	181	0	0	116	0	0	0	0	0	0	0
Grown Existing 2021 Traffic Count Volumes with 1.16 COVID Adjustment Factor Applied[1]	0	218	0	0	140	0	0	0	0	0	0	0
Pedestrians		0			0			0			0	
Heavy Vehicle %		8.8%			12.9%			0.0%			20.0%	
Peak Hour Factor		0.89			0.85			0.00			0.90	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	18	0	0	27	0	0	0	0	0	0	0
2026 Background Traffic	0	283	0	0	197	0	0	0	0	0	0	0
Trip Distribution												
New Trips IN			10%	40%	40%							
New Trips OUT		40%								10%		40%
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	31	26	104	104	0	0	0	0	8	0	31
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	31	26	104	104	0	0	0	0	8	0	31
2026 Buildout Total	**0**	**314**	**26**	**104**	**301**	**0**	**0**	**0**	**0**	**8**	**0**	**31**

1 Traffic counts collected in July 2020 and adjusted by 1.16 COVID factor based on SCDOT guidance and 4% per year growth rate

PM PEAK HOUR (4:15 PM to 5:15 PM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			Site Driveway #1 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2020 PM Volumes	0	132	0	0	151	0	0	0	0	0	0	0
Grown Existing 2021 Traffic Count Volumes with 1.11 COVID Adjustment Factor Applied[1]	0	152	0	0	174	0	0	0	0	0	0	0
Pedestrians		0			0			0			0	
Heavy Vehicle %		3.0%			8.6%			0.0%			20.0%	
Peak Hour Factor		0.80			0.94			0.00			0.90	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	31	0	0	24	0	0	0	0	0	0	0
2026 Background Traffic	0	216	0	0	236	0	0	0	0	0	0	0
Trip Distribution												
New Trips IN			10%	40%	40%							
New Trips OUT		40%								10%		40%
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	99	9	37	37	0	0	0	0	25	0	99
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	99	9	37	37	0	0	0	0	25	0	99
2026 Buildout Total	**0**	**315**	**9**	**37**	**273**	**0**	**0**	**0**	**0**	**25**	**0**	**99**

1 Traffic counts collected in July 2020 and adjusted by 1.11 COVID factor based on SCDOT guidance and 4% per year growth rate

INTERSECTION VOLUME DEVELOPMENT
95 Logistics Center
US 17 at Site Driveway #2
AM PEAK HOUR (7:00 AM to 8:00 AM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			Site Driveway #2 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2020 AM Volumes	0	181	0	0	116	0	0	0	0	0	0	0
Grown Existing 2021 Traffic Count Volumes with 1.16 COVID Adjustment Factor Applied[1]	0	218	0	0	140	0	0	0	0	0	0	0
Pedestrians		0			0			0			0	
Heavy Vehicle %		8.8%			12.9%			0.0%			10.0%	
Peak Hour Factor		0.89			0.85			0.00			0.90	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	18	0	0	27	0	0	0	0	0	0	0
2026 Background Traffic	0	283	0	0	197	0	0	0	0	0	0	0
Trip Distribution												
New Trips IN		10%	10%	40%								
New Trips OUT					10%					10%		40%
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	26	25	104	8	0	0	0	0	8	0	31
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	26	25	104	8	0	0	0	0	8	0	31
2026 Buildout Total	**0**	**309**	**25**	**104**	**205**	**0**	**0**	**0**	**0**	**8**	**0**	**31**

1 Traffic counts collected in July 2020 and adjusted by 1.16 COVID factor based on SCDOT guidance and 4% per year growth rate

PM PEAK HOUR (4:15 PM to 5:15 PM)

Description	US 17 Northbound			US 17 Southbound			- Eastbound			Site Driveway #2 Westbound		
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right
Raw 2020 PM Volumes	0	132	0	0	151	0	0	0	0	0	0	0
Grown Existing 2021 Traffic Count Volumes with 1.11 COVID Adjustment Factor Applied[1]	0	152	0	0	174	0	0	0	0	0	0	0
Pedestrians		0			0			0			0	
Heavy Vehicle %		3.0%			8.6%			0.0%			20.0%	
Peak Hour Factor		0.80			0.94			0.00			0.90	
Annual Growth Rate	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Growth Factor	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217	1.217
Approved Site Development Traffic	0	31	0	0	24	0	0	0	0	0	0	0
2026 Background Traffic	0	216	0	0	236	0	0	0	0	0	0	0
Trip Distribution												
New Trips IN		10%	10%	40%								
New Trips OUT					10%					10%		40%
Pass By Distribution												
Pass By IN												
Pass By OUT												
New Trips	0	9	9	37	25	0	0	0	0	25	0	99
Pass By Trips	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Trips	0	9	9	37	25	0	0	0	0	25	0	99
2026 Buildout Total	**0**	**225**	**9**	**37**	**261**	**0**	**0**	**0**	**0**	**25**	**0**	**99**

1 Traffic counts collected in July 2020 and adjusted by 1.11 COVID factor based on SCDOT guidance and 4% per year growth rate

1/11/2022 3:36

APPENDIX C. I-95 VISSIM CALIBRATION MEMO

Memorandum

Date: *August 29, 2022*

To: *Craig Winn, PE, CFM, SCDOT*

From: *Brandon Denny, PE, CDM Smith*

Subject: I-95 Corridor Improvements MM0-MM8 – Vissim Existing Calibration Model Analysis

This memorandum is intended to document the Vissim analyses for the 2022 existing calibration model for the I-95 Corridor Improvements Project (MM 0-8).

Vissim simulates operations on freeway segments and provides traffic operational data such as vehicle delay, density, travel speeds, travel times, and queueing at ramp terminals on freeway networks. This software has the ability to evaluate each individual vehicle for each model time step in the simulation and then assigns the appropriate driver behavior logic according to the traffic operations that the particular vehicle encounters. The microscopic simulation model was developed for the 8-mile interstate section of the project and was based on a calibration base model for the area.

2022 Existing Conditions and Calibration

The 2022 existing AM and PM Vissim base models for the 8-mile study area of I-95 were developed based on Bing Map aerial images. In addition, Synchro was used to input existing signal timing information into the network for the arterial intersections. Each simulation was run for one hour with a ten-minute seeding time to load the network. Ten-minutes was selected as the seeding time because of the length of the network and time it takes a car to enter and exit the network.

In order to calibrate the models to simulate the field observed driving behaviors, driver behavior parameters were applied to the network at specific locations. The driver behavior parameters were used to control the interaction of vehicles through the network during the simulation models. Both the car-following and lane-change models in Vissim use an extensive range of parameters. Some of these may be adopted by the user to change basic driver behavior. Vissim uses five driving behaviors, of which three were used in the base model: Urban (motorized), Freeway (free lane selection), and Freeway Merge. In addition, lane change distances were adjusted from the default value of 656.2 feet to provide realistic lane changes, especially at intersection turn lanes and freeway merge/diverge areas. This was done iteratively on an observation-by-observation basis.

Data Collection

Travel time and speed data was obtained from INRIX. April 2019 data was analyzed for the calibration of the existing conditions Vissim model for the following segments:

- Northbound 1: From SC/GA Stateline to the Exit 5 Off-Ramp
- Northbound 2: From Exit 5 Off-Ramp to Exist 5 On-Ramp
- Northbound 3: From Exist 5 On-Ramp to Exit 8 Off-Ramp
- Northbound 4: From Exit 8 Off-Ramp to Exit 8 On-Ramp
- Southbound 1: From Exit 8 Off-Ramp to Exit 8 On-Ramp
- Southbound 2: From Exit 8 On-Ramp to Exit 5 Off-Ramp
- Southbound 3: From Exit 5 Off-Ramp to Exit 5 On-Ramp
- Southbound 4: From Exit 5 On-Ramp to SC/GA Stateline

INRIX data for these segments are provided in **Attachment A**. **Figure 1** provides a visual representation of the above travel time and speed segments.

Figure 1: 2022 I-95 Northbound and Southbound Travel Time Calibration Segments

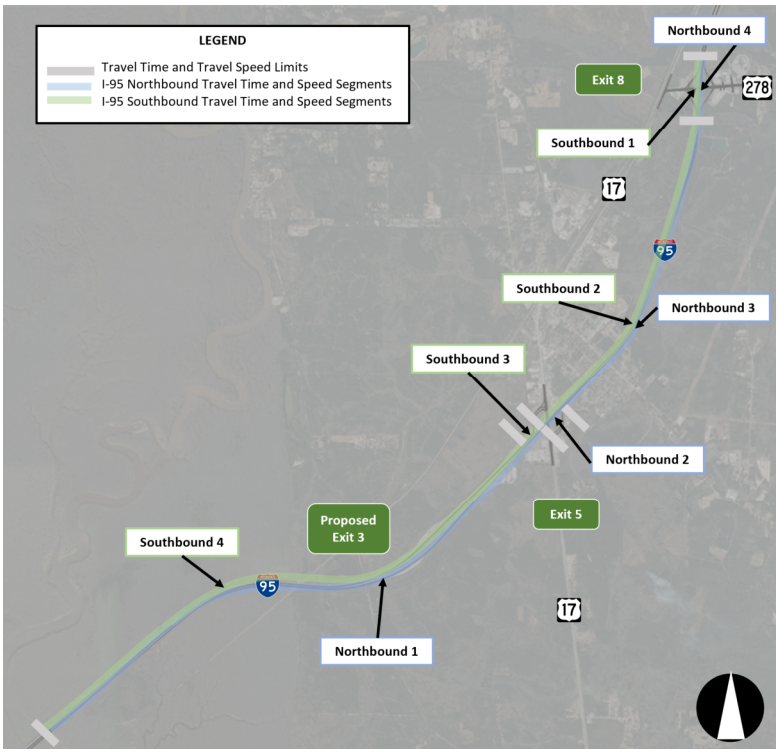


Table 1 provides the existing conditions peak hour travel times and speeds (8:00 – 9:00 AM and 5:00 – 6:00 PM) on weekdays (Monday – Thursday). The travel times and speeds were collected in fifteen-minute intervals and averaged for the VISSIM model calibration purposes.

Table 1: I-95 Project Corridor Travel Times and Travel Speeds from INRIX

INRIX Segment Identification	Segment Name	Start	End	Segment Length (miles)	Average Travel Time (mm:ss)		Average Speed (mph)	
					AM	PM	AM	PM
125P05149	Northbound 1	SC/GA Stateline	Exit 5 Off-Ramp	0.07	00:03	00:04	65	63
125+05150				5.07	04:34	05:02	61	63
125P05150	Northbound 2	Exit 5 Off-Ramp	Exit 5 On-Ramp	0.24	00:13	00:14	65	64
125+05151	Northbound 3	Exit 5 On-Ramp	Exit 8 Off-Ramp	2.57	02:20	02:24	65	65
125P05151	Northbound 4	Exit 8 Off-Ramp	Exit 8 On-Ramp	0.47	00:25	00:27	65	65
			Total	8.41	07:35	08:11		
125N05151	Southbound 1	Exit 8 Off-Ramp	Exit 8 On-Ramp	0.45	00:24	00:24	68	68
125-05150	Southbound 2	Exit 8 On-Ramp	Exit 5 Off-Ramp	2.84	02:32	02:32	67	67
125N05150	Southbound 3	Exit 5 Off-Ramp	Exit 5 On-Ramp	0.20	00:11	00:11	68	68
125-05149	Southbound 4	Exit 5 On-Ramp	SC/GA Stateline	4.81	04:15	04:14	68	68
125N05149				0.07	00:04	00:04	67	67
			Total	8.36	07:24	07:24		

Study Methodology

Model Development

This section presents the key elements for building the 2022 AM and PM peak period VISSIM models. Analysis was based on a 10-minute seeding period and one hour of simulation to capture operations during the peak periods. The VISSIM version 2020 was used for this study.

Geometry

The VISSIM model network was developed using the correctly scaled and high-resolution Bing background map that comes with the software. In addition, Google maps and existing survey were used to verify the lane geometry.

Speed Distribution

The desired speeds along the study corridor and on surface streets were developed based on posted speed limits observed from Google Earth/Streetview. Posted speed limits for the study corridor are as follows:

- I-95 Northbound: 70 mph
- I-95 Southbound: 70mph
- U.S. 278 (Exit 8): 45 mph
- I-95 On and Off-Ramps: 35 mph
- Henry Moss Boulevard: 35 mph
- U.S. 17 (at U.S. 278): 55 mph
- U.S. 17 (Exit 5): 45 mph
- I-95 Loop Off-Ramps to U.S. 17 (Exit 5): 25 mph
- I-95 On-Ramps from U.S. 17 (Exit 5): 35 mph

The desired speed distributions used as a starting point for the analysis, before calibration, are provided in **Table 2**.

Table 2: VISSIM Speed Distributions

Name	Lower Limit (mph)	Upper Limit (mph)
9 mph	8	10
15 mph	14	16
20 mph	18	23
25 mph	21	31
30 mph	25	25
35 mph	30	42
40 mph	35	44
45 mph	41	51
50 mph	46	61
55 mph	50	68
60 mph	55	75
65 mph	60	80
70 mph	65	85

Traffic Composition

The VISSIM relative flow default for a vehicle composition is 98% passenger car and 2% heavy vehicle. The traffic composition flows for vehicles entering different parts of the network were customized, based on the 2021 AM and PM peak hour traffic count data. The existing conditions vehicle composition for all vehicles entering the model network is provided in **Table 3**.

Table 3: 2022 Existing Conditions VISSIM Relative Flows

Name	AM Peak Hour		PM Peak Hour	
	Passenger Car	Heavy Vehicle	Passenger Car	Heavy Vehicle
I-95 NB	79%	21%	82%	18%
I-95 SB	76%	24%	83%	17%
U.S. 17 SB (at Exit 8)	94%	6%	91%	9%
U.S. 17 NB (at Exit 8)	93%	7%	95%	5%
U.S. 278 WB	93%	7%	93%	7%
Henry Moss SB	98%	2%	98%	2%
Henry Moss NB	98%	2%	98%	2%
U.S. 17 SB (at Exit 5)	89%	11%	93%	7%
U.S. 17 NB (at Exit 5)	76%	24%	86%	14%

Vehicle Inputs and Static Routing

The 2022 Existing Conditions VISSIM model utilizes vehicle inputs and static routing to add volume to the network. Vehicle inputs are placed on I-95 and surface street entry points to load the model network. Static routing gives the loaded volume a path to travel on. Balanced 2022 AM and PM peak hour traffic volumes, developed using the methodology outlined in the Volume Development Technical Memorandum, were utilized to determine the volume for each vehicle input and static route. The vehicle input volumes are provided in **Table 4**.

Table 4: 2022 VISSIM Vehicle Inputs

Name	AM Peak Hour Volume	PM Peak Hour Volume
I-95 SB	1,945	2,025
I-95 NB	1,900	2,650
U.S. 17 SB	230	125
U.S. 17 NB	570	230
U.S. 278 WB	650	1,415
Henry Moss SB	280	160
Henry Moss NB	175	105
U.S. 17 SB	505	585
U.S. 17 NB	695	1,080

Existing Model Calibration

This section presents the calibration criteria and process. Calibration of the 2022 Existing Conditions VISSIM microsimulation models was based on traffic volumes, travel times, and travel speeds. Raw VISSIM output can be found in **Attachment B** and **Attachment C.**

Calibration Criteria

The 2022 AM and PM peak period Vissim models were calibrated in accordance with the FHWA targets found in the *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software.*

Volume Calibration Criteria

Volume during the peak hours was calibrated for all roadway segments based on the criteria presented in **Table 5**.

Table 5: Volume Calibration Criteria

Criteria and Measures	Calibration Acceptance Targets
1. Sum of all link volumes	< 5% overall
2. Within 15%, for 700 veh/h < Flow < 2700 veh/h	> 85% of cases
3. Within 100 veh/h, for Flow < 700 veh/h	> 85% of cases
4. Within 400 veh/h, for Flow > 2700 veh/h	> 85% of cases
5. GEH Statistic < 5 for Individual Link Flows	> 85% of cases

Note: GEH Statistic is a statistical measure used to compare model output volume to observed volume and can be expressed as: $((2*(M-C)^2)/(M+C))^{1/2}$, where M is the simulation model output volume and C is the field counted volume.

Travel Time and Travel Speed Calibration Criteria

Travel time and travel speeds were calibrated for all northbound and southbound I-95 segments. FHWA guidance for calibration is to achieve travel times with a difference of 15% (or one minute, if higher) for greater than 85% of the cases. FHWA guidance for calibration of travel speeds is to "analyst's satisfaction." Travel speeds were calibrated using the same criteria as travel times, with a difference of 15%.

Volume Calibration

The models were calibrated to meet the criteria regarding volume throughput previously outlined in **Table 6.** The simulation results for the 2022 AM peak hour are shown in **Table 7**.

Table 6: 2022 AM Peak Hour Volume Calibration Results

Mainline	Location	Vissim Volume	Count Volume	% Difference	GEH Value	Individual Link Flow
I-95 NB	South of Exit 5	1,933	1,900	-2%	0.8	1.0
	I-95 Off-Ramp to Exit 5	295	280	-5%	0.9	1.1
	Between Exit 5 Ramps	1,629	1,620	-1%	0.2	1.0
	I-95 On-Ramp from Exit 5	369	355	-4%	0.7	1.0
	Between Exit 5 and Exit 8	2,001	1,975	-1%	0.6	1.0
	I-95 Off-Ramp to Exit 8	867	945	9%	2.6	0.9
	Between Exit 8 Ramps	1,029	1,030	0%	0.0	1.0
	I-95 On-Ramp from Exit 8	243	230	-5%	0.8	1.1
	North of Exit 8	1,273	1,260	-1%	0.4	1.0
I-95 SB	North of Exit 8	1,967	1,945	-1%	0.5	1.0
	I-95 Off-Ramp to Exit 8	494	495	0%	0.0	1.0
	Between Exit 8 Ramps	1,473	1,450	-2%	0.6	1.0
	I-95 On-Ramp from Exit 8	406	400	-1%	0.3	1.0
	Between Exit 8 and Exit 5	1,865	1,850	-1%	0.3	1.0
	I-95 Off-Ramp to Exit 5	232	240	3%	0.5	1.0
	Between Exit 5 Ramps	1,632	1,610	-1%	0.5	1.0
	I-95 On-Ramp from Exit 5	279	290	4%	0.7	1.0
	South of Exit 5	1,902	1,900	0%	0.0	1.0
	Total	**19,889**	**19,775**			

Table 7 shows that all five calibration criteria targets were met for the 2022 AM peak.

Table 7: 2022 AM Peak Hour Calibration Criteria

FHWA Calibration Criteria	Metric	Met?
Sum of all link flows	1%	Met
Within 15%, for 700 veh/h < Flow < 2700 veh/h	100%	Met
Within 100 veh/h, for Flow < 700 veh/h	100%	Met
Within 400 veh/h, for Flow > 2700 veh/h	100%	Met
GEH Statistic < 5 for Individual Link Flows	100%	Met

The simulation results for the 2022 PM peak hour are shown in **Table 8**.

Table 8: 2022 PM Peak Hour Volume Calibration Results

Mainline	Location	Vissim Volume	Count Volume	% Difference	GEH Value	Individual Link Flow
I-95 NB	South of Exit 5	2,694	2,650	-2%	0.9	1.0
	I-95 Off-Ramp to Exit 5	296	275	-7%	1.2	1.1
	Between Exit 5 Ramps	2,395	2,375	-1%	0.4	1.0
	I-95 On-Ramp from Exit 5	398	360	-10%	2.0	1.1
	Between Exit 5 and Exit 8	2,799	2,735	-2%	1.2	1.0
	I-95 Off-Ramp to Exit 8	508	515	1%	0.3	1.0
	Between Exit 8 Ramps	2,287	2,220	-3%	1.4	1.0
	I-95 On-Ramp from Exit 8	381	360	-6%	1.1	1.1
	North of Exit 8	2,674	2,580	-4%	1.8	1.0
I-95 SB	North of Exit 8	2,057	2,025	-2%	0.7	1.0
	I-95 Off-Ramp to Exit 8	252	245	-3%	0.4	1.0
	Between Exit 8 Ramps	1,802	1,780	-1%	0.5	1.0
	I-95 On-Ramp from Exit 8	881	890	1%	0.3	1.0
	Between Exit 8 and Exit 5	2,680	2,670	0%	0.2	1.0
	I-95 Off-Ramp to Exit 5	304	310	2%	0.3	1.0
	Between Exit 5 Ramps	2,374	2,360	-1%	0.3	1.0
	I-95 On-Ramp from Exit 5	557	540	-3%	0.7	1.0
	South of Exit 5	2,916	2,900	-1%	0.3	1.0
	Total	**28,255**	**27,790**			

Table 9 shows that all five calibration criteria targets were met for the 2022 PM peak.

Table 9: 2022 PM Peak Hour Calibration Criteria

FHWA Calibration Criteria	Metric	Met?
Sum of all link flows	2%	Met
Within 15%, for 700 veh/h < Flow < 2700 veh/h	100%	Met
Within 100 veh/h, for Flow < 700 veh/h	100%	Met
Within 400 veh/h, for Flow > 2700 veh/h	100%	Met
GEH Statistic < 5 for Individual Link Flows	100%	Met

Travel Time and Speed Calibration

Travel time and travel speeds were calibrated along I-95 using INRIX data for both northbound and southbound directions. Per Federal Highway Administration (FHWA) criteria, the threshold for observed travel times is within 15% (or within one minute) for all routes. The following sections provide graphical comparisons of the INRIX data and Vissim results for the AM and PM peak hours.

AM Peak Hour

2022 AM I-95 Northbound average travel times and travel speeds for INRIX and Vissim are presented in **Figure 2** and **Figure 3**, respectively.

Figure 2: 2022 AM I-95 Northbound Travel Time Calibration

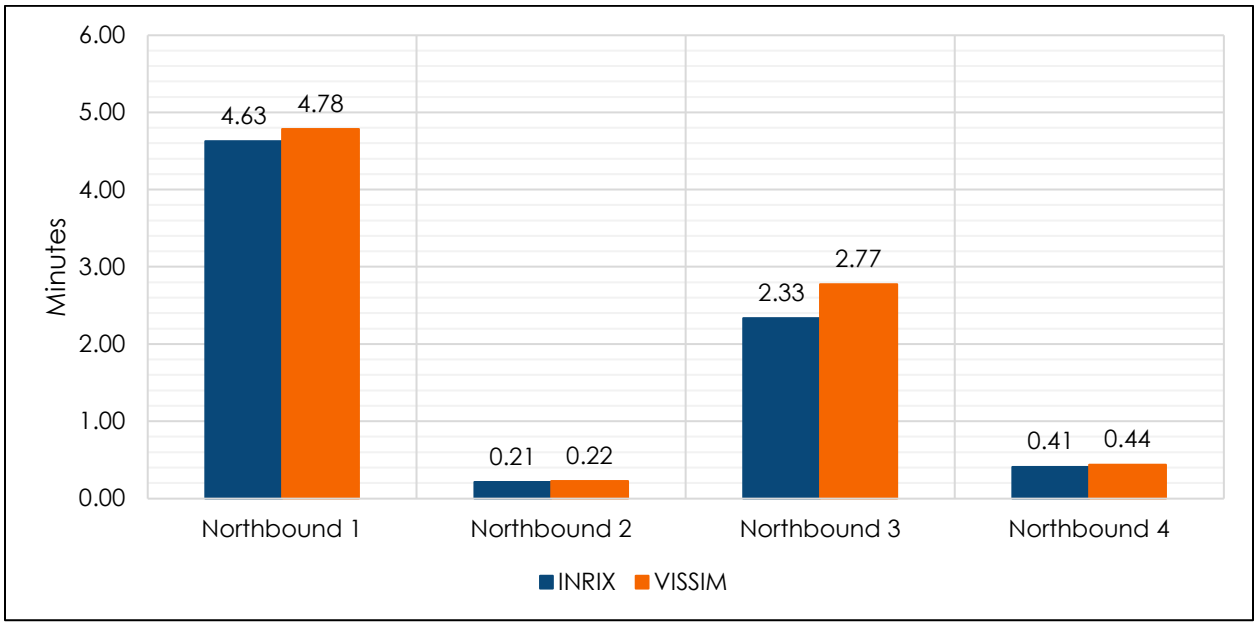
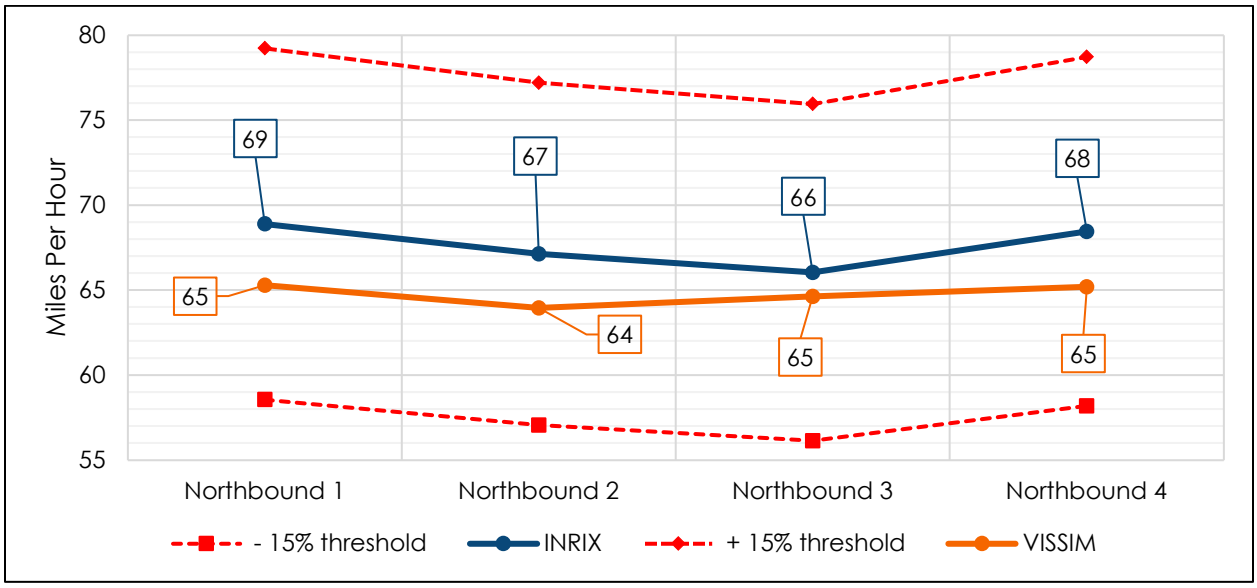


Figure 3: 2022 AM I-95 Northbound Travel Speed Calibration



2022 AM I-95 Southbound average travel times and travel speeds for INRIX and Vissim are presented in **Figure 4** and **Figure 5**, respectively.

Figure 4: 2022 AM I-95 Southbound Travel Time Calibration

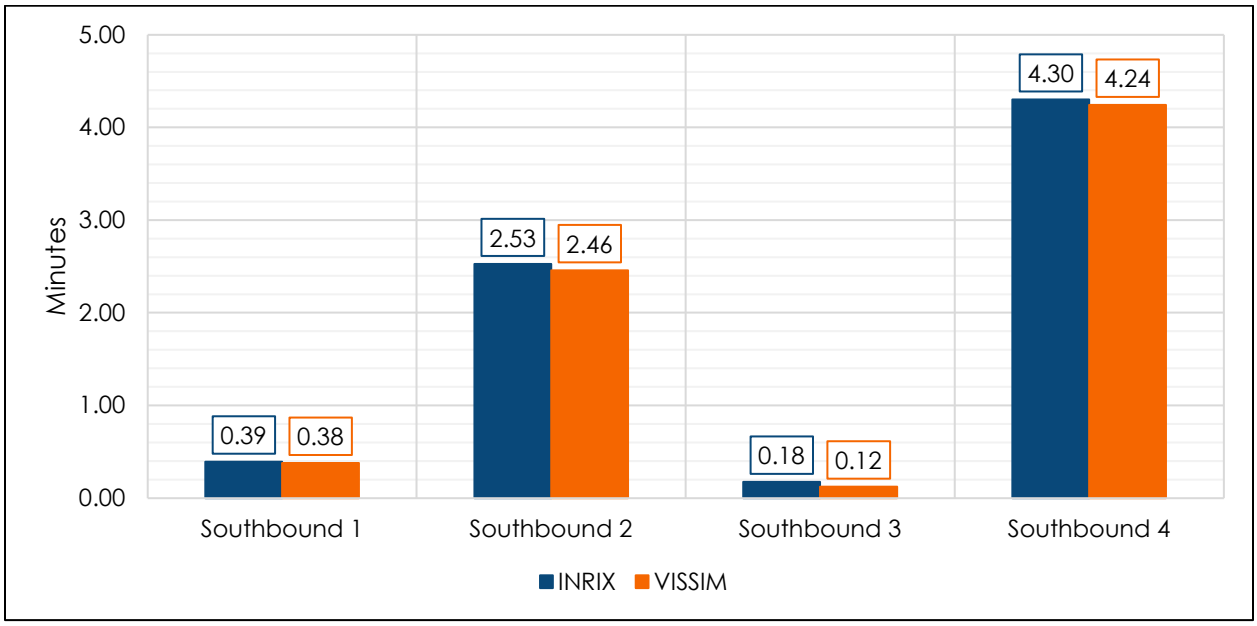
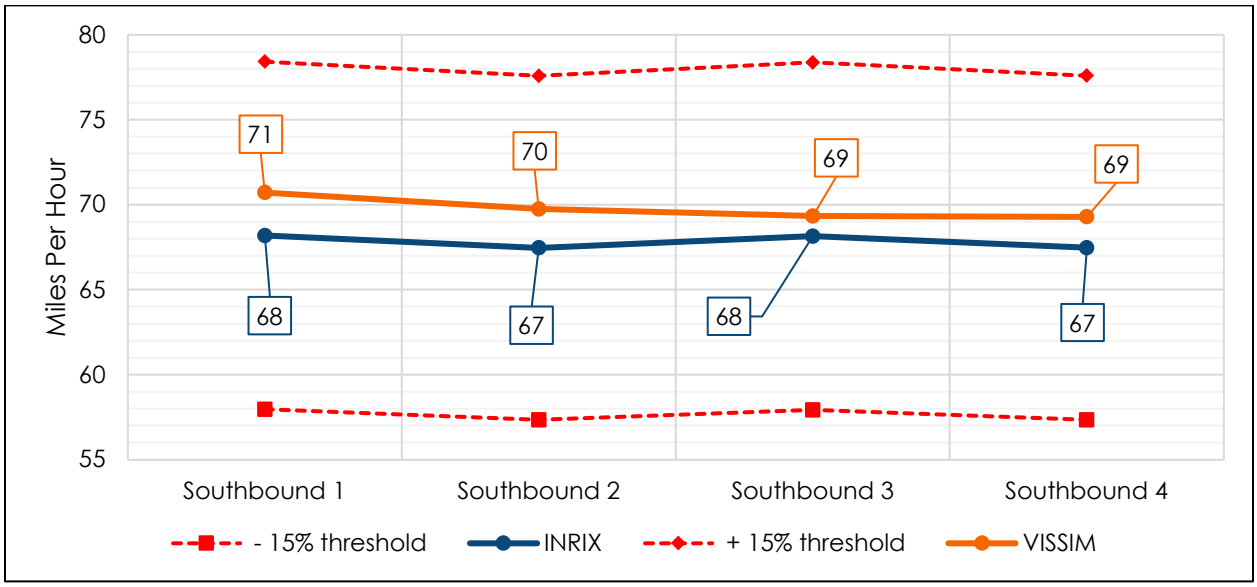


Figure 5: 2022 AM I-95 Southbound Travel Speed Calibration



PM Peak Hour

2022 PM I-95 Northbound average travel times and travel speeds for INRIX and Vissim are presented in **Figure 6** and **Figure 7**, respectively.

Figure 6: 2022 PM I-95 Northbound Travel Time Calibration

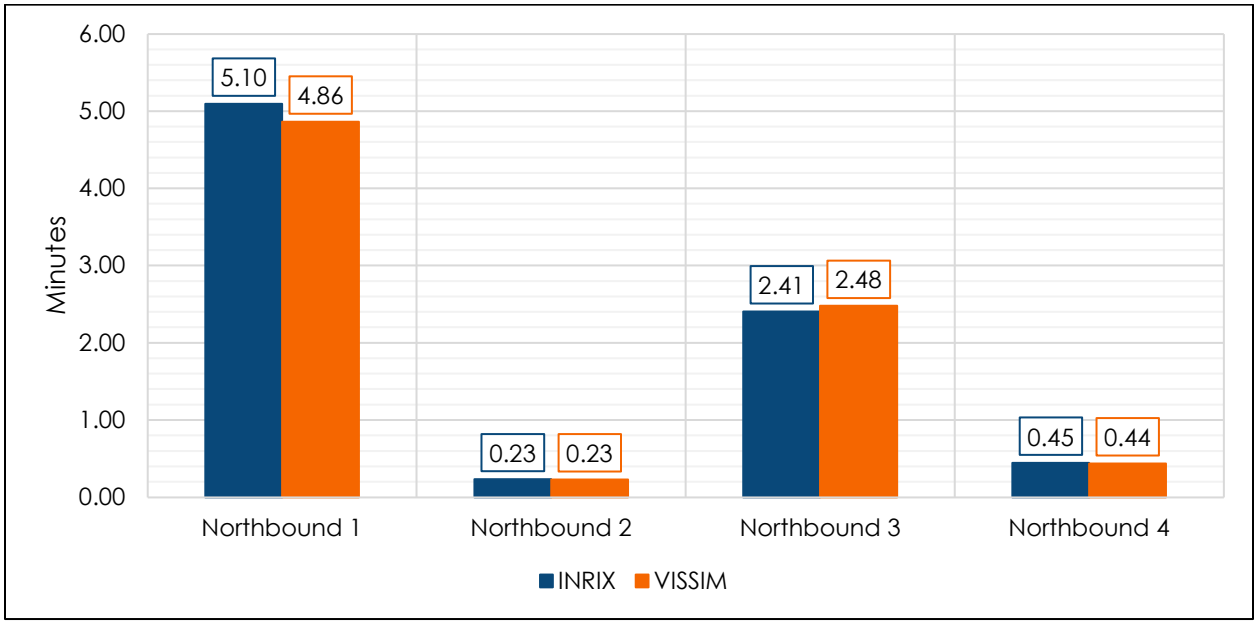
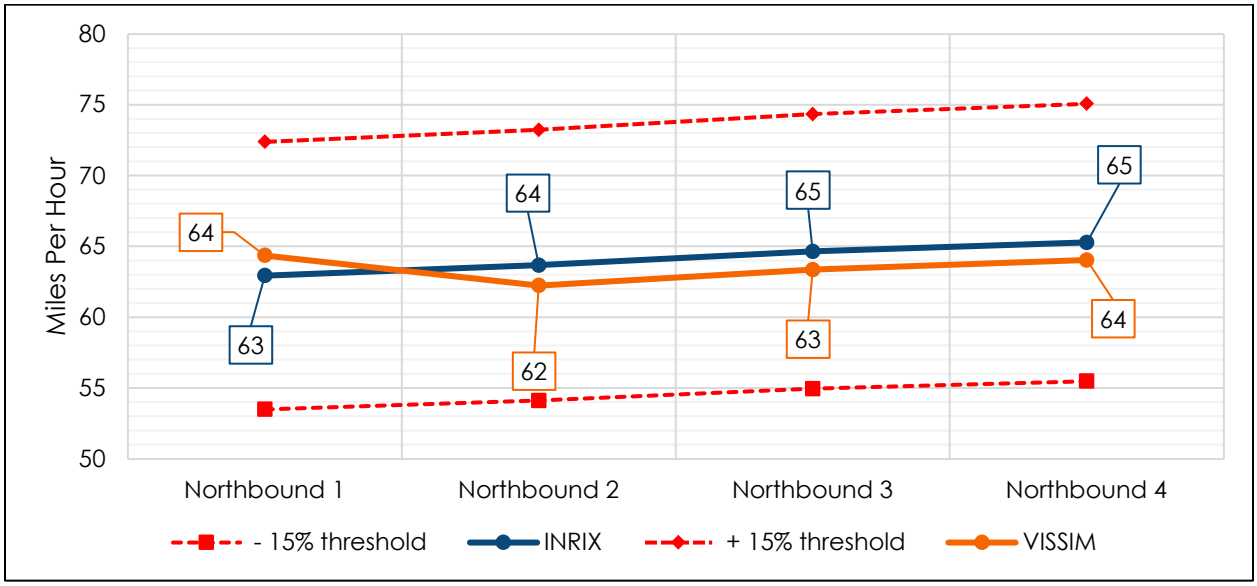


Figure 7: 2022 PM I-95 Northbound Travel Speed Calibration



2022 PM I-95 Southbound average travel times and travel speeds for INRIX and Vissim are presented in **Figure 8** and **Figure 9**, respectively.

Figure 8: 2022 PM I-95 Southbound Travel Time Calibration

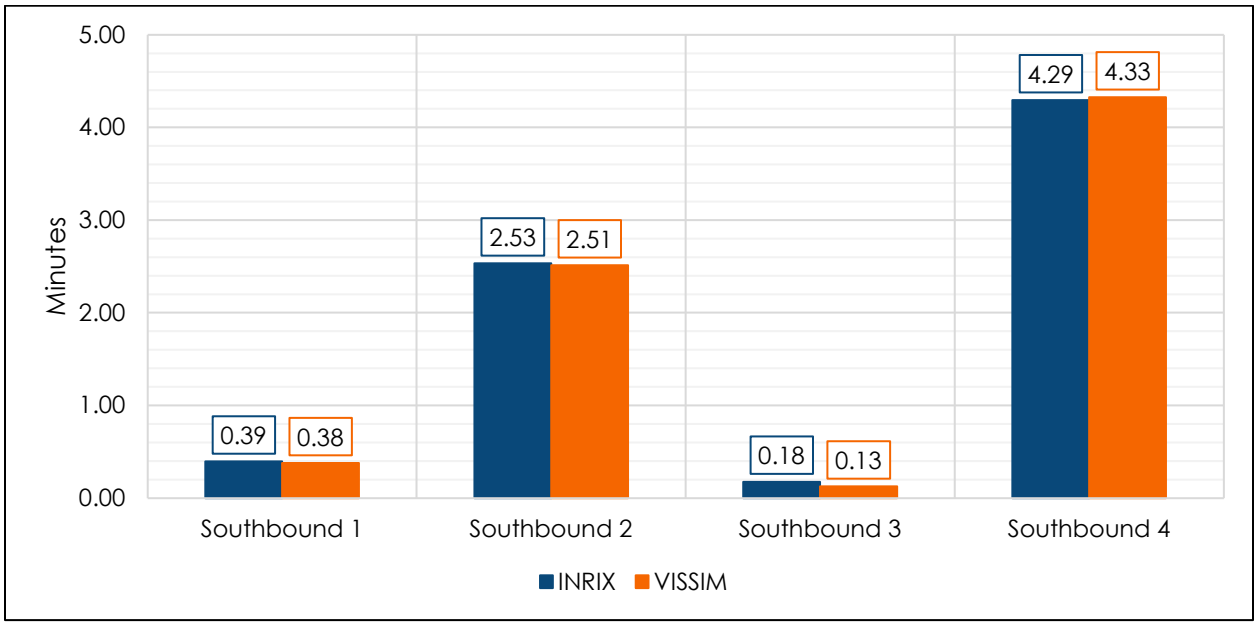
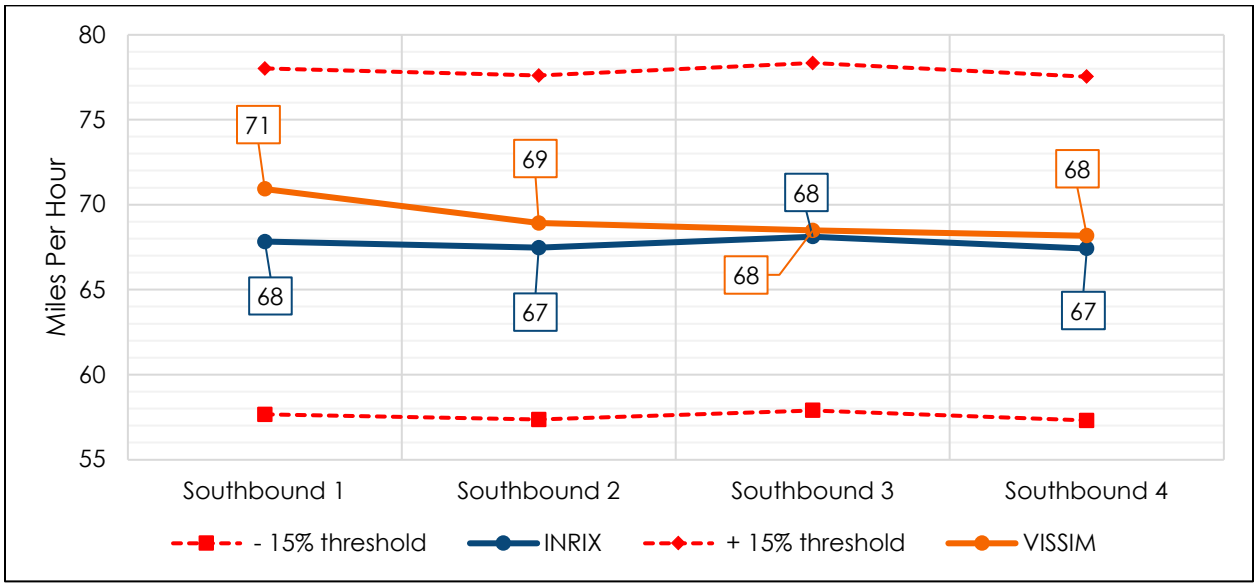


Figure 9: 2022 PM I-95 Southbound Travel Speed Calibration



A summary of the travel time and travel speed results with the differences compared to INRIX data in the 2022 AM and PM peak hours are shown in **Table 10** and **Table 11**.

Table 10: 2022 AM Peak Hour Travel Time and Travel Speed Calibration Results

Seg Name	Start	End	Average Travel Time (min)				Average Speed (mph)			
			INRX	Vissim	% Diff	FHWA Criteria	INRX	Vissim	% Diff	FHWA Criteria
Northbound 1	SC/GA Stateline	Exit 5 Off-Ramp	4:63	4:78	-3%	Met	69	65	6%	Met
Northbound 2	Exit 5 Off-Ramp	Exit 5 On-Ramp	0:21	0:22	-5%	Met	67	64	5%	Met
Northbound 3	Exit 5 On-Ramp	Exit 8 Off-Ramp	2:33	2:77	-16%	Met	66	65	2%	Met
Northbound 4	Exit 8 Off-Ramp	Exit 8 On-Ramp	0:41	0:44	-6%	Met	68	65	5%	Met
Southbound 1	Exit 8 Off-Ramp	Exit 8 On-Ramp	0:39	0:38	4%	Met	68	71	-4%	Met
Southbound 2	Exit 8 On-Ramp	Exit 5 Off-Ramp	2:53	2:46	3%	Met	67	70	-3%	Met
Southbound 3	Exit 5 Off-Ramp	Exit 5 On-Ramp	0:18	0:12	42%	Met	68	69	-2%	Met
Southbound 4	Exit 5 On-Ramp	SC/GA Stateline	4:30	4:24	1%	Met	67	69	-3%	Met

Table 11: 2022 PM Peak Hour Travel Time and Travel Speed Calibration Results

Seg Name	Start	End	Average Travel Time (min)				Average Speed (mph)			
			INRX	Vissim	% Diff	FHWA Criteria	INRX	Vissim	% Diff	FHWA Criteria
Northbound 1	SC/GA Stateline	Exit 5 Off-Ramp	5:10	4:86	5%	Met	63	64	-2%	Met
Northbound 2	Exit 5 Off-Ramp	Exit 5 On-Ramp	0:23	0:23	1%	Met	64	62	2%	Met
Northbound 3	Exit 5 On-Ramp	Exit 8 Off-Ramp	2:41	2:48	-3%	Met	65	63	2%	Met
Northbound 4	Exit 8 Off-Ramp	Exit 8 On-Ramp	0:45	0:44	2%	Met	65	64	2%	Met
Southbound 1	Exit 8 Off-Ramp	Exit 8 On-Ramp	0:39	0:38	4%	Met	68	71	-4%	Met
Southbound 2	Exit 8 On-Ramp	Exit 5 Off-Ramp	2:53	2:51	1%	Met	67	69	-2%	Met
Southbound 3	Exit 5 Off-Ramp	Exit 5 On-Ramp	0:18	0:13	40%	Met	68	68	-1%	Met
Southbound 4	Exit 5 On-Ramp	SC/GA Stateline	4:29	4:33	-1%	Met	67	68	-1%	Met

The travel time and travel speed simulation output for the 2022 AM and PM Vissim models met the calibration criteria. The only segments that fell outside of the 15% threshold were the average travel times for the Southbound segment 3 in the AM peak hour and PM peak hour. Although the percent differences fall outside of the 15% threshold, each segment satisfies the FHWA calibration requirement because the Vissim travel time is within a minute of the INRIX data.

The travel time and travel speed simulation output for the 2022 AM and PM Vissim models met all calibration criteria for volumes, travel times, and travel speeds.

Attachment A. INRIX DATA

tmc	road	direction	intersection	state	county	zip	start_latitude	start_longitude	end_latitude	end_longitude	miles
125N05151	I-95	SOUTHBOUND	US-278/EXIT 8	SC	JASPER	29927	32.31538	-81.05935	32.30893	-81.05992	0.446811
125-05150	I-95	SOUTHBOUND	US-17/EXIT 5	SC	JASPER	29927	32.30893	-81.05992	32.27304	-81.08093	2.839865
125N05150	I-95	SOUTHBOUND	US-17/EXIT 5	SC	JASPER	29927	32.27304	-81.08093	32.27097	-81.08331	0.19943
125-05149	I-95	SOUTHBOUND	SOUTH CAROLINA	SC	JASPER	29927	32.27097	-81.08331	32.23621	-81.15076	4.810031
125N05149	I-95	SOUTHBOUND	SOUTH CAROLINA	SC	JASPER	29927	32.23621	-81.15076	32.23558	-81.15161	0.066037

			Start	End
Northbound Segment 1	125P05149	NB 1	SC/GA Stateline	Exit 5 Off-Ramp
Northbound Segment 2	125+05150			
Northbound Segment 3	125P05150	NB 2	Exit 5 Off-Ramp	Exit 5 On-Ramp
Northbound Segment 4	125+05151	NB 3	Exit 5 On-Ramp	Exit 8 Off-Ramp
Northbound Segment 5	125P05151	NB 4	Exit 8 Off-Ramp	Exit 8 On-Ramp
Southbound Segment 1	125N05151	SB 1	Exit 8 Off-Ramp	Exit 8 On-Ramp
Southbound Segment 2	125-05150	SB 2	Exit 8 On-Ramp	Exit 5 Off-Ramp
Southbound Segment 3	125N05150	SB 3	Exit 5 Off-Ramp	Exit 5 On-Ramp
Southbound Segment 4	125-05149	SB 4	Exit 5 On-Ramp	SC/GA Stateline
Southbound Segment 5	125N05149			

AM Peak Hour 8:00-9:00AM
PM Peak Hour 5:00-6:00PM

Assumption: M-Th for entire month

date	Week	DOW	Time	speed	average_speed	reference_speed	travel_time_seconds	data_density
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	67.61	68	74	24.74	A
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.55	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.55	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	69.57	69	74	24.00	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	63.65	68	73	13.08	B
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.55	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.89	69	74	12.06	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	66.97	69	71	12.42	B
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.55	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	70.58	72	40	3.53	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	74.21	72	40	3.41	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	74.21	72	40	3.41	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	74.35	72	40	3.41	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	66	68	74	279.5	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.89	68	74	272.16	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.89	68	74	272.16	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	67	68	74	272.33	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.89	68	74	272.16	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	69.16	69	74	267.1	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	67.53	69	74	24.09	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.64	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	64.67	64	74	13.23	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.89	68	74	12.06	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.89	68	74	12.06	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	61.15	61	73	151.16	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	64.01	61	73	151.16	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	64.01	61	73	1420.88	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.60	51	73	138.68	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	70.65	71	40	3.53	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	70.67	71	40	3.53	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	70.67	71	40	3.53	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	69.61	71	40	3.61	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	64.55	66	76	260.67	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.89	68	74	272.16	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	68.89	68	74	272.16	C
12/05/2021 - 6/3/2568	April	Tuesday	8:00:00 AM	63.93	66	76	276.76	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	67.53	68	74	24.09	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	67.53	68	74	24.09	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	67.53	68	74	24.09	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.89	68	74	12.06	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.64	68	73	12.89	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.51	68	73	12.57	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.89	68	74	12.06	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.89	68	74	12.06	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	64.19	66	72	143.08	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	64.19	66	72	143.08	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.97	69	71	12.42	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	70.65	71	40	3.53	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	70.67	71	40	3.53	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.97	69	71	12.42	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.89	68	74	272.16	C
12/05/2021 - 6/3/2568	April	Wednesday	8:00:00 AM	68.89	68	74	272.16	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.64	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	67.53	68	74	24.09	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.89	68	74	24.06	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.89	68	74	24.06	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	69.84	68	74	24.4	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.89	68	74	24.06	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.64	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.89	68	74	12.06	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	69.51	67	73	12.48	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.64	68	72	12.89	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	67.29	67	73	12.76	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	66.97	66	72	150.05	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	66.97	66	72	150.05	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	65.64	66	72	140.68	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	64	66	72	420.94	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	68.89	68	74	12.06	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	72.24	71	40	3.61	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	71.29	71	40	3.29	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	71.29	71	40	3.29	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	67.64	67	74	260.78	C
12/05/2021 - 6/3/2568	April	Thursday	8:00:00 AM	67.53	67	74	273.05	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.89	68	74	24.06	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.89	67	74	260.78	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	69.84	69	74	24.4	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	67.64	68	74	24.37	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.89	68	74	24.06	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	64.19	66	72	143.08	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	64.19	66	72	143.08	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.64	68	72	1367.7	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.97	69	71	12.42	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.97	69	71	12.42	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.97	69	71	12.42	C
12/05/2021 - 6/3/2568	April	Monday	8:00:00 AM	68.89	68	74	24.06

base	Month	DOW	Time	speed	average_speed	reference_speed	travel_time_seconds	data_density
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.61	68	74	24.66	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.61	68	74	24.66	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.51	68	74	24.33	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.51	68	74	24.33	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	66.97	68	73	12.82	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	66.97	68	73	12.82	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.57	68	73	12.89	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.18	68	71	13.27	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.18	68	71	13.27	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	63.99	67	72	4.429	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	64.64	67	72	163	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	64.64	67	72	163	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.51	67	80	3.04	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	69.02	67	80	5.58	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.88	67	80	5.4	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.88	67	80	5.4	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.99	65	76	272.41	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.99	65	76	272.41	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.89	65	76	276.91	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.66	65	76	277.91	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.66	65	76	277.91	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.61	65	76	273.99	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	63.99	64	76	276.54	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	63.99	64	76	276.54	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.27	68	74	24.59	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.27	68	74	24.59	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	67.63	68	74	24.83	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	64.62	68	71	13.28	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	64.62	68	71	13.28	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.84	64	73	12.57	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	67.65	64	73	158.65	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.66	63	72	158.77	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.66	63	72	158.77	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.51	63	73	159.4	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	67.61	63	80	3.47	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.96	63	80	3.4	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.96	63	80	3.4	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	70.61	63	80	3.19	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	67.99	64	76	268.4	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	67.99	64	76	268.4	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	68.61	64	76	270.84	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	63.99	64	76	276.54	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	63.99	64	76	276.54	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	68.64	67	74	24.48	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	68.29	67	74	24.58	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	68.29	67	74	24.58	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.84	67	73	13.06	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.97	67	73	12.83	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.97	67	73	12.83	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	69.65	67	75	12.72	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67	69	72	157.97	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67.13	69	72	158.03	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.97	69	72	158.08	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67.13	69	72	157.26	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67.13	69	72	157.26	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.53	71	80	3.48	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	72.61	71	80	3.23	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	72.61	71	80	3.23	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.55	65	76	270.14	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	65.51	65	76	276.62	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	65.51	65	76	276.62	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	65.66	65	76	272.75	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	67.96	68	74	24.7	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	67.96	68	74	24.7	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.87	68	74	22.81	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	66.51	68	74	25.32	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	65.53	68	73	13.42	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	65.53	68	73	13.42	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.97	68	74	14.06	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	63.62	68	71	13.48	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.66	67	72	164.75	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.66	67	72	164.75	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	67.61	67	72	158.14	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.31	67	72	164.49	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.31	67	72	164.49	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	70.63	69	80	3.53	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.64	69	80	3.27	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.64	69	80	3.27	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	64.68	65	76	262.24	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	66.33	65	76	270.12	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	66.33	65	76	270.12	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.51	65	76	280.35	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.66	68	74	24.81	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.66	68	74	24.81	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.51	68	74	23.97	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.51	68	74	23.97	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.64	68	74	24.48	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.49	68	71	13.31	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.49	68	71	13.31	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	67.61	68	73	12.98	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.66	67	73	160.77	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	69.55	67	73	160.88	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	69.55	67	73	160.88	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.51	67	72	158.99	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.86	67	80	3.4	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.99	67	80	3.4	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.99	67	80	3.4	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.51	67	80	3.19	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.65	65	76	277.96	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.65	65	76	277.96	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.51	65	76	274.4	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	64.65	65	76	282.26	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	64.65	65	76	282.26	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.69	68	74	24.5	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.59	68	74	24.35	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.59	68	74	24.35	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.33	68	74	24.44	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	63.33	68	71	13.14	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	63.33	68	71	13.14	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	64.61	68	73	13.29	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.26	68	72	159.43	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.26	68	72	159.43	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.65	68	72	160.93	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.62	68	72	160.82	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.62	68	72	160.82	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	72.16	68	80	3.33	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.91	68	80	3.4	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.91	68	80	3.4	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	64.24	64	76	264.08	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.97	64	76	276.62	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.97	64	76	276.62	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	63.99	64	76	276.54	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	63.99	64	76	276.54	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.66	67	74	24.66	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.66	67	74	24.66	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	68.88	67	74	24.37	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	69.27	67	74	24.23	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	69.51	67	74	24.15	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.84	67	73	12.97	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	66.59	67	73	12.99	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	66.65	67	73	12.98	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.66	66	72	158.66	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.66	66	72	158.66	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67.65	66	72	158.43	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.34	66	72	159.46	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.34	66	72	159.46	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	69.23	71	80	3.04	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	73.29	71	80	3.2	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	73.29	71	80	3.2	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.51	65	76	272.15	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66	65	76	274.5	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.51	65	76	272.15	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	63.99	65	76	278.78	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	63.99	65	76	278.78	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	68.38	68	74	24.76	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	68.38	68	74	25.29	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	68.38	68	74	25.29	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	63.61	68	71	13.31	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	66.11	68	73	12.91	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	66.11	68	73	12.91	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	67.13	67	72	162.31	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	67.58	67	72	160.73	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	67.58	67	72	160.73	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	65.64	67	73	163.68	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	67.31	69	80	3.48	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	72.67	69	80	3.17	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	72.67	69	80	3.17	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	64.58	68	74	24.7	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	67	68	73	159.85	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	66.85	65	76	274.32	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	66.85	65	76	274.32	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	65.51	65	76	279.42	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	65.51	65	76	279.42	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.61	68	74	24.66	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.61	68	74	24.66	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.51	68	74	24.33	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.51	68	74	24.33	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	66.97	68	73	12.82	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	66.97	68	73	12.82	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.57	68	73	12.89	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.18	68	71	13.27	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.18	68	71	13.27	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	63.99	67	72	4.429	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	64.64	67	72	163	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	64.64	67	72	163	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	70.51	67	80	3.04	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	69.02	67	80	5.58	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	68.88	67	80	5.4	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	68.88	67	80	5.4	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.99	65	76	272.41	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.99	65	76	272.41	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.89	65	76	276.91	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.66	65	76	277.91	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.66	65	76	277.91	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.61	65	76	273.99	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	63.99	64	76	276.54	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	63.99	64	76	276.54	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.27	68	74	24.59	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.27	68	74	24.59	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	67.63	68	74	24.83	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	64.62	68	71	13.28	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	64.62	68	71	13.28	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.84	64	73	12.57	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	67.65	64	73	158.65	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.66	63	72	158.77	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.66	63	72	158.77	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.51	63	73	159.4	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	67.61	63	80	3.47	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.96	63	80	3.4	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.96	63	80	3.4	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	70.61	63	80	3.19	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	67.99	64	76	268.4	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	67.99	64	76	268.4	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	68.61	64	76	270.84	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	63.99	64	76	276.54	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	63.99	64	76	276.54	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	68.64	67	74	24.48	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	68.29	67	74	24.58	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	68.29	67	74	24.58	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.84	67	73	13.06	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.97	67	73	12.83	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.97	67	73	12.83	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	69.65	67	75	12.72	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67	69	72	157.97	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67.13	69	72	158.03	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.97	69	72	158.08	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67.13	69	72	157.26	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	67.13	69	72	157.26	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	67.53	71	80	3.48	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	72.61	71	80	3.23	C
1200916161 - 4/3/2048	April	Wednesday	5:45:00 PM	72.61	71	80	3.23	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	66.55	65	76	270.14	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	65.51	65	76	276.62	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	65.51	65	76	276.62	C
120-05181 - 4/3/2048	April	Wednesday	5:45:00 PM	65.66	65	76	272.75	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	67.96	68	74	24.7	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	67.96	68	74	24.7	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.87	68	74	22.81	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	66.51	68	74	25.32	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	65.53	68	73	13.42	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	65.53	68	73	13.42	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.97	68	74	14.06	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	63.62	68	71	13.48	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.66	67	72	164.75	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.66	67	72	164.75	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	67.61	67	72	158.14	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.31	67	72	164.49	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.31	67	72	164.49	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	70.63	69	80	3.53	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.64	69	80	3.27	C
1200916161 - 4/3/2048	April	Thursday	5:45:00 PM	73.64	69	80	3.27	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	64.68	65	76	262.24	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	66.33	65	76	270.12	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	66.33	65	76	270.12	C
120-05181 - 4/3/2048	April	Thursday	5:45:00 PM	63.51	65	76	280.35	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.66	68	74	24.81	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	67.66	68	74	24.81	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.51	68	74	23.97	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.51	68	74	23.97	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	68.64	68	74	24.48	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.49	68	71	13.31	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	65.49	68	71	13.31	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	67.61	68	73	12.98	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.66	67	73	160.77	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	69.55	67	73	160.88	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	69.55	67	73	160.88	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.51	67	72	158.99	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.86	67	80	3.4	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.99	67	80	3.4	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.99	67	80	3.4	C
1200916161 - 4/3/2048	April	Monday	5:45:00 PM	70.51	67	80	3.19	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.65	65	76	277.96	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	65.65	65	76	277.96	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	66.51	65	76	274.4	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	64.65	65	76	282.26	C
120-05181 - 4/3/2048	April	Monday	5:45:00 PM	64.65	65	76	282.26	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.69	68	74	24.5	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.59	68	74	24.35	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.59	68	74	24.35	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	68.33	68	74	24.44	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	63.33	68	71	13.14	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	63.33	68	71	13.14	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	64.61	68	73	13.29	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.26	68	72	159.43	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	66.26	68	72	159.43	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.65	68	72	160.93	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.62	68	72	160.82	C
120-05181 - 4/3/2048	April	Tuesday	5:45:00 PM	65.62	68	72	160.82	C
1200916161 - 4/3/2048	April	Tuesday	5:45:00 PM	72.16	68	80	3.33	C

Attachment B. 2022 AM Peak Hour Raw VISSIM Output

$VISION

SIMRUN	TIMEINT	DataCollectionMeasurement	VEHS(ALL)	SPEEDAVGARITH(ALL)
Average	1800-5400	1	1933	65.28683
Average	1800-5400	3	295	26.086725
Average	1800-5400	4	1629	63.954148
Average	1800-5400	6	369	35.090776
Average	1800-5400	7	2001	64.631544
Average	1800-5400	9	867	24.624194
Average	1800-5400	10	1029	65.197736
Average	1800-5400	12	243	35.412454
Average	1800-5400	13	1273	65.255463
Average	1800-5400	15	1967	71.290235
Average	1800-5400	17	494	45.565391
Average	1800-5400	18	1473	70.727835
Average	1800-5400	20	406	33.80578
Average	1800-5400	21	1865	69.74546
Average	1800-5400	23	232	27.482803
Average	1800-5400	24	1632	69.332332
Average	1800-5400	26	279	35.239272
Average	1800-5400	27	1902	69.289242

$VISION

SIMRUN	TIMEINT	TRAVEL TIME SEG#	SEGMENT DESCRIPTION	VEHS(ALL)	TRAVTM(ALL)	DISTTRAV(ALL)
Average	1800-5400	1	Northbound 1	1627	286.983114	27113.47035
Average	1800-5400	2	Northbound 2	1627	13.455903	1259.143338
Average	1800-5400	3	Northbound 3	1031	166.478073	13584.19902
Average	1800-5400	4	Northbound 4	1028	26.201664	2448.447284
Average	1800-5400	5	Southbound 1	1471	22.785016	2345.614344
Average	1800-5400	6	Southbound 2	1462	147.54338	14997.69445
Average	1800-5400	7	Southbound 3	1633	7.439199	754.337799
Average	1800-5400	8	Southbound 4	1626	254.638009	25788.10002

Intersectio	Intersection	Movement	UniqueID	SIMRUN	MOVEMENT	From Link	To Link	QLEN	QLENMAX	VEHS(ALL)	VEHDELAY(ALL)		LOS Calc		
1	US 278 at US 17	WBR	1WBR	Average	1: US 278 at US 17 - 25: 278- WB@21.4 - 96: US 17 NB@29.7	25: 278- WB	96: US 17 NB	20.12609	166.8079	39	1.851875		A	0.036827	unisg
1	US 278 at US 18	WBL	1WBL	Average	1: US 278 at US 17 - 25: 278- WB@21.4 - 701: US 17 SB@129.2	25: 278- WB	701: US 17 SB	20.18162	164.4771	224	12.424792		B	0.21152	
1	US 278 at US 19	SBT	1SBT	Average	1: US 278 at US 17 - 34: US 17 SB@604.5 - 701: US 17 SB@129.2	34: US 17 SB	701: US 17 SB	0	0	95	0.939638		A	0.089707	
1	US 278 at US 20	SBL	1SBL	Average	1: US 278 at US 17 - 36: Wyte Hardee Blvd SB@99.7 - 23: 278- EB@20.5	36: Wyte Hardee Blvd SB	23: 278- EB	0.13854	41.49685	140	0.853611		A	0.1322	
1	US 278 at US 21	NBR	1NBR	Average	1: US 278 at US 17 - 97: US 17 NB@164.9 - 23: 278- EB@20.5	97: US 17 NB	23: 278- EB	0	0	477	0.864738		A	0.450425	
1	US 278 at US 22	NBT	1NBT	Average	1: US 278 at US 17 - 97: US 17 NB@164.9 - 96: US 17 NB@29.7	97: US 17 NB	96: US 17 NB	0	0	84	2.500653		A	0.07932	
1	**I-95 SB at US 278**	**TOTAL**	**1TOTAL**	**Average**	**1: US 278 at US 17**			**8.089251**	**166.8079**	**1059**	**3.492612**	**3.481287**	**A**	**1**	
2	US 278 at I-95 SB Ramps	SBL	2SBL	Average	2: US 278 at I-95 SB Ramps - 5: Exit 8 SB Off Ramp@115.2 - 28: 278- EB@16.7	5: Exit 8 SB Off Ramp	28: 278- EB	40.6432	218.4032	412	25.591141		C	0.236646	sig
2	US 278 at I-95 SB Ramps	SBR	2SBR	Average	2: US 278 at I-95 SB Ramps - 6: Exit 8 SB Off Ramp@166.6 - 21: 278- WB@151.1	6: Exit 8 SB Off Ramp	21: 278- WB	0.090756	31.58002	84	1.341626		A	0.048248	
2	US 278 at I-95 SB Ramps	WBT	2WBT	Average	2: US 278 at I-95 SB Ramps - 26: 278- WB@871.3 - 21: 278- WB@151.1	26: 278- WB	21: 278- WB	3.799254	90.78609	208	7.432907		A	0.119472	
2	US 278 at I-95 SB Ramps	WBL	2WBL	Average	2: US 278 at I-95 SB Ramps - 27: 278- WB@396.0 - 12: Exit 8 SB On-Ramp@52.1	27: 278- WB	12: Exit 8 SB On-Ramp	27.59227	332.4169	368	15.923586		B	0.211373	
2	US 278 at I-95 SB Ramps	EBR	2EBR	Average	2: US 278 at I-95 SB Ramps - 686: 278- EB@251.9 - 9: Exit 8 SB On-Ramp@60.2	686: 278- EB	9: Exit 8 SB On-Ramp	0.42934	64.1432	37	0.709567		A	0.021252	
2	US 278 at I-95 SB Ramps	EBT	2EBT	Average	2: US 278 at I-95 SB Ramps - 686: 278- EB@251.9 - 28: 278- EB@16.7	686: 278- EB	28: 278- EB	40.55209	219.5421	633	22.086716		C	0.363584	
2	**US 278 at I-95 SB Ramps**	**TOTAL**	**2TOTAL**	**Average**	**2: US 278 at I-95 SB Ramps**			**18.85115**	**335.3791**	**1741**	**18.41833**	**18.42006**	**B**	**1**	
3	US 278 at I-95 NB Ramps	NBL	3NBL	Average	3: US 278 at I-95 NB Ramps - 11: Exit 8 NB Off-Ramp@155.8 - 26: 278- WB@26.7	11: Exit 8 NB Off-Ramp	26: 278- WB	0.002193	16.3421	4	10.067776		B	0.001512	unisg
3	US 278 at I-95 NB Ramps	EBT	3EBT	Average	3: US 278 at I-95 NB Ramps - 28: 278- EB@858.9 - 32: 278- EB@35.4	28: 278- EB	32: 278- EB	0.796251	83.31762	1003	9.129792		A	0.379063	
3	US 278 at I-95 NB Ramps	EBL	3EBL	Average	3: US 278 at I-95 NB Ramps - 29: 278- EB@290.2 - 8: Exit 8 NB On-Ramp@72.1	29: 278- EB	8: Exit 8 NB On-Ramp	0.794471	42.72284	39	4.358074		A	0.014739	
3	US 278 at I-95 NB Ramps	NBR	3NBR	Average	3: US 278 at I-95 NB Ramps - 684: Exit 8 NB Off-Ramp@191.9 - 32: 278- EB@35.4	684: Exit 8 NB Off-Ramp	32: 278- EB	785.2455	1673.888	825	32.713396		D	0.311791	
3	US 278 at I-95 NB Ramps	WBR	3WBR	Average	3: US 278 at I-95 NB Ramps - 711: 278- WB@255.6 - 7: Exit 8 NB On-Ramp@70.4	711: 278- WB	7: Exit 8 NB On-Ramp	1.499364	123.832	204	2.266433		A	0.077098	
3	US 278 at I-95 NB Ramps	WBT	3WBT	Average	3: US 278 at I-95 NB Ramps - 711: 278- WB@255.6 - 26: 278- WB@26.7	711: 278- WB	26: 278- WB	1.499364	123.832	571	1.504115		A	0.215797	
3	**US 278 at I-95 NB Ramps**	**TOTAL**	**3TOTAL**	**Average**	**3: US 278 at I-95 NB Ramps**			**157.6676**	**1673.888**	**2646**	**14.156029**	**14.23929**	**B**	**1**	
4	US 278 at Henry Moss Blvd	WBT	4WBT	Average	4: US 278 at Henry Moss Blvd - 86: 278- WB@289.5 - 31: 278- WB@79.5	86: 278- WB	31: 278- WB	43.01894	241.767	568	23.225616		C	0.198601	sig
4	US 278 at Henry Moss Blvd	WBL	4WBL	Average	4: US 278 at Henry Moss Blvd - 86: 278- WB@289.5 - 89: Henry Moss Blvd@117.2	86: 278- WB	89: Henry Moss Blvd	43.01894	241.767	36	34.692592		C	0.012587	
4	US 278 at Henry Moss Blvd	WBR	4WBR	Average	4: US 278 at Henry Moss Blvd - 86: 278- WB@289.5 - 91: Henry Moss Blvd@84.0	86: 278- WB	91: Henry Moss Blvd	52.17128	267.5541	64	16.83423		B	0.022378	
4	US 278 at Henry Moss Blvd	NBL	4NBL	Average	4: US 278 at Henry Moss Blvd - 93: Henry Moss Blvd@13.2 - 31: 278- WB@79.5	93: Henry Moss Blvd	31: 278- WB	11.71391	95.04456	58	31.203123		C	0.02028	
4	US 278 at Henry Moss Blvd	NBR	4NBR	Average	4: US 278 at Henry Moss Blvd - 93: Henry Moss Blvd@13.2 - 33: 278- EB@126.8	93: Henry Moss Blvd	33: 278- EB	11.47474	101.9586	91	13.237184		B	0.031818	
4	US 278 at Henry Moss Blvd	NBT	4NBT	Average	4: US 278 at Henry Moss Blvd - 93: Henry Moss Blvd@13.2 - 91: Henry Moss Blvd@84.0	93: Henry Moss Blvd	91: Henry Moss Blvd	11.71391	95.04456	15	30.903961		C	0.005245	
4	US 278 at Henry Moss Blvd	SBR	4SBR	Average	4: US 278 at Henry Moss Blvd - 94: Henry Moss Blvd@140.7 - 31: 278- WB@79.5	94: Henry Moss Blvd	31: 278- WB	309.7058	441.4252	149	169.185943		F	0.052098	
4	US 278 at Henry Moss Blvd	SBL	4SBL	Average	4: US 278 at Henry Moss Blvd - 94: Henry Moss Blvd@140.7 - 33: 278- EB@126.8	94: Henry Moss Blvd	33: 278- EB	295.7377	427.031	84	179.989552		F	0.029371	
4	US 278 at Henry Moss Blvd	SBT	4SBT	Average	4: US 278 at Henry Moss Blvd - 94: Henry Moss Blvd@140.7 - 89: Henry Moss Blvd@117.2	94: Henry Moss Blvd	89: Henry Moss Blvd	295.7377	427.031	25	191.82422		F	0.008741	
4	US 278 at Henry Moss Blvd	EBT	4EBT	Average	4: US 278 at Henry Moss Blvd - 95: 278- EB@137.5 - 33: 278- EB@126.8	95: 278- EB	33: 278- EB	566.1114	921.5025	1376	67.153403		E	0.481119	
4	US 278 at Henry Moss Blvd	EBR	4EBR	Average	4: US 278 at Henry Moss Blvd - 95: 278- EB@137.5 - 89: Henry Moss Blvd@117.2	95: 278- EB	89: Henry Moss Blvd	593.5438	949.8912	132	66.651926		E	0.046154	
4	US 278 at Henry Moss Blvd	EBL	4EBL	Average	4: US 278 at Henry Moss Blvd - 95: 278- EB@137.5 - 91: Henry Moss Blvd@84.0	95: 278- EB	91: Henry Moss Blvd	566.1114	921.5025	263	63.626512		E	0.091958	
4	**US 278 at Henry Moss Blvd**	**TOTAL**	**4TOTAL**	**Average**	**4: US 278 at Henry Moss Blvd**			**235.4347**	**949.8912**	**2860**	**63.525121**	**63.6555**	**E**	**1**	

DELAYAVG(ALL)	STOPSAVG(ALL)	SPEEDAVG(ALL)	DISTTOT(ALL)	TRAVTMTOT(ALL)	VEHACT(ALL)	VEHARR(ALL)	DELAYLATENT	DEMANDLATENT
563,182.51	6.29	51.88	38,672.15	2,695,445.68	883.00	6,789.00	35,654.66	20.60

82.95514898

Attachment C. 2022 PM Peak Hour Raw VISSIM Output

SIMRUN	TIMEINT	DataCollectionMeasurement	VEHS(ALL)	SPEEDAVGARITH(ALL)
Average	1800-5400	1	2694	64.363221
Average	1800-5400	3	296	26.193194
Average	1800-5400	4	2395	62.241338
Average	1800-5400	6	398	35.040917
Average	1800-5400	7	2799	63.353228
Average	1800-5400	9	508	34.476925
Average	1800-5400	10	2287	64.040145
Average	1800-5400	12	381	35.393887
Average	1800-5400	13	2674	61.562026
Average	1800-5400	15	2057	71.290912
Average	1800-5400	17	252	47.270852
Average	1800-5400	18	1802	70.932297
Average	1800-5400	20	881	32.770194
Average	1800-5400	21	2680	68.92811
Average	1800-5400	23	304	27.44354
Average	1800-5400	24	2374	68.480055
Average	1800-5400	26	557	34.446831
Average	1800-5400	27	2916	68.182804

$VISION

SIMRUN	TIMEINT	TRAVEL TIME SEG#	SEGMENT DESCRIPTION	VEHS(ALL)	TRAVTM(ALL)	DISTTRAV(ALL)
Average	1800-5400	1	Northbound 1	2396	291.85768	27113.47035
Average	1800-5400	2	Northbound 2	2392	13.822149	1259.143338
Average	1800-5400	3	Northbound 3	2289	148.678779	13584.19902
Average	1800-5400	4	Northbound 4	2291	26.29951	2448.447284
Average	1800-5400	5	Southbound 1	1802	22.641673	2345.614344
Average	1800-5400	6	Southbound 2	1793	150.740677	14997.69445
Average	1800-5400	7	Southbound 3	2372	7.525916	754.337799
Average	1800-5400	8	Southbound 4	2368	259.517741	25788.10002

Intersectio	Intersection	Movement	UniqueID	SIMRUN	MOVEMENT	From Link	To Link	QLEN	QLENMAX	VEHS(ALL)	VEHDELAY(ALL)		LOS Calc	
1	US 278 at US 17	WBR	1WBR	Average	1: US 278 at US 17 - 25: 278- WB@21.4 - 96: US 17 NB@29.7	25: 278- WB	96: US 17 NB	17.8117	162.6	122	2.08552		A	0.176301 unisg
1	US 278 at US 18	WBL	1WBL	Average	1: US 278 at US 17 - 25: 278- WB@21.4 - 701: US 17 SB@129.2	25: 278- WB	701: US 17 SB	17.97587	160.2691	217	11.50427		B	0.313584
1	US 278 at US 19	SBT	1SBT	Average	1: US 278 at US 17 - 34: US 17 SB@604.5 - 701: US 17 SB@129.2	34: US 17 SB	701: US 17 SB	0	0	67	0.692709		A	0.096821
1	US 278 at US 20	SBL	1SBL	Average	1: US 278 at US 17 - 36: Wyte Hardee Blvd SB@99.7 - 23: 278- EB@20.5	36: Wyte Hardee Blvd SB	23: 278- EB	0.025847	16.01283	59	0.573095		A	0.08526
1	US 278 at US 21	NBR	1NBR	Average	1: US 278 at US 17 - 97: US 17 NB@168.8 - 23: 278- EB@15.8	97: US 17 NB	23: 278- EB	0	0	127	0.348308		A	0.183526
1	US 278 at US 22	NBT	1NBT	Average	1: US 278 at US 17 - 97: US 17 NB@168.8 - 96: US 17 NB@35.8	97: US 17 NB	96: US 17 NB	0	0	100	1.223832		A	0.144509
1	**I-95 SB at US 278**	**TOTAL**	**1TOTAL**	**Average**	**1: US 278 at US 17**			**7.162682**	**162.6**	**692**	**4.354442**	**4.33194**	**A**	**1**
2	US 278 at I-95 SB Ramps	SBL	2SBL	Average	2: US 278 at I-95 SB Ramps - 5: Exit 8 SB Off Ramp@115.2 - 28: 278- EB@16.7	5: Exit 8 SB Off Ramp	28: 278- EB	26.45871	128.4866	195	33.400911		C	0.11518 sig
2	US 278 at I-95 SB Ramps	SBR	2SBR	Average	2: US 278 at I-95 SB Ramps - 6: Exit 8 SB Off Ramp@166.6 - 21: 278- WB@151.1	6: Exit 8 SB Off Ramp	21: 278- WB	0.146546	42.733	58	1.452427		A	0.034259
2	US 278 at I-95 SB Ramps	WBT	2WBT	Average	2: US 278 at I-95 SB Ramps - 26: 278- WB@871.3 - 21: 278- WB@151.1	26: 278- WB	21: 278- WB	4.620029	102.6263	363	5.28206		A	0.214412
2	US 278 at I-95 SB Ramps	WBL	2WBL	Average	2: US 278 at I-95 SB Ramps - 27: 278- WB@396.0 - 12: Exit 8 SB On-Ramp@52.1	27: 278- WB	12: Exit 8 SB On-Ramp	62.51678	580.5812	816	12.825302		B	0.481985
2	US 278 at I-95 SB Ramps	EBR	2EBR	Average	2: US 278 at I-95 SB Ramps - 686: 278- EB@251.9 - 9: Exit 8 SB On-Ramp@60.2	686: 278- EB	9: Exit 8 SB On-Ramp	0.019755	7.277684	60	0.249541		A	0.03544
2	US 278 at I-95 SB Ramps	EBT	2EBT	Average	2: US 278 at I-95 SB Ramps - 686: 278- EB@251.9 - 28: 278- EB@16.7	686: 278- EB	28: 278- EB	18.66485	125.6019	201	29.40168		C	0.118724
2	**US 278 at I-95 SB Ramps**	**TOTAL**	**2TOTAL**	**Average**	**2: US 278 at I-95 SB Ramps**			**18.73778**	**580.5812**	**1693**	**14.725586**	**14.71055**	**B**	**1**
3	US 278 at I-95 NB Ramps	NBL	3NBL	Average	3: US 278 at I-95 NB Ramps - 11: Exit 8 NB Off-Ramp@155.8 - 26: 278- WB@26.7	11: Exit 8 NB Off-Ramp	26: 278- WB	0.007464	34.81432	10	10.030732		B	0.004141 unisg
3	US 278 at I-95 NB Ramps	EBT	3EBT	Average	3: US 278 at I-95 NB Ramps - 28: 278- EB@858.9 - 32: 278- EB@35.4	28: 278- EB	32: 278- EB	0	0	346	0.113744		A	0.143271
3	US 278 at I-95 NB Ramps	EBL	3EBL	Average	3: US 278 at I-95 NB Ramps - 29: 278- EB@290.2 - 8: Exit 8 NB On-Ramp@72.1	29: 278- EB	8: Exit 8 NB On-Ramp	2.071384	86.54411	47	7.763164		A	0.019462
3	US 278 at I-95 NB Ramps	NBR	3NBR	Average	3: US 278 at I-95 NB Ramps - 684: Exit 8 NB Off-Ramp@191.9 - 32: 278- EB@35.4	684: Exit 8 NB Off-Ramp	32: 278- EB	0	0	498	1.027218		A	0.206211
3	US 278 at I-95 NB Ramps	WBR	3WBR	Average	3: US 278 at I-95 NB Ramps - 711: 278- WB@255.6 - 7: Exit 8 NB On-Ramp@70.4	711: 278- WB	7: Exit 8 NB On-Ramp	8.528209	175.71	335	4.202083		A	0.138716
3	US 278 at I-95 NB Ramps	WBT	3WBT	Average	3: US 278 at I-95 NB Ramps - 711: 278- WB@255.6 - 26: 278- WB@26.7	711: 278- WB	26: 278- WB	8.528209	175.71	1178	3.692946		A	0.487785
3	**US 278 at I-95 NB Ramps**	**TOTAL**	**3TOTAL**	**Average**	**3: US 278 at I-95 NB Ramps**			**2.121411**	**175.71**	**2415**	**2.810407**	**2.805**	**A**	**1**
4	US 278 at Henry Moss Blvd	WBT	4WBT	Average	4: US 278 at Henry Moss Blvd - 86: 278- WB@289.5 - 31: 278- WB@79.5	86: 278- WB	31: 278- WB	51.66012	379.0383	1343	13.396209		B	0.539791 sig
4	US 278 at Henry Moss Blvd	WBL	4WBL	Average	4: US 278 at Henry Moss Blvd - 86: 278- WB@289.5 - 89: Henry Moss Blvd@117.2	86: 278- WB	89: Henry Moss Blvd	51.66012	379.0383	39	13.93915		B	0.015675
4	US 278 at Henry Moss Blvd	WBR	4WBR	Average	4: US 278 at Henry Moss Blvd - 86: 278- WB@289.5 - 91: Henry Moss Blvd@84.0	86: 278- WB	91: Henry Moss Blvd	60.78032	404.8262	42	12.001838		B	0.016881
4	US 278 at Henry Moss Blvd	NBL	4NBL	Average	4: US 278 at Henry Moss Blvd - 93: Henry Moss Blvd@13.2 - 31: 278- WB@79.5	93: Henry Moss Blvd	31: 278- WB	7.67778	82.97332	59	26.325622		C	0.023714
4	US 278 at Henry Moss Blvd	NBR	4NBR	Average	4: US 278 at Henry Moss Blvd - 93: Henry Moss Blvd@13.2 - 33: 278- EB@126.8	93: Henry Moss Blvd	33: 278- EB	5.078847	89.89194	33	6.930548		A	0.013264
4	US 278 at Henry Moss Blvd	NBT	4NBT	Average	4: US 278 at Henry Moss Blvd - 93: Henry Moss Blvd@13.2 - 91: Henry Moss Blvd@84.0	93: Henry Moss Blvd	91: Henry Moss Blvd	7.67778	82.97332	8	26.440464		C	0.003215
4	US 278 at Henry Moss Blvd	SBR	4SBR	Average	4: US 278 at Henry Moss Blvd - 94: Henry Moss Blvd@140.7 - 31: 278- WB@79.5	94: Henry Moss Blvd	31: 278- WB	30.05172	202.6596	79	21.91134		C	0.031752
4	US 278 at Henry Moss Blvd	SBL	4SBL	Average	4: US 278 at Henry Moss Blvd - 94: Henry Moss Blvd@140.7 - 33: 278- EB@126.8	94: Henry Moss Blvd	33: 278- EB	23.14594	188.2654	71	34.13298		C	0.028537
4	US 278 at Henry Moss Blvd	SBT	4SBT	Average	4: US 278 at Henry Moss Blvd - 94: Henry Moss Blvd@140.7 - 89: Henry Moss Blvd@117.2	94: Henry Moss Blvd	89: Henry Moss Blvd	23.14594	188.2654	18	37.746645		D	0.007235
4	US 278 at Henry Moss Blvd	EBT	4EBT	Average	4: US 278 at Henry Moss Blvd - 95: 278- EB@137.5 - 33: 278- EB@126.8	95: 278- EB	33: 278- EB	20.42991	188.1596	651	9.620937		A	0.261656
4	US 278 at Henry Moss Blvd	EBR	4EBR	Average	4: US 278 at Henry Moss Blvd - 95: 278- EB@137.5 - 89: Henry Moss Blvd@117.2	95: 278- EB	89: Henry Moss Blvd	23.31874	216.5483	52	5.356072		A	0.0209
4	US 278 at Henry Moss Blvd	EBL	4EBL	Average	4: US 278 at Henry Moss Blvd - 95: 278- EB@137.5 - 91: Henry Moss Blvd@84.0	95: 278- EB	91: Henry Moss Blvd	20.42991	188.1596	94	23.637624		C	0.037781
4	**US 278 at Henry Moss Blvd**	**TOTAL**	**4TOTAL**	**Average**	**4: US 278 at Henry Moss Blvd**			**27.76792**	**404.8262**	**2488**	**13.91422**	**13.91874**	**B**	**1**

DELAYAVG(ALL)	STOPSAVG(ALL)	SPEEDAVG(ALL)	DISTTOT(ALL)	TRAVTMTOT(ALL)	VEHACT(ALL)	VEHARR(ALL)	DELAYLATENT	DEMANDLATENT
260,043.06	0.38	60.89	55,133.06	3,259,785.88	919.00	8,546.00	650.70	-

30.42862883

APPENDIX D. EXIT 8 EXISTING CONDITIONS CAPACITY ANALYSIS TABLES

2022

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Unsignalized)	WBR	900	A (2.1)	179	A (2.7)	181
	WBL	900	B (12.7)	177	B (11.6)	178
	SBT	-	A (0.8)	-	A (0.7)	-
	SBL	155	A (0.9)	44	A (0.6)	20
	NBR	-	A (0.9)	-	A (0.3)	-
	NBT	-	A (2.5)	-	A (1.2)	-
	Intersection		**B (12.7)**		**B (11.6)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	C (21.8)	230	C (28.6)	123
	EBR	300	A (0.5)	75	A (0.3)	-
	SBL	1,360	C (27.1)	216	D (35.9)	145
	SBR	400	A (1.6)	50	A (1.5)	43
	WBL	530	B (15.6)	312	B (13.7)	**610**
	WBT	880	A (7.7)	92	A (4.7)	100
	Intersection		**B (18.6)**		**B (15.2)**	
US 278 at I-95 NB Ramps (Unsignalized)	EBL	300	A (4.0)	56	A (8.1)	84
	EBT	880	A (5.5)	54	A (0.1)	-
	WBT	700	A (1.5)	115	A (3.4)	196
	WBR	360	A (2.6)	115	A (4.1)	196
	NBL	275	C (18.0)	37	B (12.4)	37
	NBR	1,830	C (18.3)	1,604	A (1.2)	-
	Intersection		**C (18.3)**		**B (12.4)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	230	D (52.9)	**921**	C (24.6)	184
	EBT	700	E (59.0)	**921**	A (9.9)	184
	EBR	670	E (56.5)	**949**	A (5.3)	213
	SBL	-	F (188.8)	418	C (29.9)	151
	SBT	-	F (196.9)	418	C (32.3)	151
	SBR	-	F (173.4)	433	B (19.0)	165
	WBL	425	C (30.4)	253	B (10.9)	373
	WBT	-	C (23.2)	253	B (12.8)	373
	WBR	-	B (17.7)	282	B (10.9)	401
	NBL	-	C (28.1)	98	C (26.7)	90
	NBT	-	C (28.8)	98	C (27.6)	90
	NBR	130	B (12.2)	105	A (6.7)	97
	Intersection		**E (58.7)**		**B (13.4)**	

*Note: Queues exceeding available storage in **bold***

2030

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Unsignalized)	WBR	900	C (15.2)	277	A (7.7)	239
	WBL	900	D (32.5)	275	C (20.3)	236
	SBT	-	A (1.6)	-	A (1.2)	-
	SBL	155	A (1.0)	41	A (1.0)	44
	NBR	-	A (1.1)	-	A (0.7)	-
	NBT	-	A (3.2)	-	A (2.6)	-
		Intersection	**D (32.5)**		**C (20.3)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	C (27.9)	295	E (62.9)	244
	EBR	300	A (0.9)	142	A (0.6)	89
	SBL	1,360	D (42.1)	316	E (70.8)	217
	SBR	400	A (2.2)	73	A (1.9)	40
	WBL	530	D (48.7)	**1,080**	B (16.7)	**1,161**
	WBT	880	A (9.0)	145	A (4.3)	145
		Intersection	**C (31.6)**		**C (23.7)**	
US 278 at I-95 NB Ramps (Unsignalized)	EBL	300	C (23.5)	108	F (74.9)	263
	EBT	880	E (39.6)	747	A (0.4)	20
	WBT	700	D (29.8)	321	C (24.4)	649
	WBR	360	B (13.4)	321	C (17.1)	**649**
	NBL	275	F (78.7)	**717**	D (29.7)	84
	NBR	1,830	F (77.6)	1,674	A (1.9)	-
		Intersection	**F (78.7)**		**D (29.7)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	230	F (84.7)	**936**	E (58.3)	**467**
	EBT	700	F (84.2)	**936**	C (29.6)	467
	EBR	670	F (86.4)	**965**	C (26.7)	496
	SBL	-	F (211.4)	429	F (167)	426
	SBT	-	F (214.9)	429	F (169.7)	426
	SBR	-	F (202.8)	444	F (153.2)	440
	WBL	425	D (37.6)	581	C (26.5)	**833**
	WBT	-	D (38.3)	581	C (26.8)	833
	WBR	-	C (33.7)	609	C (25)	861
	NBL	-	D (37.9)	146	D (42.8)	136
	NBT	-	D (35.4)	146	C (34.1)	136
	NBR	130	B (12.9)	153	A (8.8)	**143**
		Intersection	**E (74.6)**		**D (37.2)**	

*Note: Queues exceeding available storage in **bold***

2050

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Unsignalized)	WBR	900	C (22.7)	363	A (4.0)	196
	WBL	900	E (39.0)	361	C (15.7)	193
	SBT	-	A (1.6)	-	A (1.0)	-
	SBL	155	A (3.9)	64	A (0.9)	36
	NBR	-	A (7.5)	226	A (0.7)	-
	NBT	-	A (7.1)	226	A (2.3)	-
		Intersection	**E (39.0)**		**C (15.7)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	F (100.5)	**954**	E (61.4)	241
	EBR	300	C (23.6)	**800**	A (0.6)	87
	SBL	1,360	F (199.8)	**1,674**	E (61.2)	197
	SBR	400	B (10.3)	112	A (2.0)	47
	WBL	530	D (38.7)	**1,163**	C (26.1)	**1,163**
	WBT	880	A (7.3)	144	A (3.7)	118
		Intersection	**E (76.4)**		**C (27.6)**	
US 278 at I-95 NB Ramps (Unsignalized)	EBL	300	D (32.3)	125	F (159.8)	**404**
	EBT	880	F (97.5)	**1,001**	A (0.8)	12
	WBT	700	E (35.3)	507	F (66.7)	**753**
	WBR	360	C (18.4)	**507**	E (45.9)	**753**
	NBL	275	F (82.7)	90	F (51.3)	64
	NBR	1,830	F (108.9)	1,674	A (2.2)	133
		Intersection	**F (97.5)**		**F (51.3)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	230	F (112.1)	**936**	E (71.4)	572
	EBT	700	F (91.0)	**936**	D (36.4)	572
	EBR	670	F (90.4)	**965**	C (32.2)	601
	SBL	-	F (205.7)	428	F (290)	426
	SBT	-	F (210.9)	428	F (278.4)	426
	SBR	-	F (192.7)	442	F (269.8)	440
	WBL	425	D (42.2)	**701**	C (26.7)	**840**
	WBT	-	D (36.4)	701	E (57.1)	840
	WBR	-	C (32.1)	729	D (49.9)	868
	NBL	-	C (34.7)	202	F (82.4)	243
	NBT	-	C (33.0)	202	E (57.2)	243
	NBR	130	B (13.7)	**208**	B (13.7)	**250**
		Intersection	**E (73.3)**		**E (65.6)**	

*Note: Queues exceeding available storage in **bold***

APPENDIX E. VISSIM VOLUME SERVED RESULTS

2030 AM Peak Hour Volume Served Summary

Intersection	Movement	2022 Existing	2030 No Build	2030 Expand. Dia.	2030 SPUI	2030 4-Lane DDI	2030 6-Lane DDI	2030 ParClo - NW	2030 ParClo - SW
U.S. 278 at U.S. 17	WBR	98%	91%	88%	100%	100%	100%	100%	100%
	WBL	97%	88%	84%	98%	100%	98%	99%	100%
	SBT	100%	99%	98%	99%	98%	98%	98%	99%
	SBL	100%	100%	100%	100%	100%	100%	100%	100%
	NBR	97%	98%	90%	98%	98%	98%	98%	100%
	NBT	100%	100%	95%	100%	100%	100%	100%	100%
U.S. 278 at I-95 SB Ramps	EBT	98%	91%	87%	99%	99%	99%	99%	99%
	EBR	97%	88%	87%	-	99%	99%	99%	99%
	SBL	100%	99%	86%	100%	100%	100%	100%	-
	SBR	100%	100%	89%	-	100%	100%	100%	100%
	WBL	97%	98%	46%	99%	99%	99%	-	100%
	WBT	100%	100%	100%	99%	100%	98%	100%	100%
U.S. 278 at I-95 NB Ramps	EBL	100%	100%	88%	100%	100%	100%	100%	100%
	EBT	99%	97%	83%	99%	99%	99%	99%	98%
	WBT	99%	96%	89%	99%	99%	99%	99%	99%
	WBR	100%	100%	93%	-	100%	100%	100%	100%
	NBL	80%	48%	89%	100%	100%	96%	100%	100%
	NBR	91%	47%	93%	-	100%	92%	100%	100%
U.S. 278 at Henry Moss Blvd	EBL	97%	73%	90%	100%	100%	99%	100%	100%
	EBT	92%	69%	85%	98%	100%	94%	98%	98%
	EBR	100%	72%	90%	100%	100%	100%	100%	100%
	SBL	89%	81%	100%	100%	100%	100%	100%	100%
	SBT	100%	87%	100%	100%	100%	100%	100%	100%
	SBR	94%	86%	100%	99%	100%	100%	100%	100%
	WBL	100%	100%	100%	100%	100%	100%	100%	100%
	WBT	100%	99%	92%	100%	100%	100%	100%	100%
	WBR	98%	100%	95%	100%	100%	100%	100%	100%
	NBL	97%	96%	97%	97%	97%	97%	97%	99%
	NBT	100%	100%	100%	100%	100%	100%	100%	100%
	NBR	91%	91%	92%	91%	91%	92%	91%	91%

*Note: Output below 80% in **red***

2030 PM Peak Hour Volume Served Summary

Intersection	Movement	2022 Existing	2030 No Build	2030 Expand. Dia.	2030 SPUI	2030 4-Lane DDI	2030 6-Lane DDI	2030 ParClo - NW	2030 ParClo - SW
U.S. 278 at U.S. 17	WBR	100%	97%	83%	86%	99%	98%	100%	100%
	WBL	100%	98%	84%	84%	99%	99%	100%	100%
	SBT	100%	100%	100%	100%	100%	100%	100%	100%
	SBL	98%	99%	99%	99%	98%	98%	99%	99%
	NBR	100%	98%	98%	98%	98%	98%	98%	98%
	NBT	95%	100%	100%	100%	100%	100%	100%	100%
U.S. 278 at I-95 SB Ramps	EBT	100%	97%	100%	98%	98%	99%	99%	99%
	EBR	92%	98%	94%	-	94%	94%	94%	94%
	SBL	100%	100%	100%	100%	100%	100%	100%	-
	SBR	100%	99%	99%	-	99%	100%	99%	100%
	WBL	100%	98%	33%	100%	100%	100%	-	100%
	WBT	100%	100%	100%	100%	99%	98%	99%	100%
U.S. 278 at I-95 NB Ramps	EBL	100%	100%	100%	100%	100%	100%	100%	100%
	EBT	100%	97%	100%	98%	100%	100%	100%	100%
	WBT	99%	99%	77%	100%	100%	100%	100%	100%
	WBR	100%	100%	80%	-	100%	100%	100%	100%
	NBL	100%	83%	97%	98%	95%	85%	97%	95%
	NBR	99%	87%	100%	-	99%	88%	100%	100%
U.S. 278 at Henry Moss Blvd	EBL	98%	90%	100%	100%	100%	94%	100%	100%
	EBT	99%	88%	100%	98%	99%	91%	100%	99%
	EBR	100%	89%	100%	100%	100%	93%	100%	100%
	SBL	100%	100%	99%	100%	100%	100%	100%	99%
	SBT	100%	100%	100%	100%	100%	100%	100%	100%
	SBR	100%	100%	100%	98%	100%	100%	100%	100%
	WBL	100%	100%	89%	100%	100%	100%	100%	100%
	WBT	100%	100%	78%	99%	100%	100%	100%	100%
	WBR	93%	91%	73%	89%	91%	91%	91%	91%
	NBL	98%	100%	99%	99%	99%	99%	99%	99%
	NBT	80%	80%	80%	80%	80%	80%	80%	80%
	NBR	94%	91%	91%	91%	91%	91%	91%	91%

*Note: Output below 80% in **red***

2050 AM Peak Hour Volume Served Summary

Intersection	Movement	2022 Existing	2050 No Build	2050 Expand. Dia.	2050 SPUI	2050 4-Lane DDI	2050 6-Lane DDI	2050 ParClo - NW	2050 ParClo - SW
U.S. 278 at U.S. 17	WBR	98%	81%	80%	100%	100%	100%	100%	100%
	WBL	97%	76%	77%	100%	100%	100%	99%	100%
	SBT	100%	99%	100%	99%	100%	100%	100%	100%
	SBL	100%	100%	97%	100%	100%	100%	100%	100%
	NBR	97%	100%	71%	97%	97%	97%	97%	97%
	NBT	100%	16%	81%	100%	100%	100%	100%	100%
U.S. 278 at I-95 SB Ramps	EBT	98%	95%	72%	97%	98%	98%	97%	97%
	EBR	97%	98%	74%	-	99%	99%	99%	99%
	SBL	100%	66%	54%	100%	100%	100%	100%	-
	SBR	100%	68%	54%	-	100%	100%	100%	98%
	WBL	97%	90%	85%	99%	99%	99%	-	100%
	WBT	100%	79%	87%	100%	100%	100%	100%	100%
U.S. 278 at I-95 NB Ramps	EBL	100%	100%	74%	100%	100%	100%	100%	100%
	EBT	99%	79%	61%	97%	98%	98%	98%	98%
	WBT	99%	92%	86%	100%	100%	99%	99%	98%
	WBR	100%	96%	89%	-	100%	100%	100%	100%
	NBL	80%	29%	78%	100%	97%	98%	100%	99%
	NBR	91%	27%	80%	-	95%	96%	100%	99%
U.S. 278 at Henry Moss Blvd	EBL	97%	51%	72%	100%	99%	99%	100%	100%
	EBT	92%	51%	69%	98%	96%	97%	98%	97%
	EBR	100%	51%	74%	100%	100%	100%	100%	100%
	SBL	89%	62%	47%	100%	100%	100%	97%	100%
	SBT	100%	65%	53%	95%	100%	100%	98%	98%
	SBR	94%	65%	49%	97%	100%	100%	100%	100%
	WBL	100%	100%	100%	100%	100%	100%	100%	100%
	WBT	100%	100%	98%	100%	100%	100%	100%	100%
	WBR	98%	94%	94%	96%	95%	95%	95%	95%
	NBL	97%	93%	93%	95%	93%	94%	93%	95%
	NBT	100%	100%	100%	100%	100%	100%	100%	100%
	NBR	91%	91%	91%	92%	93%	93%	92%	92%

*Note: Output below 80% in **red***

2050 PM Peak Hour Volume Served Summary

Intersection	Movement	2022 Existing	2050 No Build	2050 Expand. Dia.	2050 SPUI	2050 4-Lane DDI	2050 6-Lane DDI	2050 ParClo - NW	2050 ParClo - SW
U.S. 278 at U.S. 17	WBR	100%	71%	80%	84%	95%	98%	98%	98%
	WBL	100%	70%	81%	84%	95%	97%	99%	99%
	SBT	100%	100%	100%	100%	100%	100%	100%	100%
	SBL	98%	97%	100%	100%	100%	100%	100%	100%
	NBR	100%	98%	97%	97%	97%	97%	97%	97%
	NBT	95%	100%	100%	100%	100%	100%	100%	100%
U.S. 278 at I-95 SB Ramps	EBT	100%	71%	100%	100%	100%	100%	100%	100%
	EBR	92%	70%	95%	-	95%	95%	95%	95%
	SBL	100%	100%	100%	100%	100%	100%	100%	-
	SBR	100%	97%	97%	-	96%	97%	97%	91%
	WBL	100%	98%	78%	100%	97%	100%	-	100%
	WBT	100%	100%	76%	100%	95%	98%	99%	99%
U.S. 278 at I-95 NB Ramps	EBL	100%	100%	100%	100%	100%	100%	100%	100%
	EBT	100%	80%	100%	100%	100%	100%	100%	100%
	WBT	99%	73%	77%	100%	97%	100%	100%	100%
	WBR	100%	76%	80%	-	100%	100%	100%	100%
	NBL	100%	42%	96%	96%	87%	87%	96%	96%
	NBR	99%	39%	96%	-	85%	85%	95%	96%
U.S. 278 at Henry Moss Blvd	EBL	98%	51%	100%	100%	93%	92%	100%	100%
	EBT	99%	50%	96%	97%	89%	89%	96%	96%
	EBR	100%	50%	100%	99%	91%	91%	99%	100%
	SBL	100%	81%	95%	97%	99%	100%	97%	95%
	SBT	100%	80%	100%	100%	100%	100%	100%	100%
	SBR	100%	83%	94%	98%	99%	100%	100%	100%
	WBL	100%	82%	85%	100%	100%	100%	100%	100%
	WBT	100%	72%	76%	100%	99%	100%	100%	100%
	WBR	93%	64%	69%	94%	94%	96%	96%	94%
	NBL	98%	96%	96%	96%	96%	96%	96%	96%
	NBT	80%	85%	85%	85%	85%	85%	85%	85%
	NBR	94%	93%	93%	89%	93%	93%	93%	93%

*Note: Output below 80% in **red***

APPENDIX F. EXIT 8 ALTERNATIVE INTERCHANGE CONDITIONS CAPACITY ANALYSIS TABLES

Expanded Diamond Interchange

2030

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	A (9.3)	277	A (9.9)	239
	WBL	900	C (28.6)	275	C (20.2)	236
	SBT	-	B (19.3)	-	B (15.8)	-
	SBL	155	D (35.3)	41	C (20.5)	44
	NBR	-	C (25.1)	-	A (0.3)	-
	NBT	-	D (54.2)	-	B (16.2)	-
	Intersection		**C (28.1)**		**B (11.9)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	F (97.2)	295	C (22.2)	244
	EBR	300	B (13.7)	142	A (0.7)	89
	SBL	1,360	F (191.6)	316	C (33.1)	217
	SBR	1,360	C (34.4)	73	A (0.5)	40
	WBL	530	F (97.5)	**1,080**	C (24.5)	**1,161**
	WBT	880	F (141.0)	145	D (36.8)	145
	Intersection		**F (119.4)**		**C (27.9)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	300	E (65.5)	108	C (24.4)	263
	EBT	880	E (76.7)	747	B (13.8)	20
	WBT	700	E (71.5)	321	E (74.7)	649
	WBR	360	D (40.2)	321	E (68.6)	**649**
	NBL	1,830	E (76.1)	717	B (17.1)	84
	NBR	1,830	F (82.8)	1,674	A (9.9)	-
	Intersection		**E (73.6)**		**D (42.3)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	400	D (51.8)	**936**	B (18.8)	**467**
	EBT	700	D (53.5)	**936**	B (11.2)	467
	EBR	670	D (50.3)	**965**	A (7.4)	496
	SBL	-	E (73.0)	429	F (103.1)	426
	SBT	-	E (72.5)	429	F (111.0)	426
	SBR	-	E (77.0)	444	F (122.3)	440
	WBL	425	D (44.6)	**581**	D (36.5)	**833**
	WBT	-	D (51.1)	581	E (71.1)	833
	WBR	-	D (44.7)	609	E (57.7)	861
	NBL	-	D (50.8)	146	D (45.7)	136
	NBT	-	D (51.8)	146	D (40.3)	136
	NBR	130	D (44.1)	**153**	C (31.5)	**143**
	Intersection		**D (53.2)**		**D (46.0)**	

*Note: Queues exceeding available storage in **bold***

2050

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	A (5.3)	482	A (7.5)	440
	WBL	900	B (15.4)	459	B (17.4)	418
	SBT	-	E (67.5)	401	C (33.6)	130
	SBL	155	D (48.7)	**394**	A (1.3)	48
	NBR	-	E (70.7)	758	A (0.0)	68
	NBT	-	F (120.0)	876	D (35.0)	440
	Intersection		**D (50.0)**		**B (12.0)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	F (161.0)	**1,041**	D (36.7)	218
	EBR	300	C (30.9)	876	A (0.2)	71
	SBL	1,360	F (328.6)	**1,674**	E (66.2)	243
	SBR	1,360	F (92.8)	-	A (0.6)	-
	WBL	530	C (31.6)	**653**	C (31.5)	**808**
	WBT	880	D (35.6)	653	D (40.5)	808
	Intersection		**F (112.3)**		**D (37.1)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	300	F (86.8)	**413**	C (34.5)	225
	EBT	880	F (85.4)	**985**	A (9.8)	231
	WBT	700	E (62.1)	**730**	D (52.9)	**779**
	WBR	360	E (62.2)	**730**	D (52.4)	**779**
	NBL	1,830	F (88.3)	223	C (26.9)	87
	NBR	1,830	F (90.3)	1,674	B (12.0)	242
	Intersection		**E (78.1)**		**C (32.4)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	400	E (57.8)	**826**	C (34.9)	**654**
	EBT	700	E (56.4)	**826**	B (16.6)	618
	EBR	670	E (56.5)	**826**	B (12.3)	618
	SBL	-	F (261.0)	415	F (153.7)	409
	SBT	-	F (261.1)	415	F (159.3)	409
	SBR	-	F (263.2)	415	F (157.0)	409
	WBL	425	D (35.4)	**738**	D (39.5)	**839**
	WBT	-	D (36.8)	738	D (52.7)	839
	WBR	-	C (31.7)	738	D (44.2)	839
	NBL	-	E (74.8)	262	D (54.5)	171
	NBT	-	E (59.9)	262	D (47.1)	171
	NBR	130	E (63.7)	**262**	D (47.8)	**171**
	Intersection		**E (61.1)**		**D (43.3)**	

*Note: Queues exceeding available storage in **bold***

SPUI Interchange

2030

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	B (15.0)	430	B (12.3)	334
	WBL	900	C (23.8)	408	C (21.2)	311
	SBT	-	B (17.0)	109	B (15.1)	76
	SBL	155	B (16.4)	**172**	B (15.4)	105
	NBR	185	A (0.8)	40	A (0.3)	-
	NBT	-	D (46.9)	148	B (15.4)	105
	Intersection		**B (14.5)**		**B (11.8)**	
US 278 at I-95 Ramps (Signalized)	EBL	350	C (30.0)	296	D (36.4)	141
	EBT	1,300	D (36.6)	296	D (47.1)	141
	EBR	-	Free Right Turn			
	SBL	1,140	D (38.9)	269	C (34.5)	161
	SBR	-	Free Right Turn			
	WBL	500	D (38.1)	421	D (35.4)	**666**
	WBT	1,540	C (26.1)	196	C (28.6)	261
	WBR	-	Free Right Turn			
	NBL	300	D (35.9)	168	D (40.2)	87
	NBR	-	Free Right Turn			
	Intersection		**D (35.9)**		**D (35.3)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (48.6)	**401**	D (54.2)	112
	EBT	1,600	C (20.7)	717	B (15.7)	353
	EBR	260	B (19.5)	717	B (16.1)	**353**
	SBL	110	D (43.6)	**244**	D (41.6)	**184**
	SBT	200	D (41.2)	**244**	D (42.6)	184
	SBR	325	D (39.3)	244	D (40.6)	184
	WBL	260	B (15.3)	59	C (20.8)	84
	WBT	-	D (40.2)	403	C (33.8)	778
	WBR	160	D (35.4)	**403**	C (34.5)	**778**
	NBL	170	D (44.5)	124	D (42.8)	100
	NBT	-	D (42.3)	124	D (37.7)	100
	NBR	170	D (46.6)	124	D (39.6)	100
	Intersection		**C (31.0)**		**C (28.5)**	

*Note: Queues exceeding available storage in **bold***

2050

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	B (14.8)	359	B (12.1)	410
	WBL	900	C (20.6)	337	B (17.4)	387
	SBT	-	D (45.9)	188	D (50.8)	165
	SBL	155	D (54.5)	**466**	E (64.4)	**253**
	NBR	185	A (1.1)	138	A (0.5)	140
	NBT	-	E (76.8)	253	D (54.9)	257
		Intersection	**C (22.4)**		**C (23.5)**	
US 278 at I-95 Ramps (Signalized)	EBL	350	C (30.1)	**464**	E (61.0)	195
	EBT	1,300	D (46.1)	464	E (57.5)	195
	EBR	-	Free Right Turn			
	SBL	1,140	D (45.2)	398	E (64.0)	224
	SBR	-	Free Right Turn			
	WBL	500	D (54.0)	**613**	C (31.3)	**1,403**
	WBT	1,540	C (34.3)	227	B (19.2)	296
	WBR	-	Free Right Turn			
	NBL	300	D (41.3)	165	E (64.3)	111
	NBR	-	Free Right Turn			
		Intersection	**D (46.2)**		**D (36.5)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (43.0)	**570**	D (54.7)	140
	EBT	1,600	C (22.2)	1,037	B (18.5)	783
	EBR	260	C (21.9)	**1,037**	B (19.1)	**783**
	SBL	110	D (35.5)	**251**	D (50.6)	**248**
	SBT	200	C (32.2)	**251**	D (42.4)	**248**
	SBR	325	C (31.6)	251	D (45.1)	248
	WBL	260	B (14.6)	75	B (12.7)	59
	WBT	-	C (34.2)	436	C (22.0)	807
	WBR	160	C (31.0)	**436**	C (21.3)	**807**
	NBL	170	C (34.2)	129	E (55.0)	118
	NBT	-	C (28.8)	129	D (42.7)	118
	NBR	170	C (34.4)	129	D (48.8)	118
		Intersection	**C (28.4)**		**C (24.3)**	

*Note: Queues exceeding available storage in **bold***

4-Lane DDI Interchange

2030

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	A (2.4)	286	A (5.4)	265
	WBL	900	A (7.7)	259	B (10.1)	238
	SBT	-	C (28.6)	123	C (34.0)	99
	SBL	155	D (38.8)	**236**	D (43.8)	**184**
	NBR	185	A (2.2)	**307**	A (2.8)	**247**
	NBT	-	C (32.7)	398	D (37.4)	338
		Intersection	**B (12.2)**		**B (14.8)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	820	C (32.8)	359	D (38.0)	195
	EBR	720	A (8.5)	206	A (1.9)	42
	SBL	1,260	B (11.4)	157	A (5.5)	79
	SBR	400	A (8.0)	127	A (7.9)	66
	WBL	940	A (3.6)	224	A (2.6)	171
	WBT	1,000	A (6.4)	295	A (6.9)	228
		Intersection	**B (14.3)**		**A (8.4)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	750	B (15.3)	376	A (3.3)	131
	EBT	885	C (25.8)	534	D (37.8)	296
	WBT	-	B (12.6)	514	B (17.1)	887
	WBR	360	A (1.3)	**421**	A (1.5)	**754**
	NBL	175	B (16.7)	115	C (26.0)	82
	NBR	1,700	A (5.5)	300	A (2.1)	98
		Intersection	**B (13.7)**		**B (13.7)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	E (71.1)	**589**	D (40.8)	96
	EBT	1,600	B (10.3)	308	A (5.4)	227
	EBR	260	B (11.7)	**308**	A (3.4)	**227**
	SBL	110	D (40.3)	**126**	A (0.5)	66
	SBT	200	D (36.5)	126	D (46.4)	66
	SBR	325	A (3.1)	126	A (4.6)	66
	WBL	260	D (42.9)	99	D (44.3)	99
	WBT	-	B (13.1)	195	A (8.6)	300
	WBR	160	A (5.0)	18	A (4.0)	8
	NBL	170	D (38.1)	77	A (4.9)	46
	NBT	-	C (33.1)	77	D (41.7)	46
	NBR	170	A (8.0)	109	A (5.7)	78
		Intersection	**B (17.7)**		**A (8.7)**	

*Note: Queues exceeding available storage in **bold***

2050

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	A (3.3)	411	A (3.0)	246
	WBL	900	A (8.9)	384	A (4.4)	219
	SBT	-	C (28.1)	162	D (35.6)	128
	SBL	155	D (35.7)	**252**	E (64.1)	**279**
	NBR	185	A (2.0)	**265**	A (3.4)	**295**
	NBT	-	C (28.7)	356	D (35.5)	386
	Intersection		**B (11.9)**		**B (15.2)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	820	C (30.5)	386	C (28.7)	209
	EBR	720	A (8.8)	233	A (1.7)	57
	SBL	1,260	B (15.1)	224	A (7.6)	99
	SBR	400	A (8.8)	116	A (8.5)	78
	WBL	940	A (5.6)	486	A (3.8)	449
	WBT	1,000	B (13.9)	505	B (11.6)	218
	Intersection		**B (15.8)**		**A (8.8)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	750	C (24.0)	633	A (1.6)	111
	EBT	885	C (34.2)	791	C (34.7)	277
	WBT	-	D (45.5)	943	D (38.3)	1,634
	WBR	360	A (4.2)	**850**	A (6.9)	**1,606**
	NBL	175	C (29.5)	135	C (30.0)	72
	NBR	1,700	B (12.6)	1,674	A (3.3)	214
	Intersection		**C (28.2)**		**C (23.9)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (36.0)	319	D (46.1)	110
	EBT	1,600	B (17.2)	908	A (4.8)	184
	EBR	260	B (16.6)	**908**	A (5.0)	**184**
	SBL	110	D (41.4)	**187**	A (0.6)	**178**
	SBT	200	D (40.8)	187	D (45.1)	178
	SBR	325	A (4.7)	187	D (35.8)	178
	WBL	260	D (48.1)	119	D (39.8)	122
	WBT	-	C (27.4)	366	C (20.5)	533
	WBR	160	A (7.9)	20	A (6.7)	4
	NBL	170	D (44.3)	102	B (11.4)	65
	NBT	-	C (32.9)	102	D (46.3)	65
	NBR	170	B (11.6)	134	A (6.8)	86
	Intersection		**C (22.1)**		**B (15.7)**	

*Note: Queues exceeding available storage in **bold***

6-Lane DDI Interchange

2030

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	A (2.6)	265	A (2.6)	182
	WBL	900	A (6.3)	238	A (3.6)	155
	SBT	-	C (27.5)	120	C (34.2)	128
	SBL	155	D (36)	**229**	D (46.9)	**179**
	NBR	185	A (1.8)	**263**	A (2.9)	**202**
	NBT	-	C (30.6)	354	D (36.8)	292
		Intersection	**B (11.1)**		**B (12.7)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	820	C (31.2)	346	C (29.1)	133
	EBR	720	A (6.7)	192	A (0.9)	0
	SBL	1,260	B (10.6)	141	A (7.3)	92
	SBR	400	A (7.3)	128	A (7.4)	64
	WBL	1,000	A (1.3)	53	A (1.6)	76
	WBT	940	A (5.0)	128	A (9.1)	146
		Intersection	**B (12.8)**		**A (7.3)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	750	A (0.5)	346	A (1.0)	80
	EBT	885	C (29.0)	501	C (34.9)	245
	WBT	-	B (12.0)	358	B (12.7)	329
	WBR	360	A (4.7)	284	A (2.2)	208
	NBL	175	A (7.0)	83	A (9.4)	56
	NBR	1,500	A (3.8)	-	A (2.4)	145
		Intersection	**B (14.1)**		**B (11.5)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	C (21)	176	D (47.6)	104
	EBT	1,600	A (8.9)	454	A (3.9)	162
	EBR	260	A (7.7)	**454**	A (3.7)	162
	SBL	110	D (41.4)	**171**	A (0.4)	70
	SBT	200	D (36.5)	171	D (50.2)	70
	SBR	325	A (6.9)	171	A (4.8)	70
	WBL	260	D (43.2)	111	D (39.6)	102
	WBT	-	C (26.7)	276	A (7.7)	268
	WBR	160	A (7.2)	31	A (4.1)	4
	NBL	170	D (40.2)	78	A (4.5)	44
	NBT	-	D (36.2)	78	D (47.9)	44
	NBR	170	A (8.5)	110	A (6.1)	75
		Intersection	**B (16.7)**		**A (8.0)**	

*Note: Queues exceeding available storage in **bold***

2050

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	A (3.3)	349	A (3.3)	199
	WBL	900	A (8.4)	322	A (4.7)	172
	SBT	-	C (29.7)	169	D (35.5)	128
	SBL	155	D (36.2)	**268**	E (63.8)	**287**
	NBR	185	A (2.1)	**258**	A (3.4)	**295**
	NBT	-	C (28.8)	349	D (35.4)	386
		Intersection	**B (12)**		**B (15.2)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	820	C (31.1)	360	C (29.4)	165
	EBR	720	A (8.3)	206	A (1.4)	-
	SBL	1,260	B (12.5)	207	A (7.6)	101
	SBR	400	A (7.8)	112	A (8.7)	81
	WBL	940	A (1.8)	128	A (1.9)	190
	WBT	1,000	A (8.2)	176	B (10.5)	216
		Intersection	**B (13.3)**		**A (7.7)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	750	A (0.5)	476	A (1.1)	82
	EBT	885	C (27.9)	632	C (33.6)	247
	WBT	-	C (25.8)	576	B (18.1)	633
	WBR	360	B (13.0)	**484**	A (6.2)	**521**
	NBL	175	B (13.9)	128	B (14.4)	67
	NBR	1,500	A (8.8)	416	A (3.7)	190
		Intersection	**B (19.4)**		**B (14.5)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (35.1)	**342**	D (47.6)	114
	EBT	1,600	B (16.3)	861	A (4.9)	184
	EBR	260	B (16.6)	**861**	A (5.0)	184
	SBL	110	D (46.9)	**176**	A (0.6)	109
	SBT	200	D (44.7)	176	D (45.6)	109
	SBR	325	A (3.7)	176	A (8.0)	109
	WBL	260	D (53.5)	140	D (40.9)	122
	WBT	-	C (32.0)	432	A (9.8)	371
	WBR	160	A (5.3)	38	A (5.1)	8
	NBL	170	D (48.2)	102	A (6.5)	54
	NBT	-	D (41.1)	102	D (46.8)	54
	NBR	170	B (12.0)	134	A (6.4)	79
		Intersection	**C (23.0)**		**A (9.4)**	

*Note: Queues exceeding available storage in **bold***

ParClo - NW Interchange

2030

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	B (18.9)	421	B (15)	287
	WBL	900	C (21.5)	421	B (19.7)	265
	SBT	-	B (16.6)	94	B (14.9)	80
	SBL	155	B (17.4)	141	B (15.2)	106
	NBR	185	A (0.8)	20	A (0.4)	6
	NBT	-	B (17.0)	98	B (15.4)	109
		Intersection	**B (12.2)**		**B (12.3)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	B (16.1)	191	A (9.7)	100
	EBR	360	A (0.6)	5	A (0.5)	-
	SBL	1,360	B (11.7)	158	B (12.1)	100
	SBR	480	A (2.3)	86	A (1.7)	36
	NW Loop	360	-	200	-	183
	WBT	860	B (15.4)	183	B (10.9)	173
		Intersection	**B (13.1)**		**A (9)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	480	C (29.9)	150	D (41.3)	138
	EBT	860	A (6.7)	70	A (1.8)	633
	WBT	1,600	B (16.2)	536	B (14)	19
	WBR	360	A (1.8)	4	A (2.5)	97
	NBL	1,550	C (27.3)	107	D (43.6)	-
	NBR	1,700	A (2.4)	-	A (1.2)	173
		Intersection	**A (8.5)**		**A (8.9)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (37.7)	93	D (44.4)	113
	EBT	1,600	A (7.3)	201	A (9.1)	283
	EBR	260	A (4.2)	22	A (4.1)	180
	SBL	110	D (46.8)	**136**	D (44.7)	**161**
	SBT	200	D (41.1)	136	D (38.5)	161
	SBR	325	A (4.4)	153	A (6.9)	178
	WBL	260	A (6.4)	114	D (47.5)	115
	WBT	-	B (14.5)	341	B (11.4)	479
	WBR	160	A (3.2)	106	A (6.1)	23
	NBL	170	D (41.6)	86	A (2.2)	106
	NBT	-	D (37.3)	42	C (33.5)	63
	NBR	170	A (8.4)	75	A (7.2)	96
		Intersection	**B (13.4)**		**B (12.5)**	

*Note: Queues exceeding available storage in **bold***

2050

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	B (17.1)	427	B (17.2)	369
	WBL	900	C (21.0)	427	B (18.6)	347
	SBT	-	C (26.8)	142	C (30.8)	117
	SBL	155	C (30.1)	**255**	D (37.3)	**183**
	NBR	185	A (1.0)	32	A (0.4)	48
	NBT	-	C (26.9)	140	C (31.7)	166
	Intersection		**B (15.2)**		**B (17.5)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	B (11.0)	252	A (5.6)	96
	EBR	360	A (0.7)	59	A (0.6)	-
	SBL	1,360	C (30.6)	321	C (34.0)	168
	SBR	480	A (2.6)	65	A (1.7)	32
	NW Loop	360	-	200	-	**480**
	WBT	860	A (8.8)	152	B (10.3)	173
	Intersection		**B (15.0)**		**B (12.2)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	480	D (40.5)	123	D (48.7)	138
	EBT	860	A (2.3)	162	A (4.4)	633
	WBT	1,600	A (6.3)	288	B (15.4)	19
	WBR	360	A (2.5)	-	A (3.2)	97
	NBL	1,550	E (56.7)	561	D (44.7)	-
	NBR	1,700	A (7.5)	-	A (2.2)	173
	Intersection		**A (6.9)**		**A (10.0)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (37.4)	**349**	D (44.6)	113
	EBT	1,600	B (12.7)	581	B (11.0)	283
	EBR	260	A (6.7)	**321**	A (5.0)	180
	SBL	110	E (62.9)	**157**	D (49.6)	**161**
	SBT	200	D (54.3)	157	D (45)	161
	SBR	325	A (6.0)	175	B (10.7)	178
	WBL	260	B (15.6)	78	D (48.9)	115
	WBT	-	B (18.1)	266	B (13.4)	479
	WBR	160	A (4.6)	**286**	A (7.9)	23
	NBL	170	D (49.3)	107	A (2.2)	106
	NBT	-	D (39.2)	107	D (43.1)	63
	NBR	170	B (11.7)	135	A (7.6)	96
	Intersection		**B (17.8)**		**B (14.3)**	

*Note: Queues exceeding available storage in **bold***

ParClo - SW Interchange

2030

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	B (14.2)	399	B (10.8)	318
	WBL	900	B (20.0)	399	B (17.5)	295
	SBT	-	B (15.9)	90	B (14.9)	76
	SBL	155	B (17.0)	146	B (15.2)	101
	NBR	185	A (0.8)	21	A (0.3)	6
	NBT	-	B (17.8)	98	B (15.1)	112
		Intersection	**B (11.5)**		**B (10.9)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	A (0.0)	-	E (57.4)	218
	EBR	360	A (0.8)	-	A (0.7)	26
	SBL	-	Replaced with SW Loop Off-Ramp			
	SBR	480	A (1.7)	68	A (1.7)	51
	WBL	415	A (1.6)	-	A (5.6)	195
	WBT	960	A (0.1)	-	A (0.2)	-
		Intersection	**A (0.7)**		**B (11.4)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	480	D (47.0)	123	B (14.7)	183
	EBT	970	A (2.7)	117	A (6.2)	129
	WBT	1,600	A (6.5)	226	A (7.3)	358
	WBR	360	A (2.0)	-	A (2.3)	-
	NBL	1,550	E (57.1)	211	E (70.6)	128
	NBR	1,700	A (2.7)	-	A (1.2)	-
		Intersection	**A (5.8)**		**A (6.1)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (43.7)	317	E (67.4)	121
	EBT	1,600	A (8.8)	338	A (7.5)	225
	EBR	260	A (4.5)	163	A (3.2)	93
	SBL	110	D (45.7)	**144**	E (63.4)	**147**
	SBT	200	D (50.2)	144	E (75.2)	147
	SBR	325	A (4.3)	162	A (5.8)	164
	WBL	260	A (9.7)	71	E (68.6)	134
	WBT	-	B (18.4)	259	B (10.2)	382
	WBR	160	A (3.4)	**249**	A (4.9)	74
	NBL	170	D (45.2)	96	A (2.2)	89
	NBT	-	D (44.0)	96	D (54.5)	50
	NBR	170	A (9.1)	122	A (8.1)	83
		Intersection	**B (15.8)**		**B (13.0)**	

*Note: Queues exceeding available storage in **bold***

2050

Intersection	Movement	Available Storage (ft)	AM Peak		PM Peak	
			LOS (Delay)	Max. Queue (ft)	LOS (Delay)	Max. Queue (ft)
US 278 at US 17 (Signalized)	WBR	900	B (13.9)	428	B (12.9)	410
	WBL	900	B (17.4)	428	B (15.9)	388
	SBT	-	D (36.7)	175	D (40.1)	149
	SBL	155	D (43.2)	**350**	D (51.6)	**262**
	NBR	185	A (0.9)	49	A (0.4)	97
	NBT	-	C (34.9)	163	D (44.8)	213
	Intersection		**B (16.7)**		**B (19.2)**	
US 278 at I-95 SB Ramps (Signalized)	EBT	930	B (16.4)	297	E (58.7)	252
	EBR	360	A (0.9)	207	A (0.7)	61
	SBL	-	Replaced with SW Loop Off-Ramp			
	SBR	480	A (1.9)	79	A (2.1)	52
	WBL	415	B (13.6)	**417**	A (6.8)	263
	WBT	960	A (0.1)	-	A (0.3)	-
	Intersection		**B (10.6)**		**B (11.7)**	
US 278 at I-95 NB Ramps (Signalized)	EBL	480	E (62.3)	130	B (14.1)	223
	EBT	970	A (4.5)	270	A (6.1)	158
	WBT	1,600	A (5.1)	239	A (6.0)	425
	WBR	360	A (2.8)	-	A (3.1)	-
	NBL	1,550	E (72.4)	1,262	E (69.7)	121
	NBR	1,700	B (11.5)	225	A (2.0)	225
	Intersection		**A (9.2)**		**A (5.5)**	
Henry Moss Blvd at US 278 (Signalized)	EBL	320	D (44.5)	**399**	E (71.5)	151
	EBT	1,600	B (14.0)	610	A (9.5)	275
	EBR	260	A (7.8)	**327**	A (4.1)	133
	SBL	110	D (45.1)	**157**	E (63.6)	**161**
	SBT	200	D (42.0)	157	E (57.0)	161
	SBR	325	A (6.6)	175	A (8.8)	178
	WBL	260	B (12.7)	83	E (70.3)	146
	WBT	-	C (23.4)	317	B (13.4)	715
	WBR	160	A (6.1)	356	A (9.3)	181
	NBL	170	D (41.4)	108	A (2.1)	105
	NBT	-	D (43.3)	108	E (59.2)	61
	NBR	170	B (12.9)	141	A (8.3)	91
	Intersection		**B (19.7)**		**B (15.2)**	

*Note: Queues exceeding available storage in **bold***

APPENDIX G. U.S. 278 SIGNAL WARRANTS

INTERSECTION: **I-95 NB Ramp at US278**
SCENARIO: **EXISTING 2022**
DATE: 08/31/2022

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	45	NEAREST SIGNALIZED INTERSECTION:	1200
POPULATION:	6,788	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	3	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	2	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	1		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	0
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	YES	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	1870		
1058% MINOR:	950	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 630	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 105		INTERRUPTION WARRANT 1B 53		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	1,820	433%	289%	950	905%	YES	1810%	YES	YES	1583%	YES	1267%	YES
8-9	0	1,398	333%	222%	730	695%	YES	1390%	YES	YES	1216%	YES	973%	YES
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	1,058	252%	168%	557	530%	YES	1061%	YES	YES	928%	YES	573%	YES
12-13	0	1,040	248%	165%	548	522%	YES	1043%	YES	YES	913%	YES	544%	YES
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	1,363	325%	216%	371	353%	YES	707%	YES	YES	618%	YES	495%	YES
15-16	0	1,526	363%	242%	415	396%	YES	791%	YES	YES	692%	YES	554%	YES
16-17	0	1,719	409%	273%	468	446%	YES	891%	YES	YES	780%	YES	624%	YES
17-18	0	1,870	445%	297%	509	485%	YES	970%	YES	YES	848%	YES	679%	YES
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

SUMMARY

WARRANT	WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
1 A	MINIMUM VOLUME:	YES	8	0	88
B	INTERUPTION:	YES	8	0	80
A & B	COMBINATION:	YES	8	N/A	72
2	FOUR-HOUR:	YES	8	0	128
3 A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
B	PEAK HOUR VOLUME:	YES	8	0	448
4 No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
5	SCHOOL CROSSING:	NO	N/A	N/A	0
6	CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
7	ACCIDENT EXPERIENCE:	NO	8	N/A	0
8	ROADWAY NETWORK:	NO	8	N/A	0
9	INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
			PRIORITY VALUE		816

INTERSECTION: **US17 @ US278**
SCENARIO: **EXISTING 2022**
DATE: 08/31/2022

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	55	NEAREST SIGNALIZED INTERSECTION:	1000
POPULATION:	6,788	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	3	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	1	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	2		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	0
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	NO	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	331		
40% MINOR:	244	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 525	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 140		INTERRUPTION WARRANT 1B 70		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	800	190%	152%	270	193%	YES	386%	YES	YES	338%	YES	165%	YES
8-9	0	423	101%	81%	143	102%	YES	204%	NO	YES	71%	NO	44%	NO
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	237	56%	45%	164	117%	NO	234%	NO	NO	55%	NO	38%	NO
12-13	0	207	49%	39%	143	102%	NO	204%	NO	NO	46%	NO	32%	NO
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	259	62%	49%	206	147%	NO	295%	NO	NO	73%	NO	49%	NO
15-16	0	338	80%	64%	269	192%	NO	384%	NO	NO	111%	YES	72%	NO
16-17	0	328	78%	63%	261	187%	NO	373%	NO	NO	106%	YES	69%	NO
17-18	0	416	99%	79%	331	236%	YES/NO	473%	NO	NO	162%	YES	101%	YES
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

	WARRANT	WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
	1 A	MINIMUM VOLUME:	NO	2	1	22
	B	INTERUPTION:	NO	1	0	10
S	A & B	COMBINATION:	NO	2	N/A	18
U	2	FOUR-HOUR:	YES	4	0	64
M	3 A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
M	B	PEAK HOUR VOLUME:	YES	2	0	112
A	4 No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
R	5	SCHOOL CROSSING:	NO	N/A	N/A	0
Y	6	CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
	7	ACCIDENT EXPERIENCE:	NO	4	N/A	0
	8	ROADWAY NETWORK:	NO	1	N/A	0
	9	INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
				PRIORITY VALUE		226

INTERSECTION: **US17 at US278**
SCENARIO: **2030**
DATE: 08/31/2022

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	55	NEAREST SIGNALIZED INTERSECTION:	1000
POPULATION:	6,788	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	3	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	1	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	2		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	0
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	NO	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	480		
88% MINOR:	465	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 525	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 140		INTERRUPTION WARRANT 1B 70		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	960	229%	183%	525	375%	YES	750%	YES	YES	656%	YES	444%	YES
8-9	0	507	121%	97%	278	198%	YES	396%	YES/NO	YES	168%	YES	98%	YES/NO
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	297	71%	57%	368	263%	NO	526%	NO	NO	140%	YES	93%	YES/NO
12-13	0	259	62%	49%	322	230%	NO	459%	NO	NO	113%	YES	77%	NO
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	390	93%	74%	299	214%	YES/NO	428%	NO	NO	138%	YES	87%	NO
15-16	0	508	121%	97%	390	279%	YES	557%	YES/NO	YES	236%	YES	138%	YES
16-17	0	493	117%	94%	379	271%	YES	541%	YES/NO	YES	221%	YES	131%	YES
17-18	0	625	149%	119%	480	343%	YES	686%	YES	YES	389%	YES	210%	YES
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

	WARRANT	WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
	1 A	MINIMUM VOLUME:	NO	5	1	55
	B	INTERUPTION:	NO	2	3	20
S	A & B	COMBINATION:	NO	5	N/A	45
U	2	FOUR-HOUR:	YES	8	0	128
M	3 A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
M	B	PEAK HOUR VOLUME:	YES	4	2	224
A	4 No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
R	5	SCHOOL CROSSING:	NO	N/A	N/A	0
Y	6	CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
	7	ACCIDENT EXPERIENCE:	NO	6	N/A	0
	8	ROADWAY NETWORK:	NO	2	N/A	0
	9	INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
				PRIORITY VALUE		472

INTERSECTION: **US17 at US278**
SCENARIO: **2050**
DATE: 08/31/2022

		PEDESTRIAN GAPS/HOUR :	0
		ESTABLISHED SCHOOL CROSSING, MINIMUM 20 Xing (YES/NO):	NO
85TH PERCENTILE SPEED:	55	NEAREST SIGNALIZED INTERSECTION:	1000
POPULATION:	6,788	IMPROVE PROGRESSION-PLATOONING (YES/NO):	NO
NUMBER OF APPROACHES:	3	MAJOR ROUTES (YES/NO):	NO
LANES ON MAIN STREET:	1	WARRANTS IN 5 YRS (YES/NO):	NO
MINOR STREET APPROACH LANES:	2		
		ALTERNATIVES TO A SIGNAL EXPLORED:	YES
PEDESTRIANS:	N/A	NUMBER OF ACCIDENTS/YR:	0
PEAK-HOUR VOLUME (4-CONSECUTIVE 15MIN PERIODS)	YES	PEAK HOUR DELAY (VEH-HR):	0
MAJOR:	595		
110% MINOR:	515	PROXIMITY OF RR ON MINOR APPROACH TO MAJOR STREET:	0
		RAIL TRAFFIC FREQUENCY:	0 0
		MINOR APPROACH HIGH-OCCUPANCY BUSES :	0.0% 0
EXISTING OR PROPOSED SIGNAL SYSTEM (YES/NO):	N/A	TRACTOR-TRAILER PERCENTAGE	0.0% 0

	MAIN STREET				MINOR STREET								
HOUR	PEDESTRIAN VOLUME	MAIN STREET VOLUME	PERCENT OF WARRANT 1A 420	PERCENT OF WARRANT 1B 525	MINOR STREET VOLUME	MINIMUM VOLUME WARRANT 1A 140		INTERRUPTION WARRANT 1B 70		COMBINATION WARRANT A&B	4-HOUR WARRANT 2		PEAK HOUR WARRANT 3B	
24-1	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
1-2	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
2-3	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
3-4	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
4-5	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
5-6	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
6-7	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
7-8	0	1,130	269%	215%	625	446%	YES	893%	YES	YES	781%	YES	733%	YES
8-9	0	597	142%	114%	330	236%	YES	472%	YES	YES	249%	YES	137%	YES
9-10	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
10-11	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
11-12	0	237	56%	45%	164	117%	NO	234%	NO	NO	55%	NO	38%	NO
12-13	0	207	49%	39%	143	102%	NO	204%	NO	NO	46%	NO	32%	NO
13-14	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
14-15	0	440	105%	84%	371	265%	YES	530%	NO	YES	192%	YES	117%	YES
15-16	0	573	136%	109%	483	345%	YES	691%	YES	YES	343%	YES	192%	YES
16-17	0	556	132%	106%	469	335%	YES	671%	YES	YES	320%	YES	181%	YES
17-18	0	705	168%	134%	595	425%	YES	850%	YES	YES	594%	YES	302%	YES
18-19	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
19-20	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
20-21	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
21-22	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
22-23	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO
23-24	0	0	0%	0%	0	0%	NO	0%	NO	NO	0%	NO	0%	NO

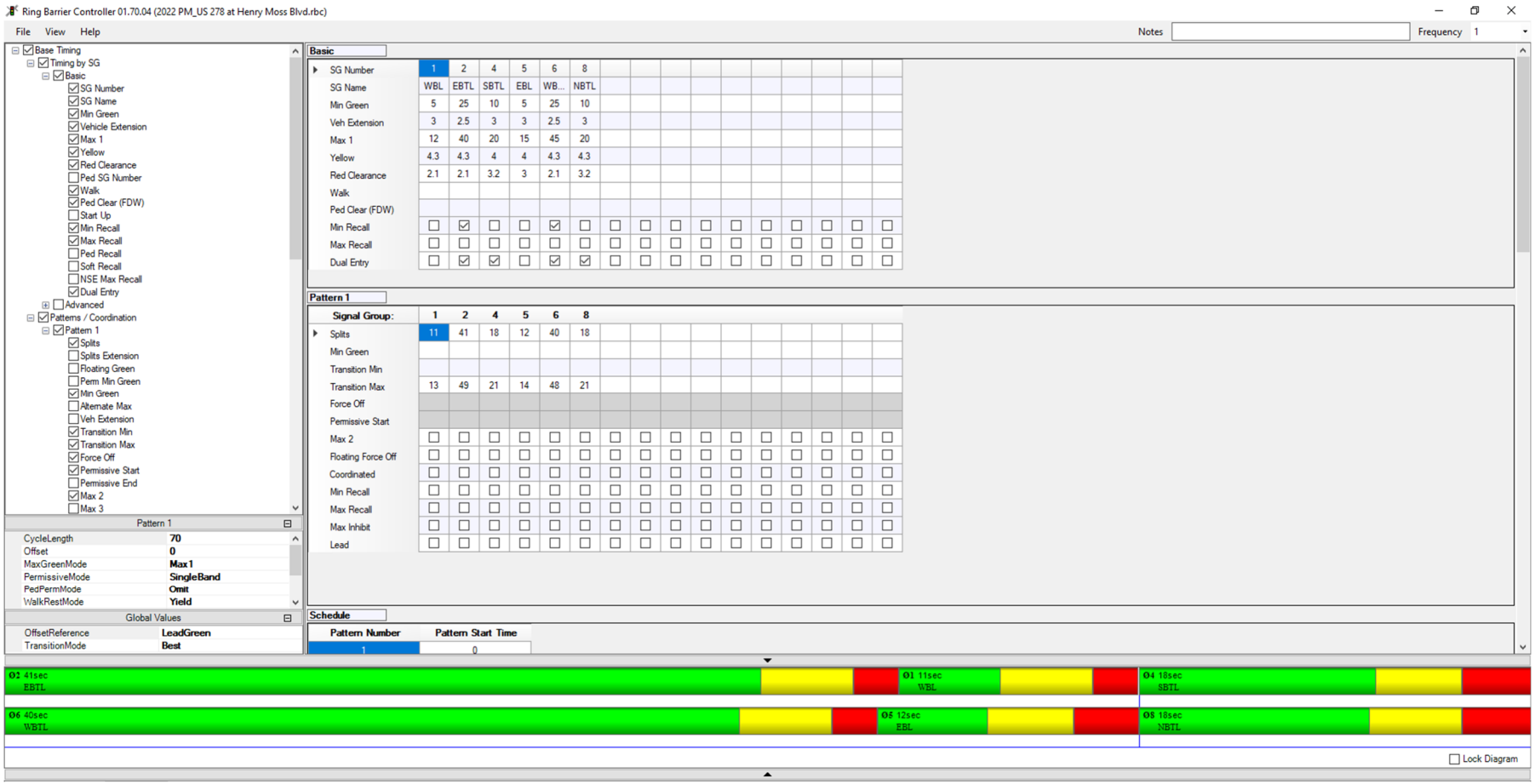
SUMMARY

WARRANT		WARRANT DESCRIPTION	WARRANT OBTAINED?	HOURS	>=90% HOURS	PRIORITY POINTS
1	A	MINIMUM VOLUME:	NO	6	0	66
	B	INTERUPTION:	NO	5	0	50
	A & B	COMBINATION:	NO	6	N/A	54
2		FOUR-HOUR:	YES	6	0	96
3	A	PEAK HOUR DELAY:	N/A	N/A	N/A	0
	B	PEAK HOUR VOLUME:	YES	6	0	336
4	No data collected	MINIMUM PED. VOLUMES:	N/A	N/A	N/A	N/A
5		SCHOOL CROSSING:	NO	N/A	N/A	0
6		CORD. SIGNAL SYSTEM:	NO	N/A	N/A	0
7		ACCIDENT EXPERIENCE:	NO	6	N/A	0
8		ROADWAY NETWORK:	NO	4	N/A	0
9		INTERSECTION NEAR A GRADE CROSS	N/A	0	0	0
				PRIORITY VALUE		602

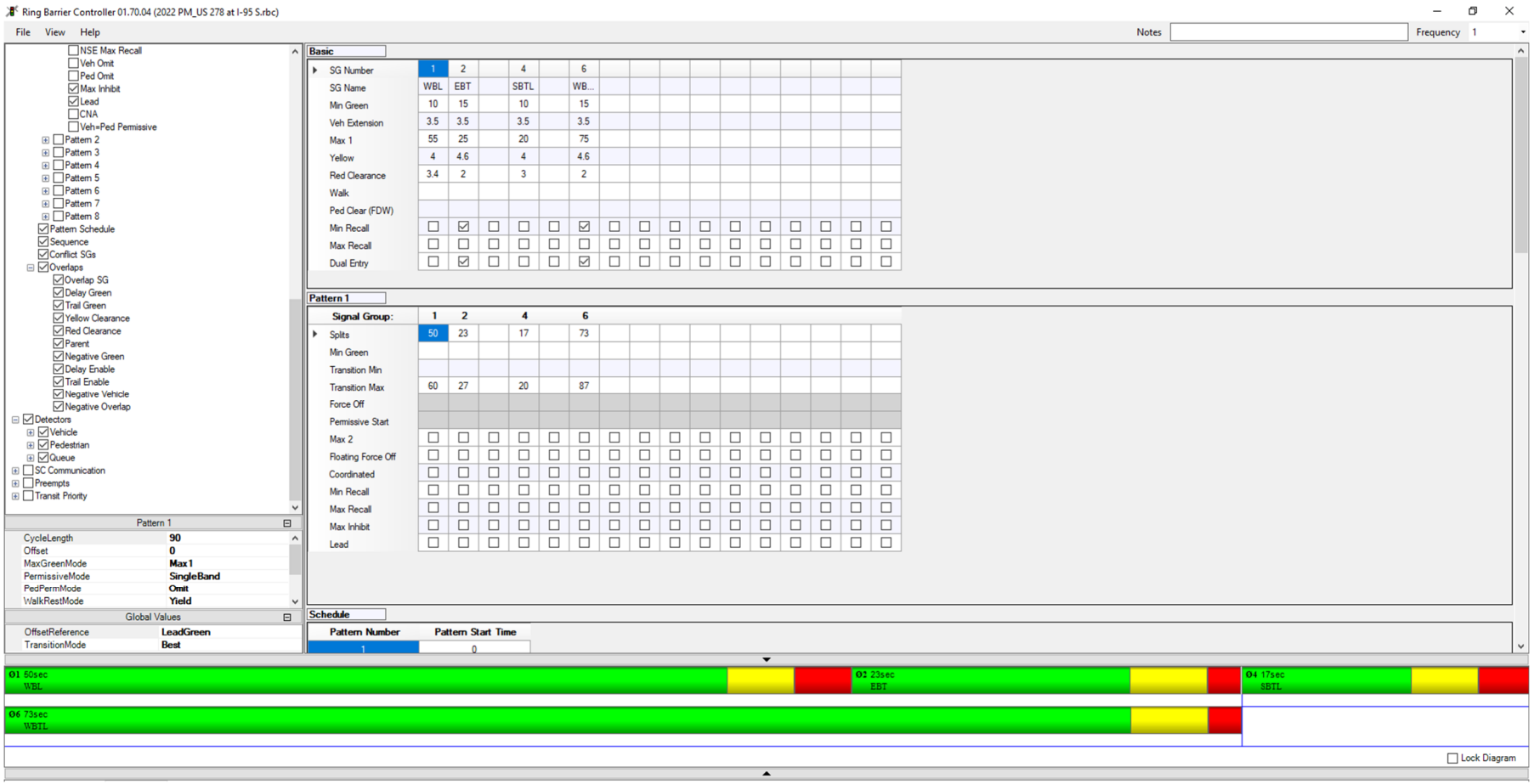
APPENDIX H. VISSIM SIGNAL TIMING INPUTS

2022 Existing Conditions

2022 Existing PM US 278 at Henry Moss Boulevard

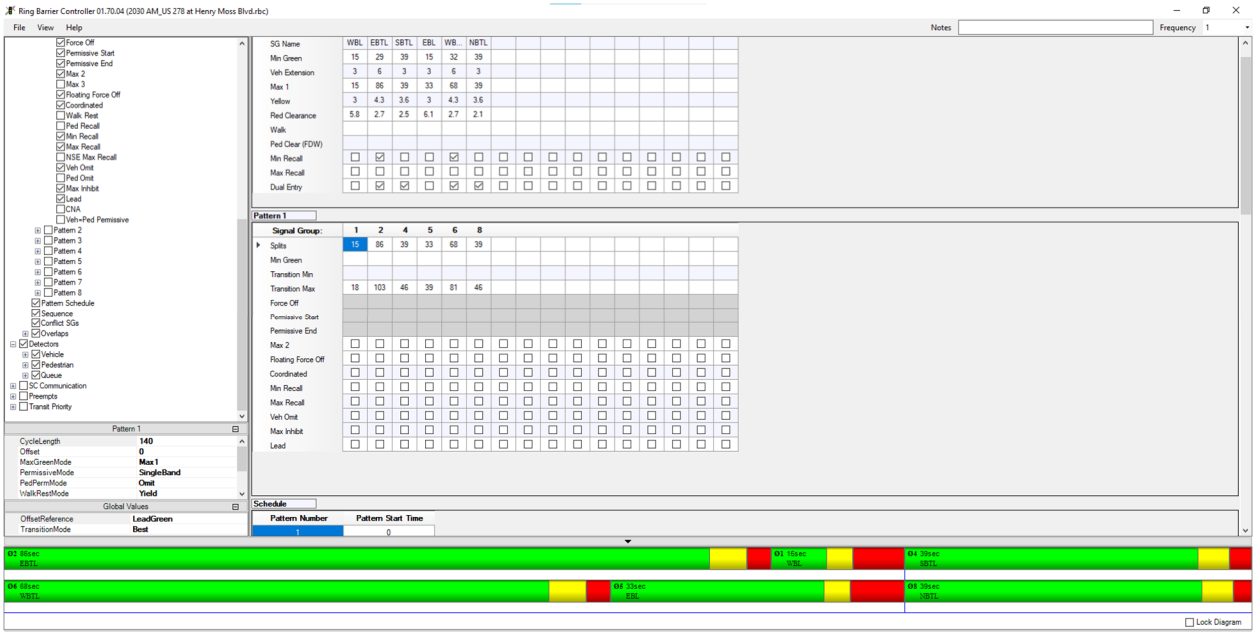


2022 Existing PM US 278 at I-95 SB Ramps

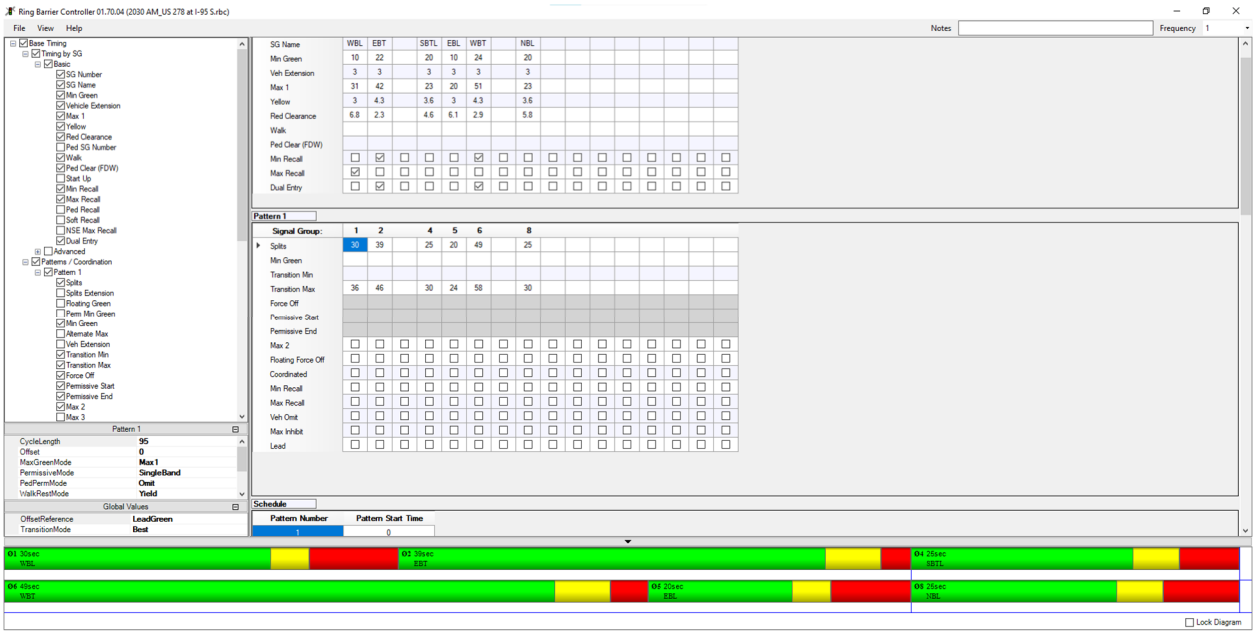


SPUI 2030

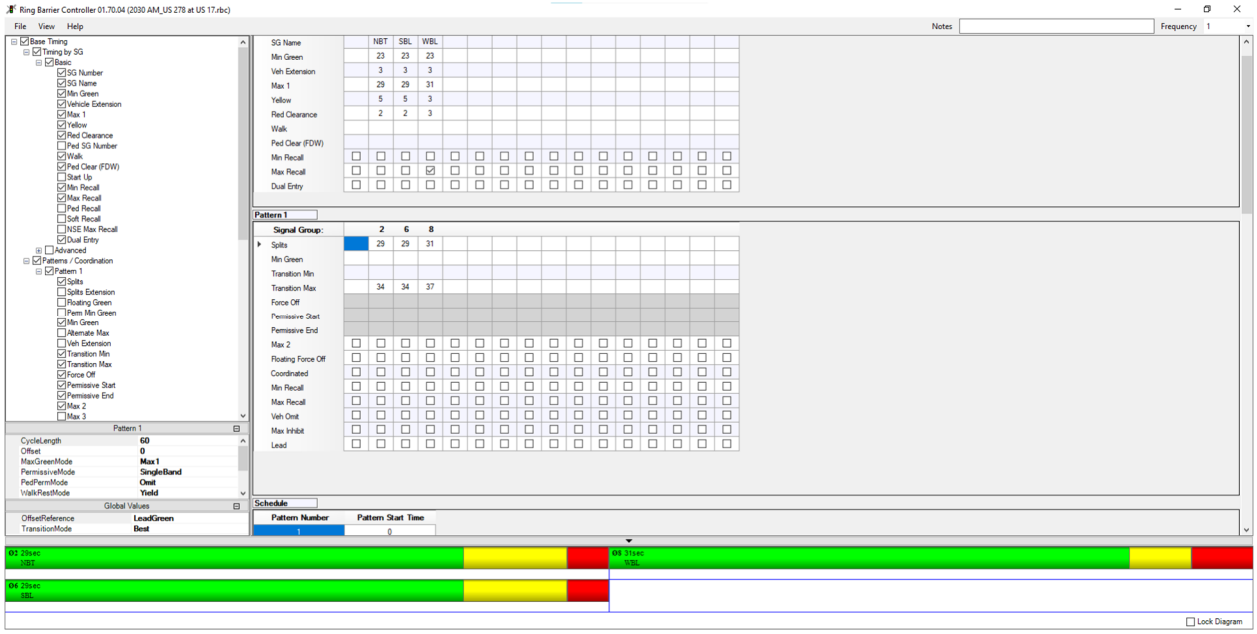
2030 Single Point Urban Interchange AM US 278 at Henry Moss Boulevard



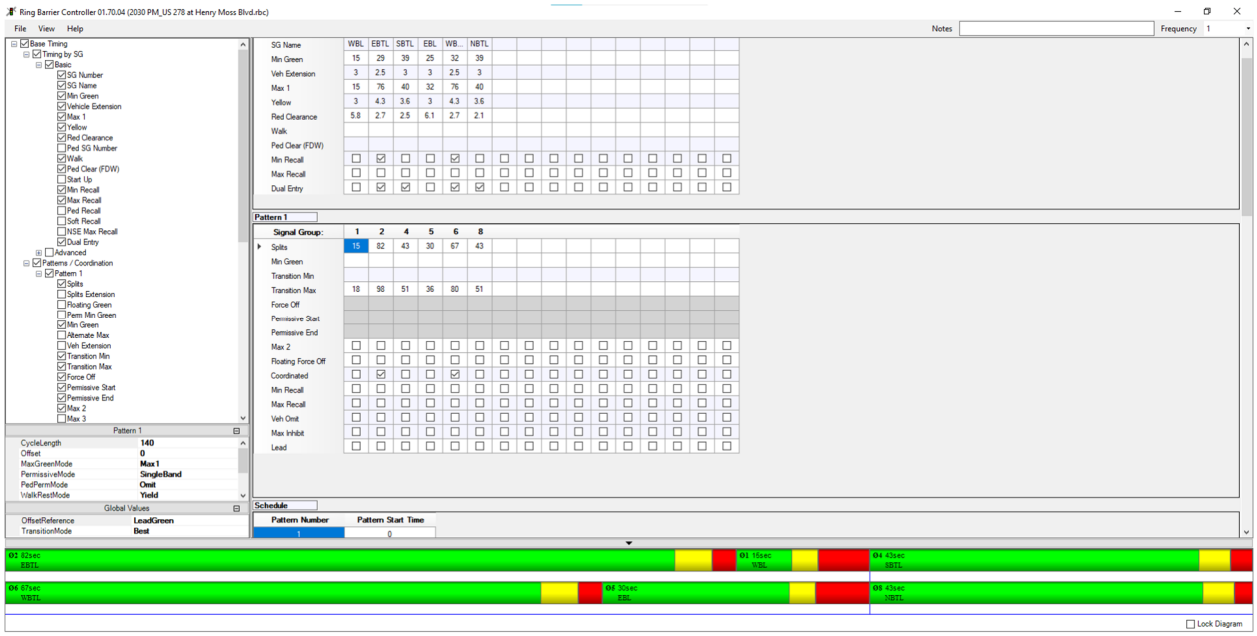
2030 Single Point Urban Interchange AM US 278 at I-95 Ramps



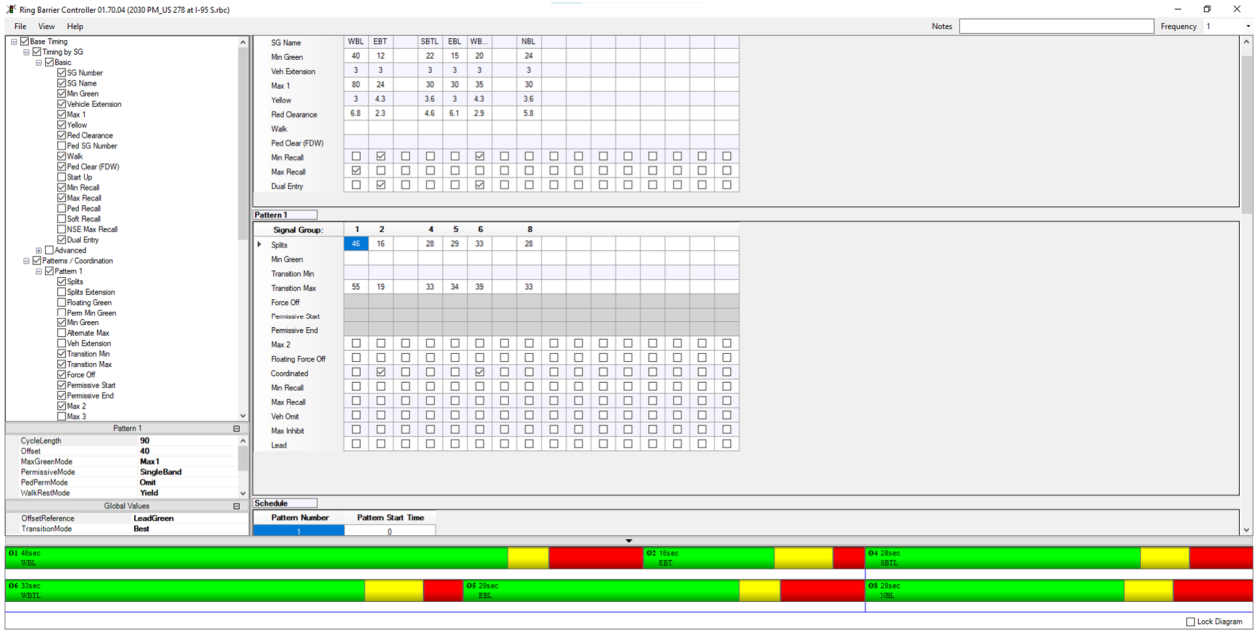
2030 Single Point Urban Interchange AM US 278 at US 17



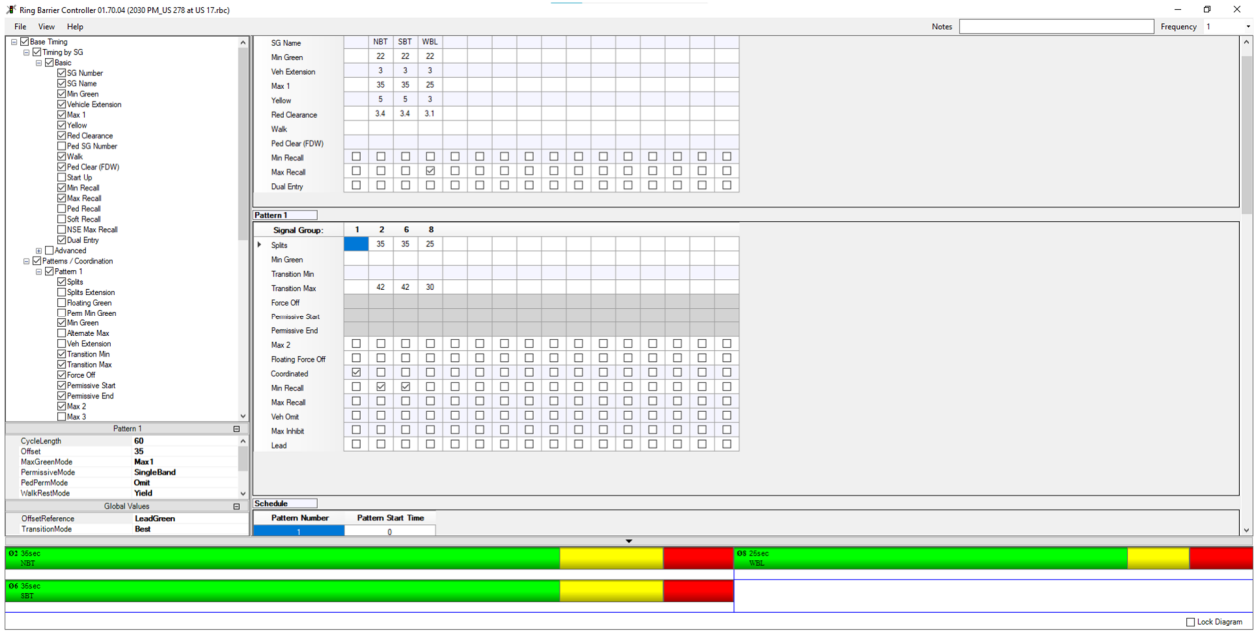
2030 Single Point Urban Interchange PM US 278 at Henry Moss Boulevard



2030 Single Point Urban Interchange PM US 278 at I-95 Ramps

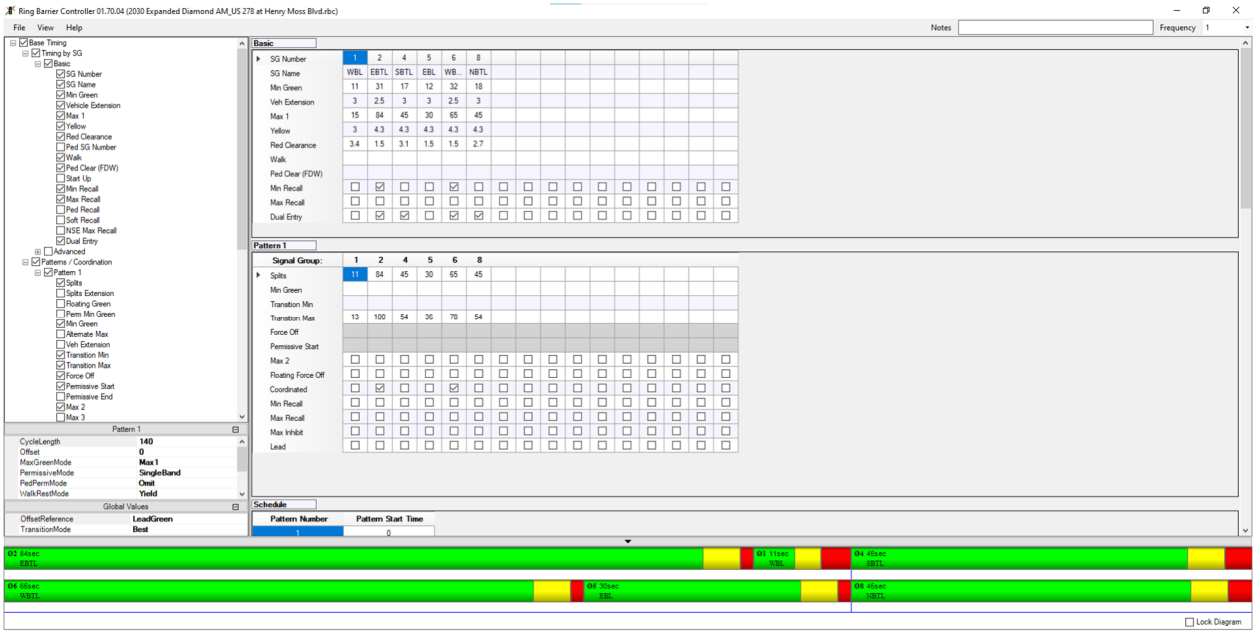


2030 Single Point Urban Interchange PM US 278 at US 17

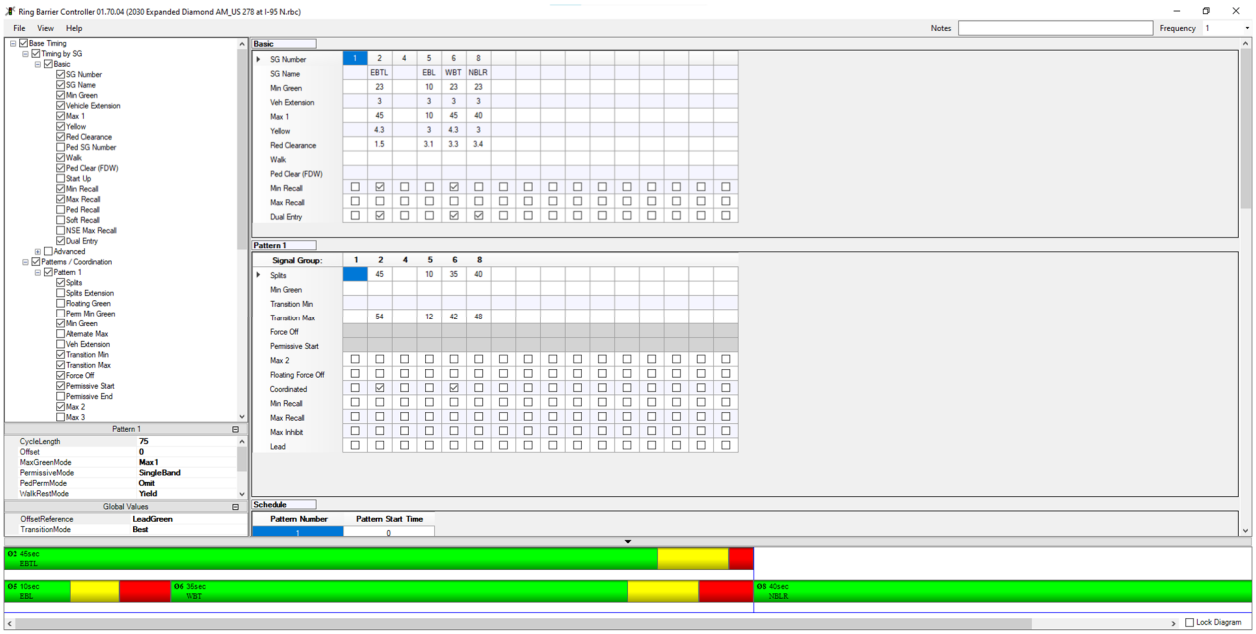


EXPANDED DIAMOND 2030

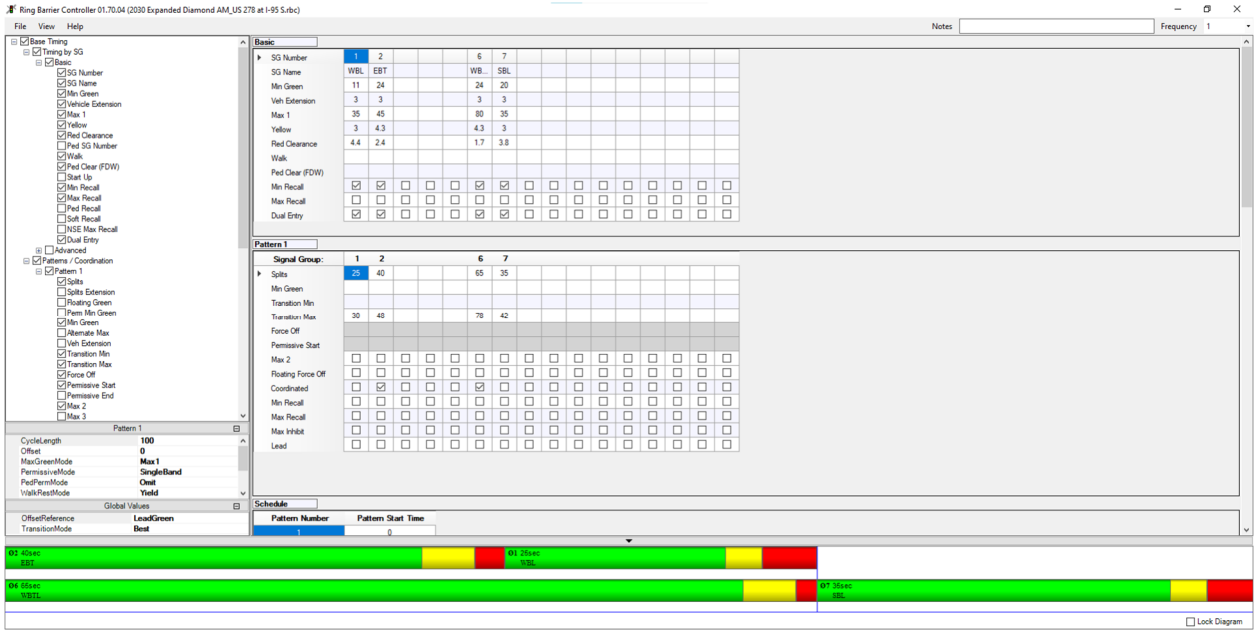
2030 Build AM Expanded US 278 at Henry Moss Boulevard



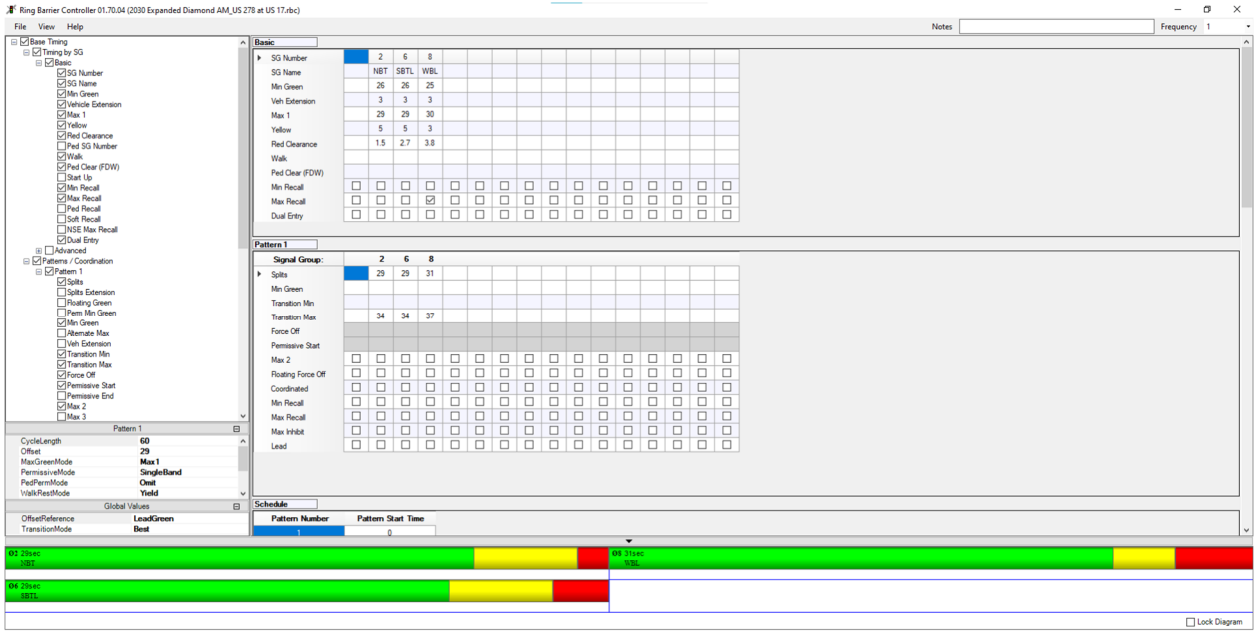
2030 Build AM Expanded US 278 at I-95 NB Ramps



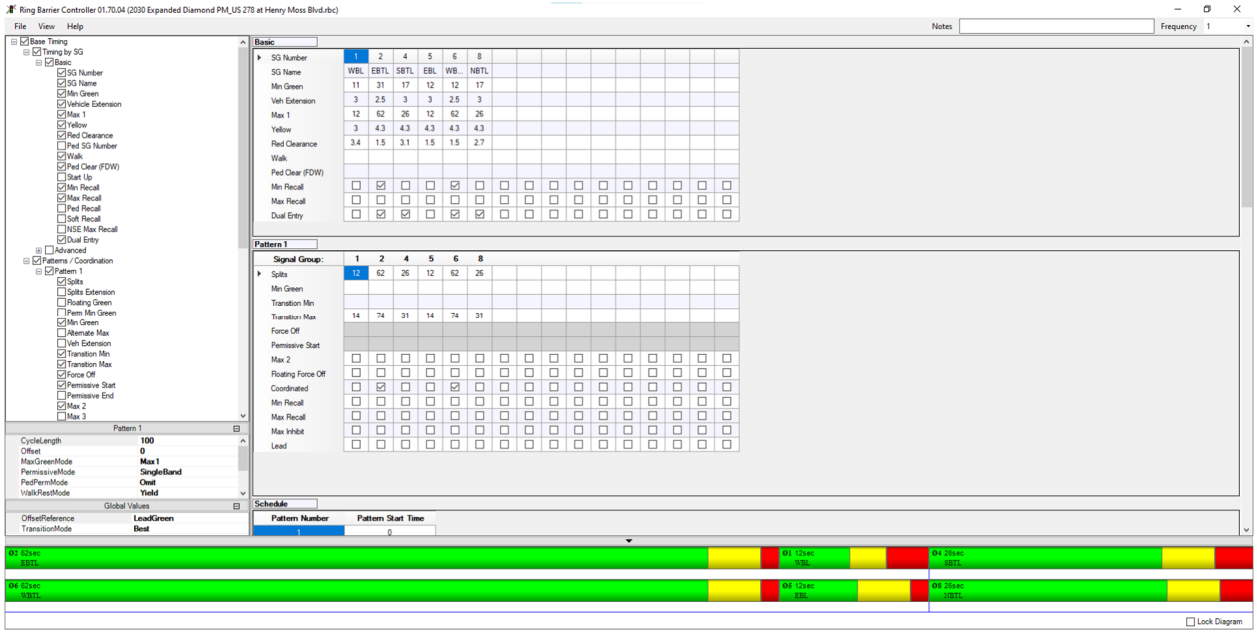
2030 Build AM Expanded US 278 at I-95 SB Ramps



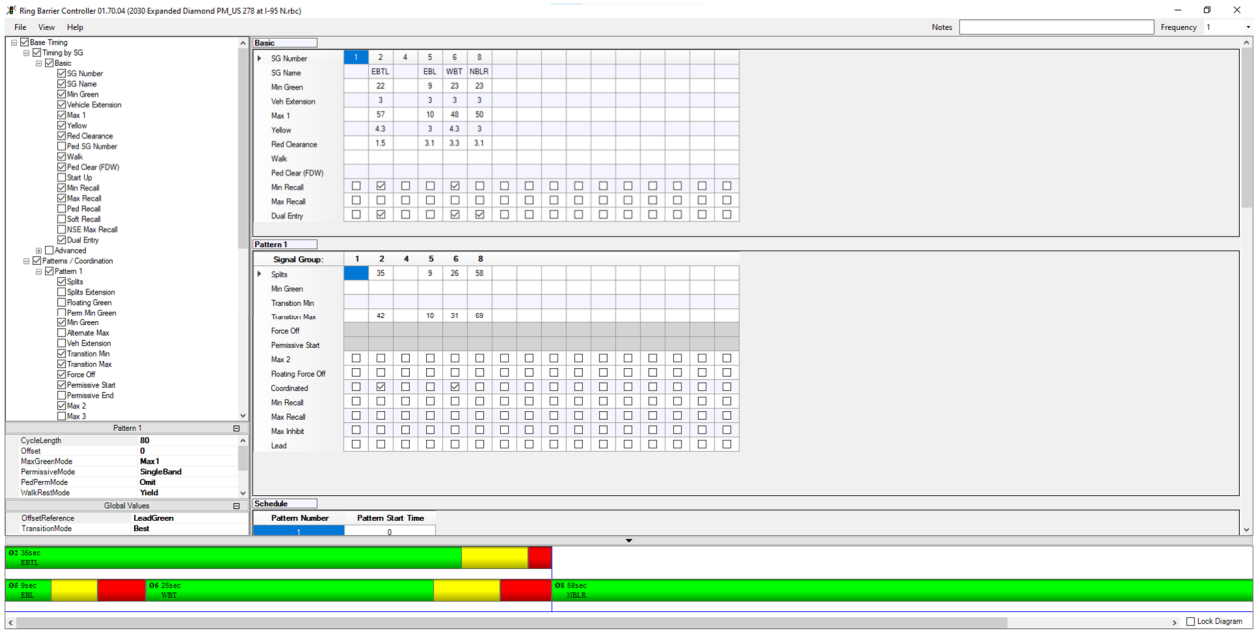
2030 Build AM Expanded US 278 at US17



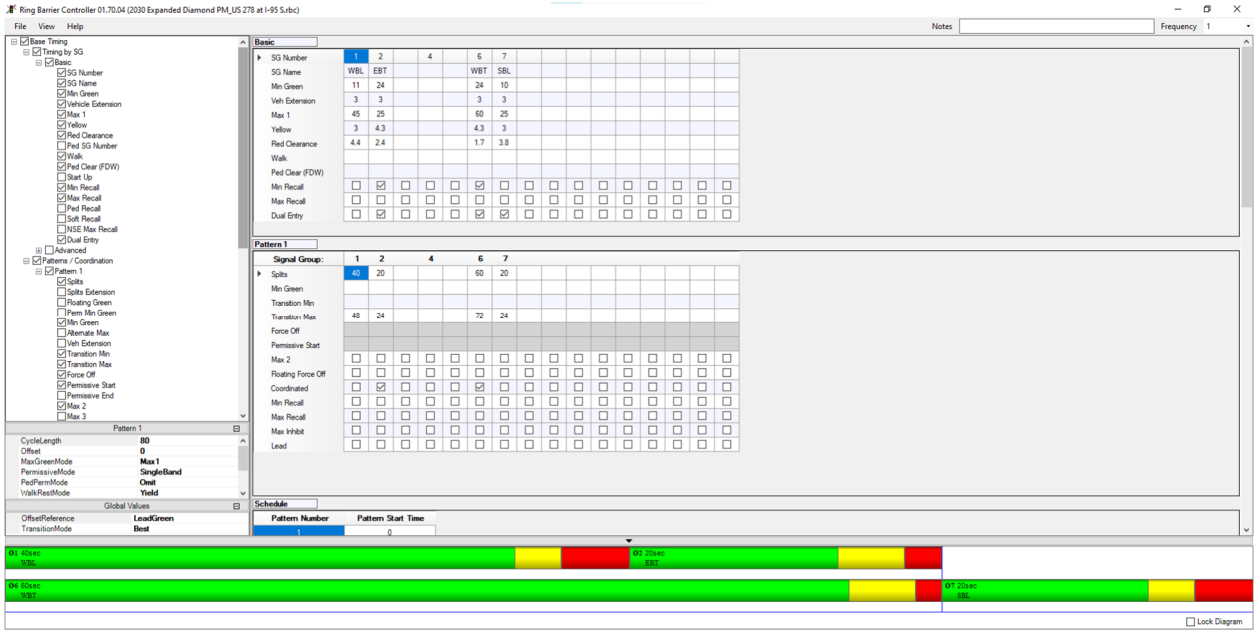
2030 Build PM Expanded US 278 at Henry Moss Boulevard



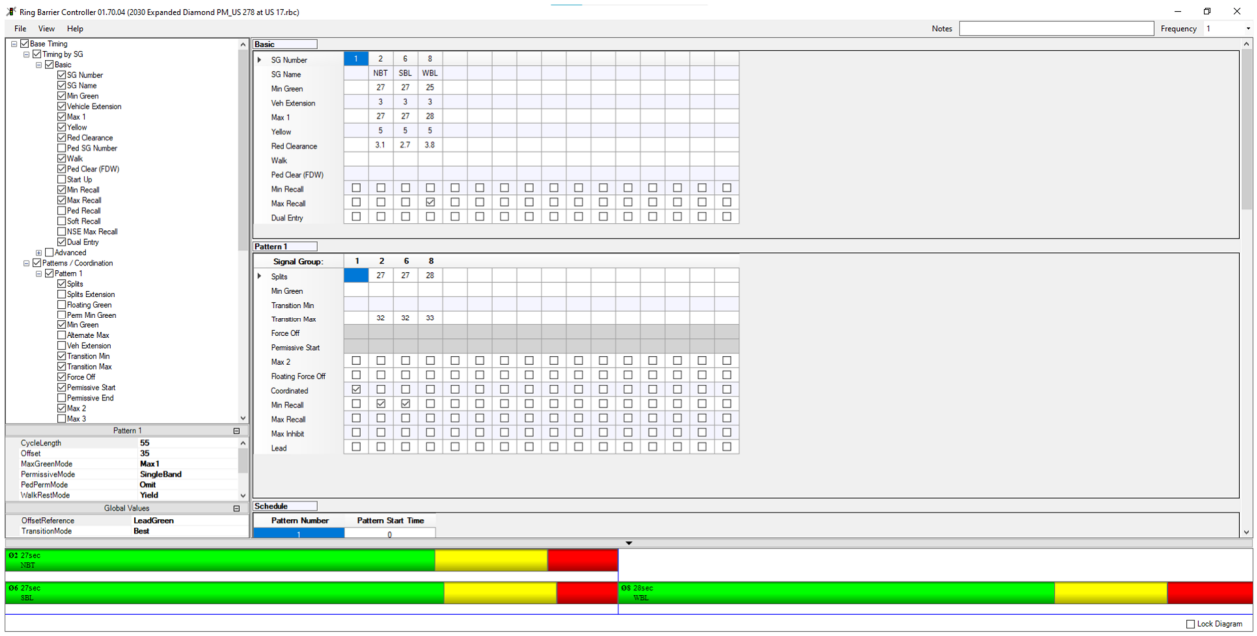
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2030 Build PM Expanded US 278 at I-95 SB Ramps

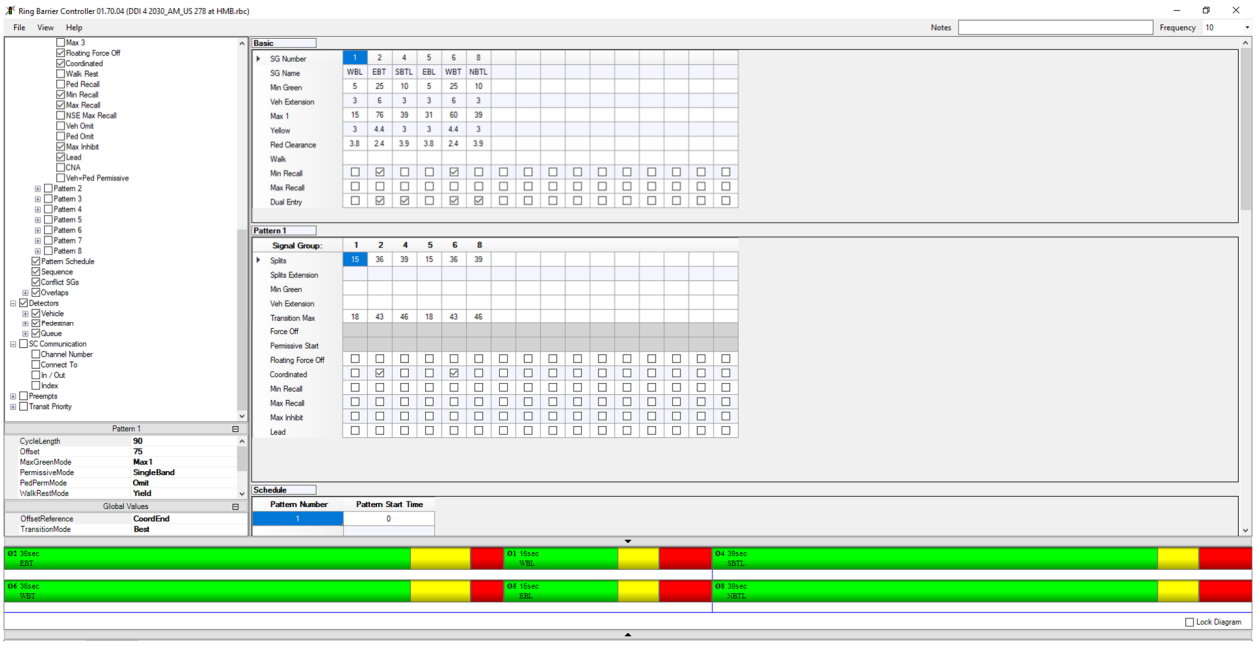


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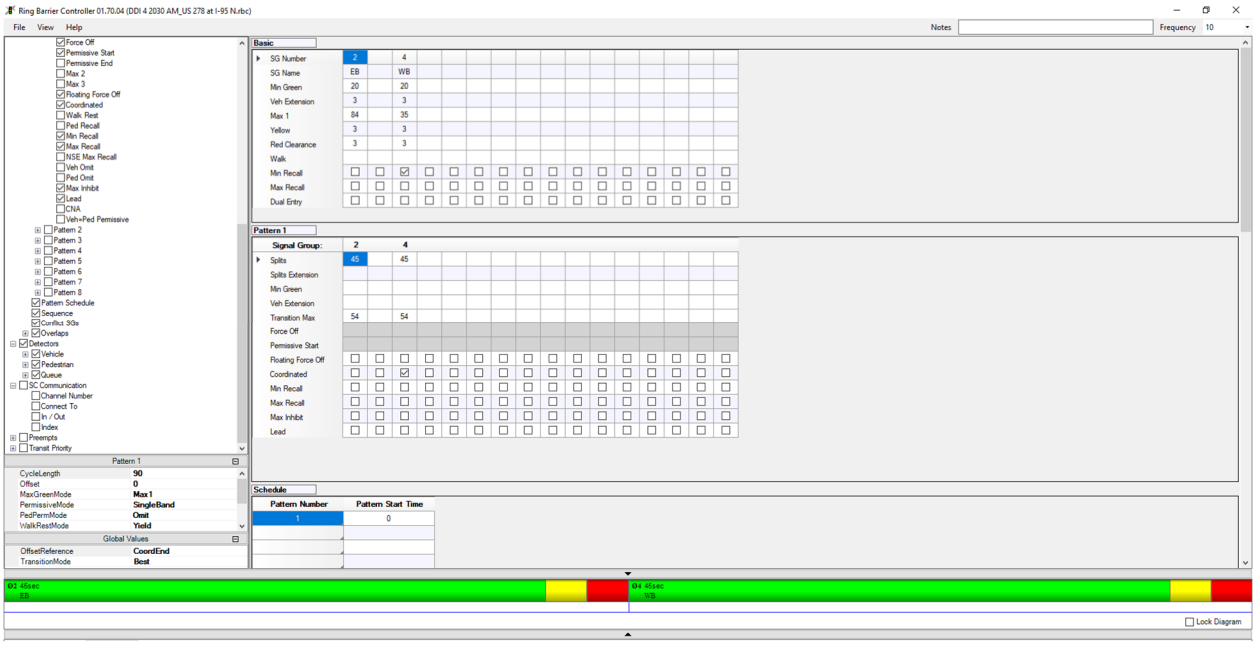


DDI 4 lane 2030

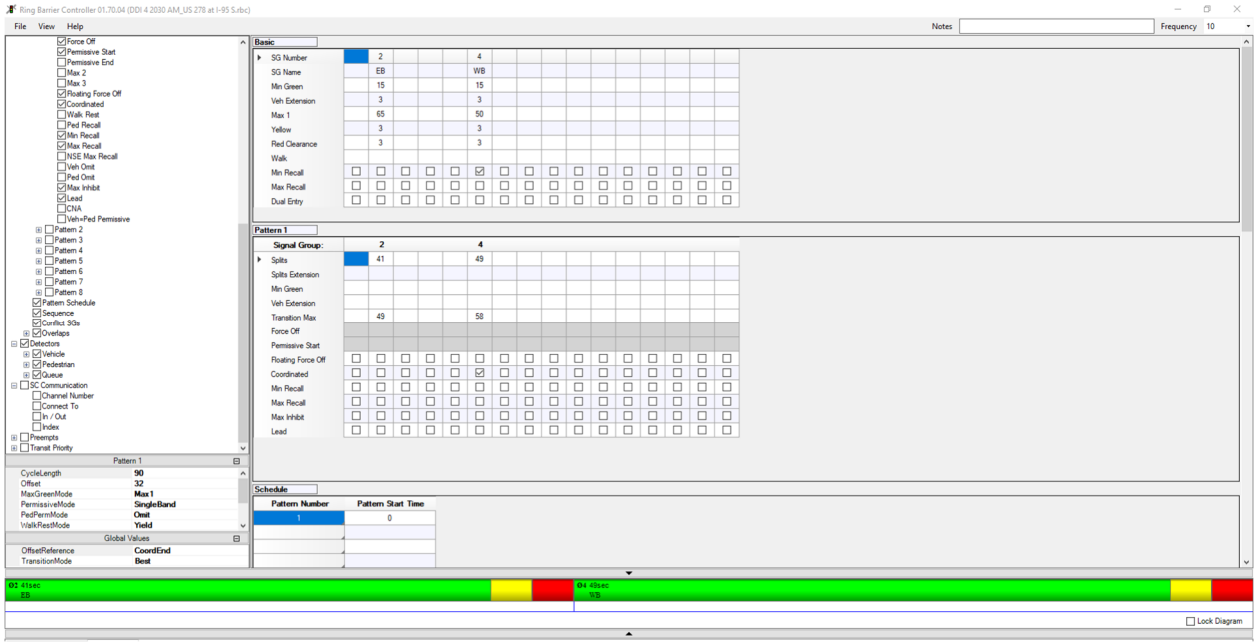
2030 4 lane AM US 278 at Henry Moss Boulevard



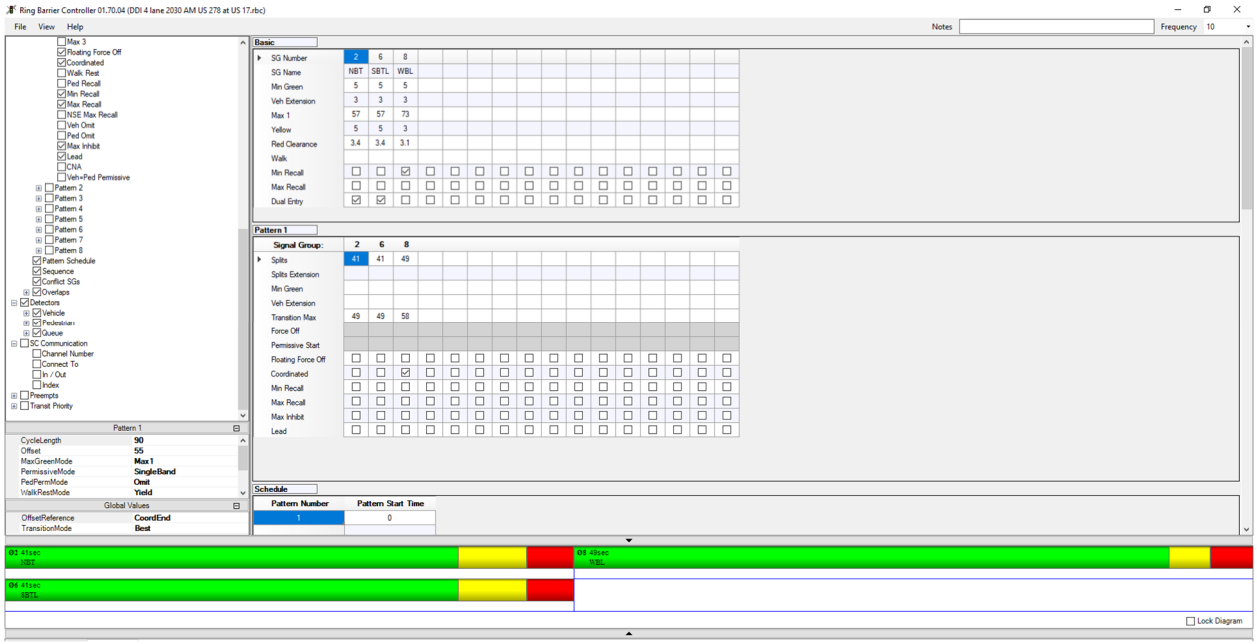
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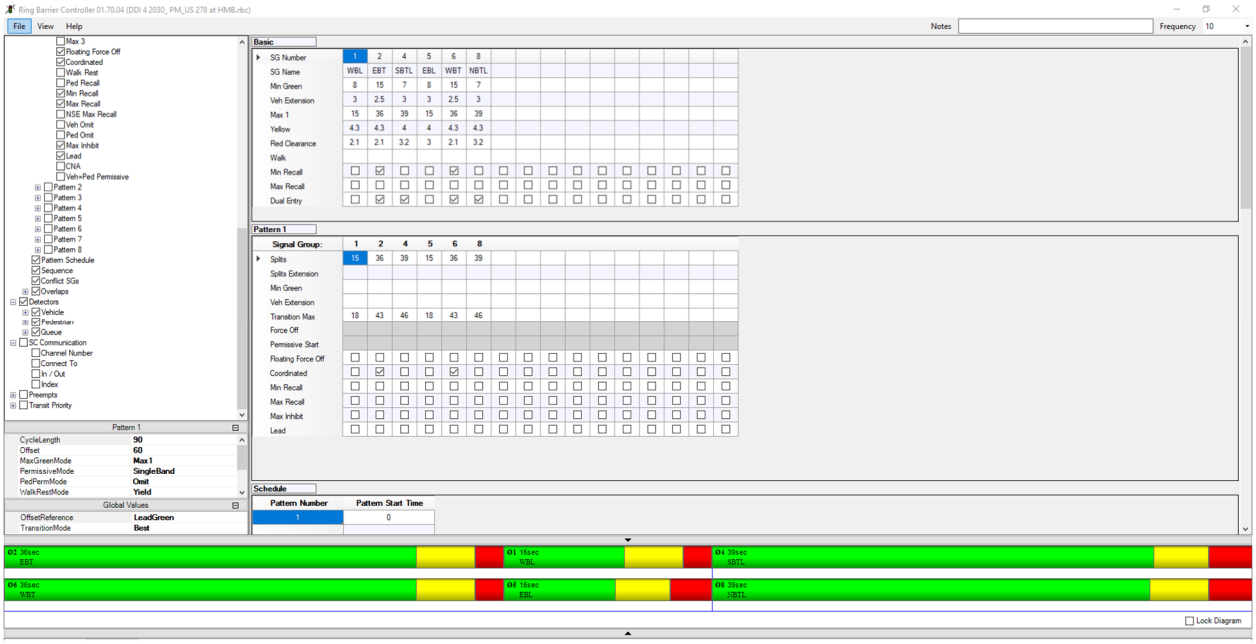
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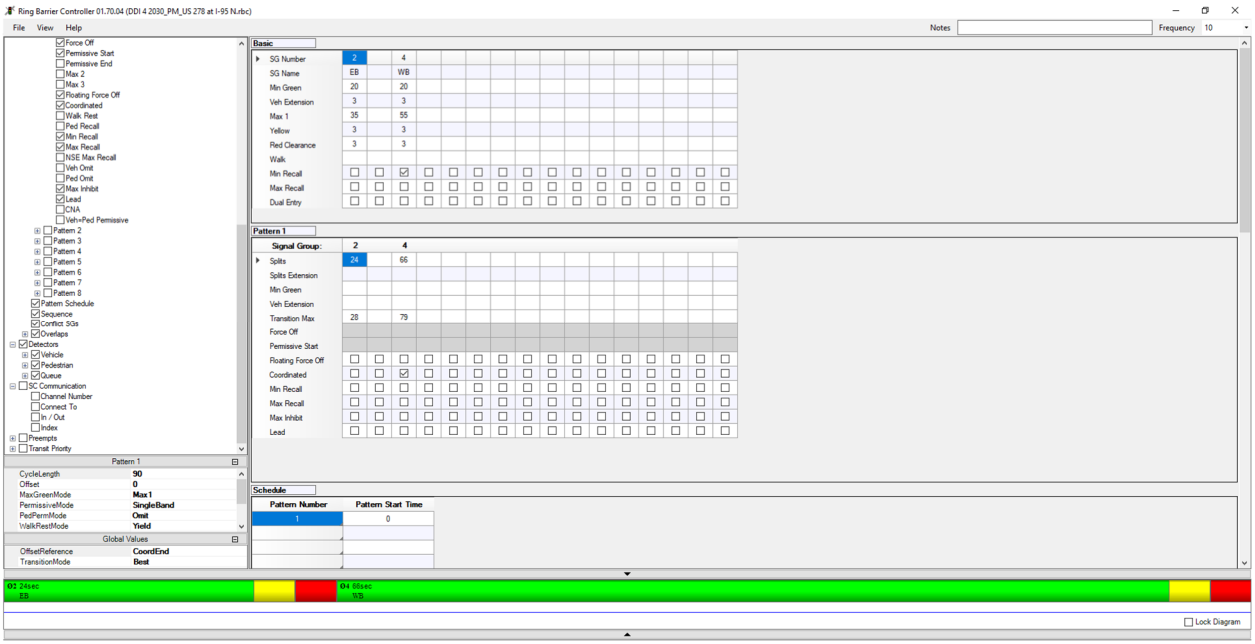
2030 4 lane AM US 278 at US 17



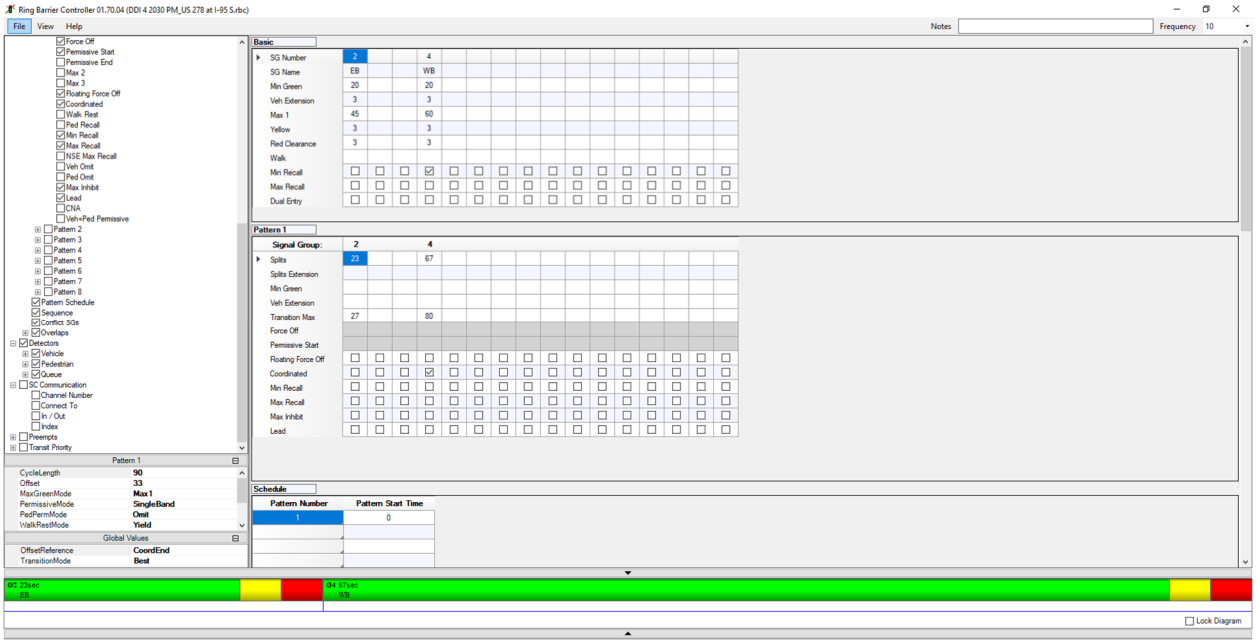
2030 4 lane PM US 278 at Henry Moss Boulevard



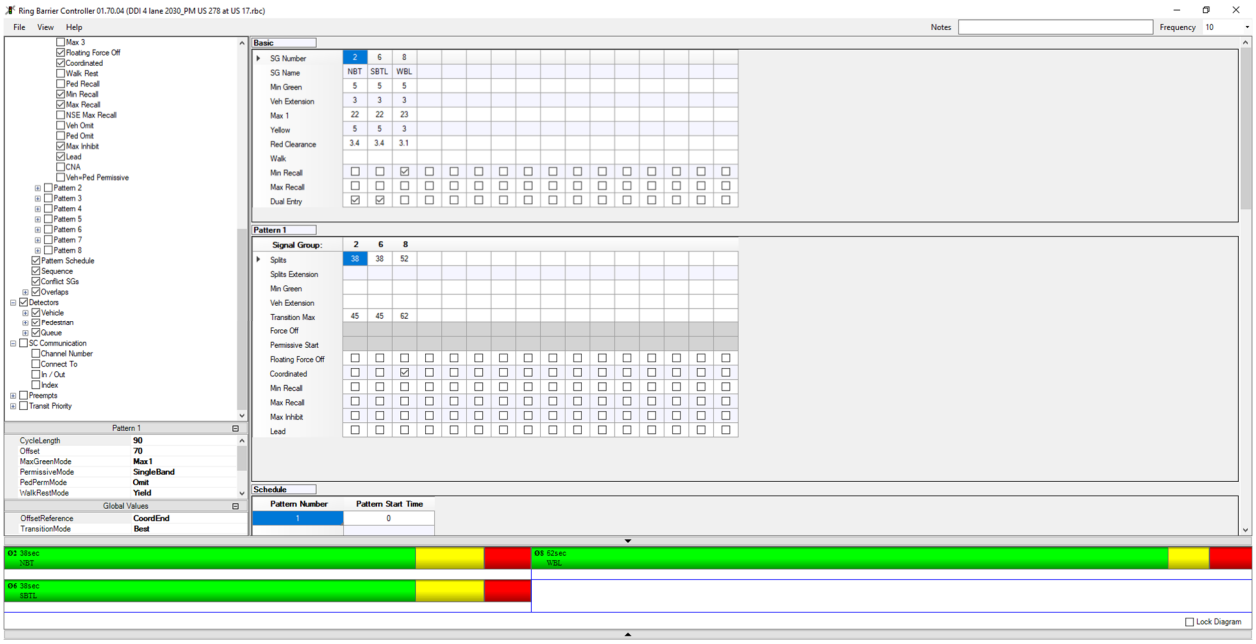
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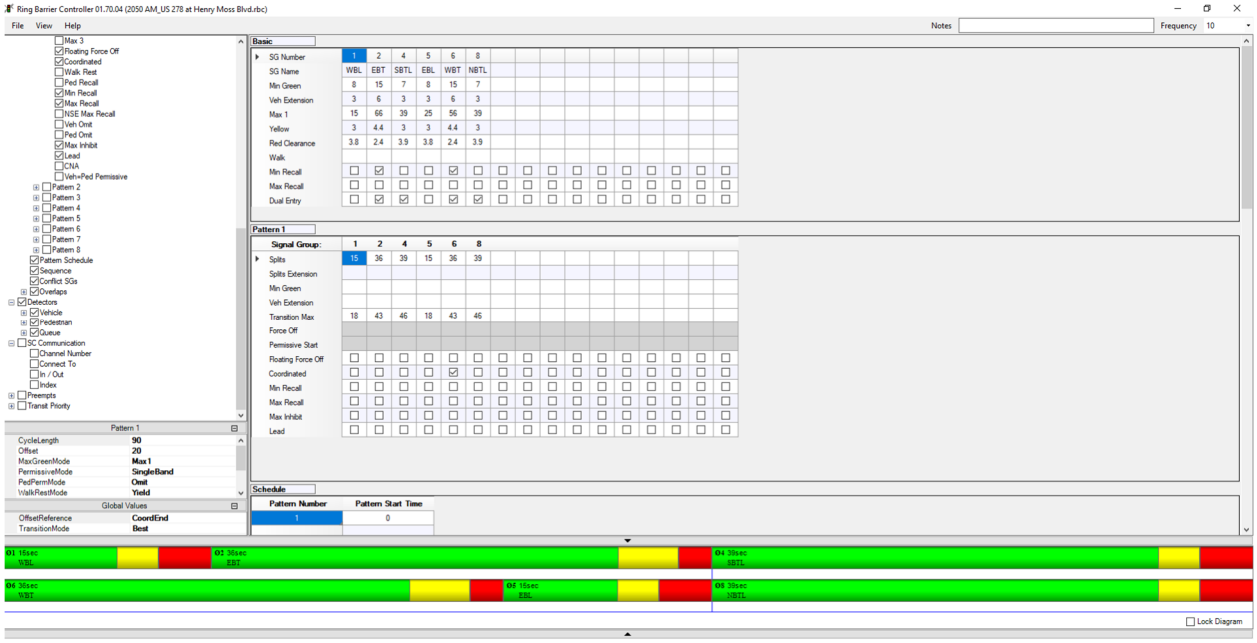


2030 4 lane PM US 278 at US 17

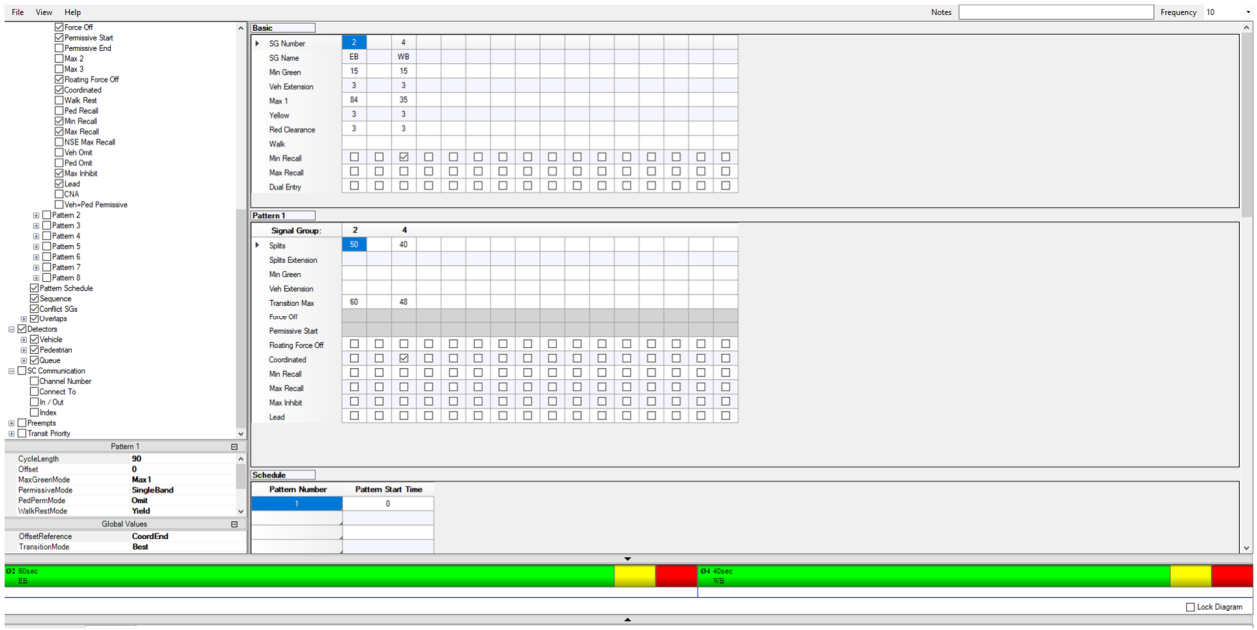


DDI 6 lane 2030

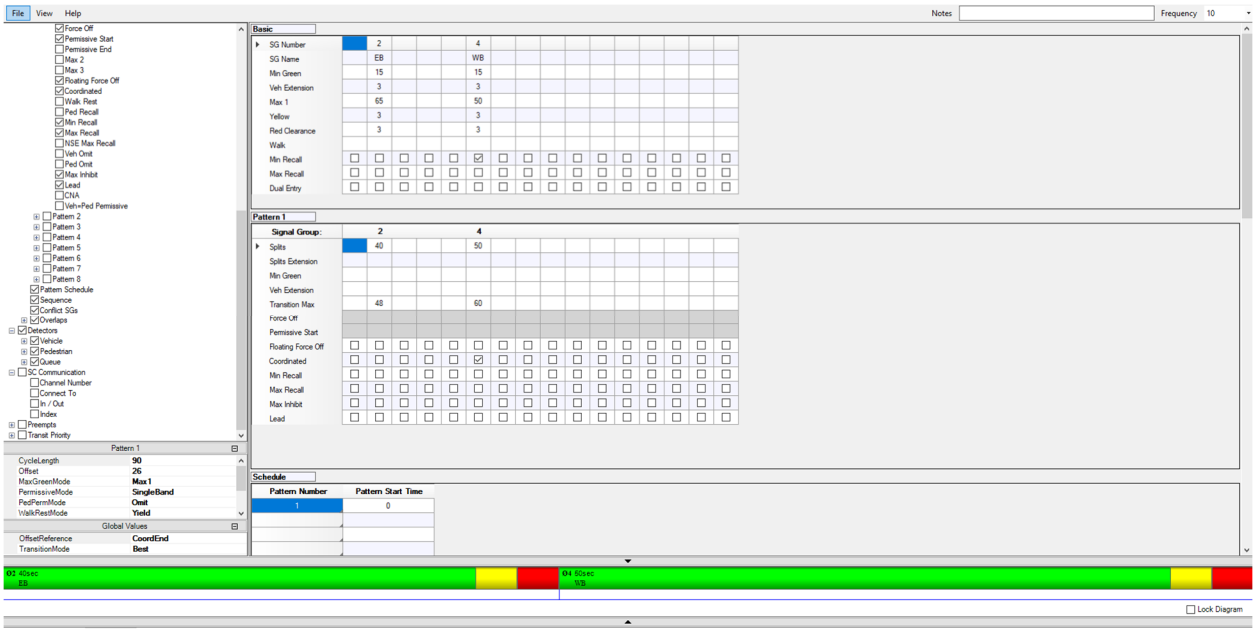
2030 6 lane AM US 278 at Henry Moss Boulevard



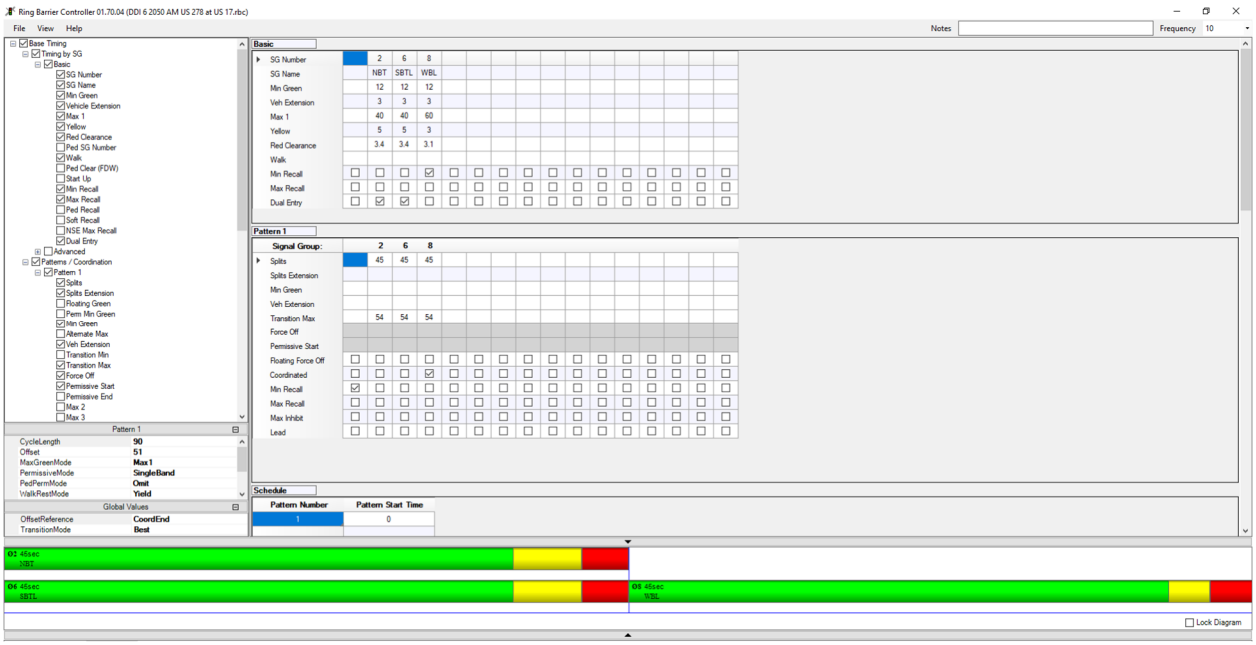
2030 6 lane AM US 278 at i-95 NB Ramps



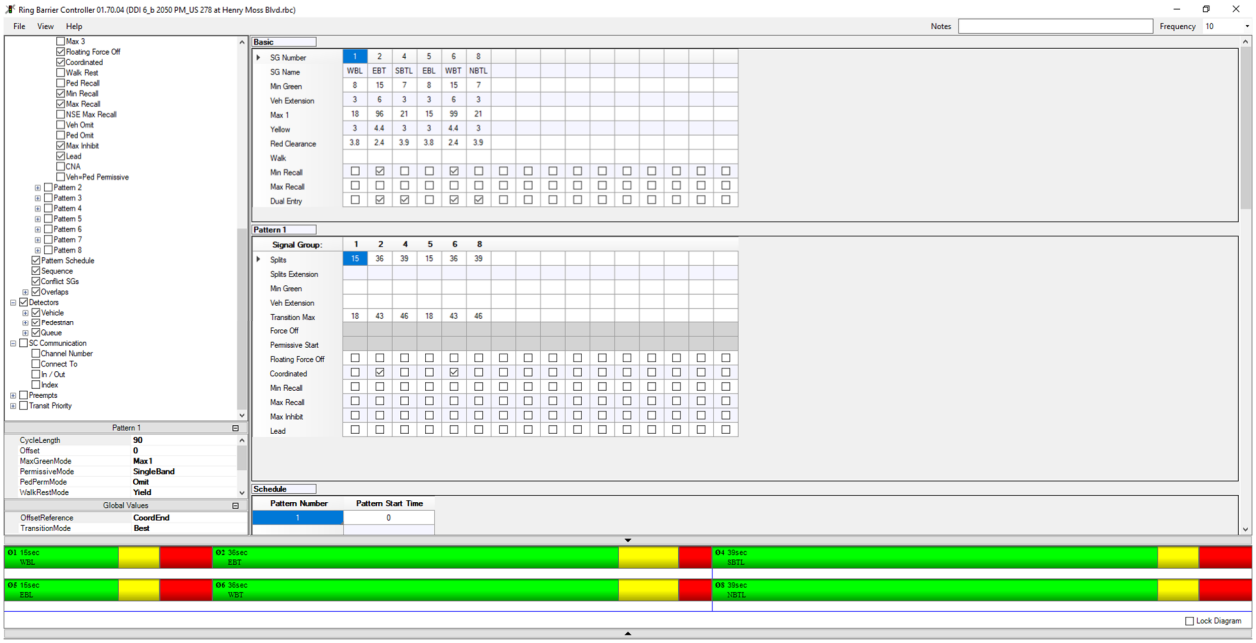
2030 6 lane AM US 278 at I-95 SB Ramps



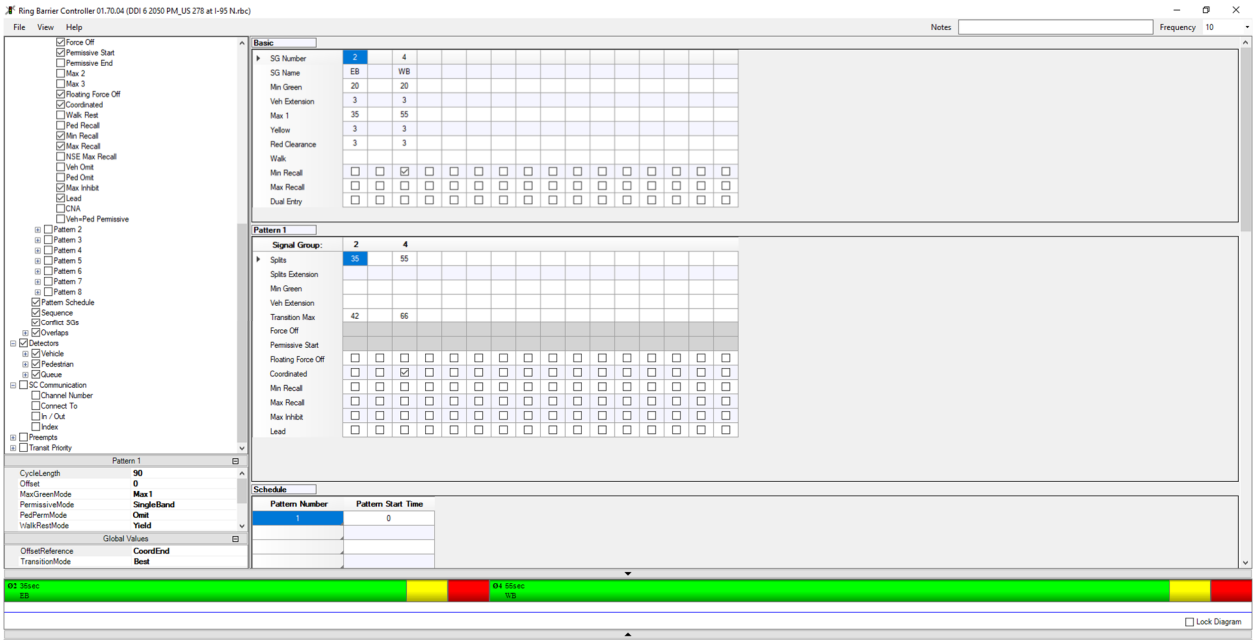
2030 6 lane AM US 278 at US 17



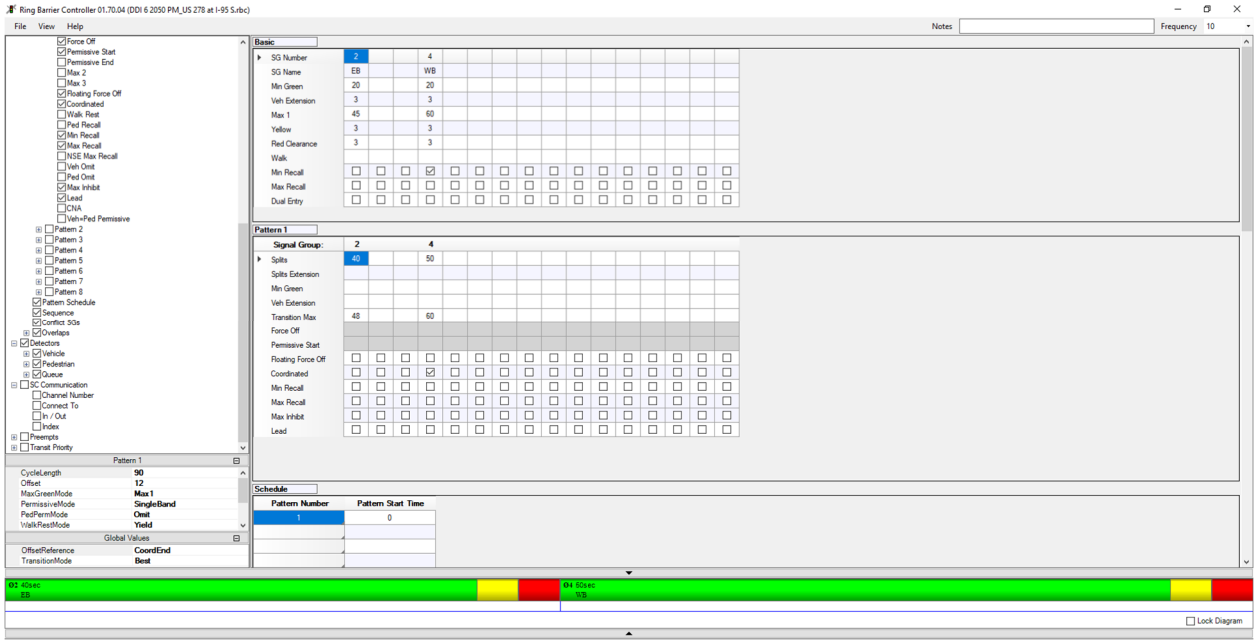
2030 6 lane PM US 278 at Henry Moss Boulevard



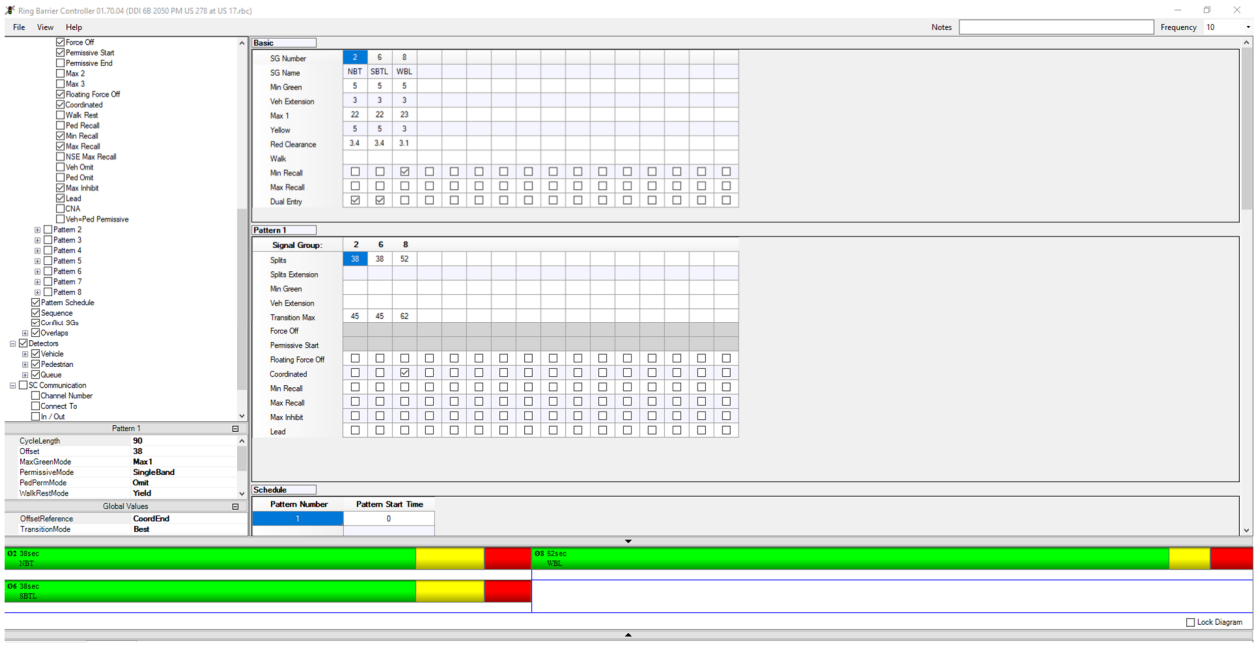
2030 6 lane PM US 278 at i-95 NB Ramps



2030 6 lane PM US 278 at I-95 SB Ramps

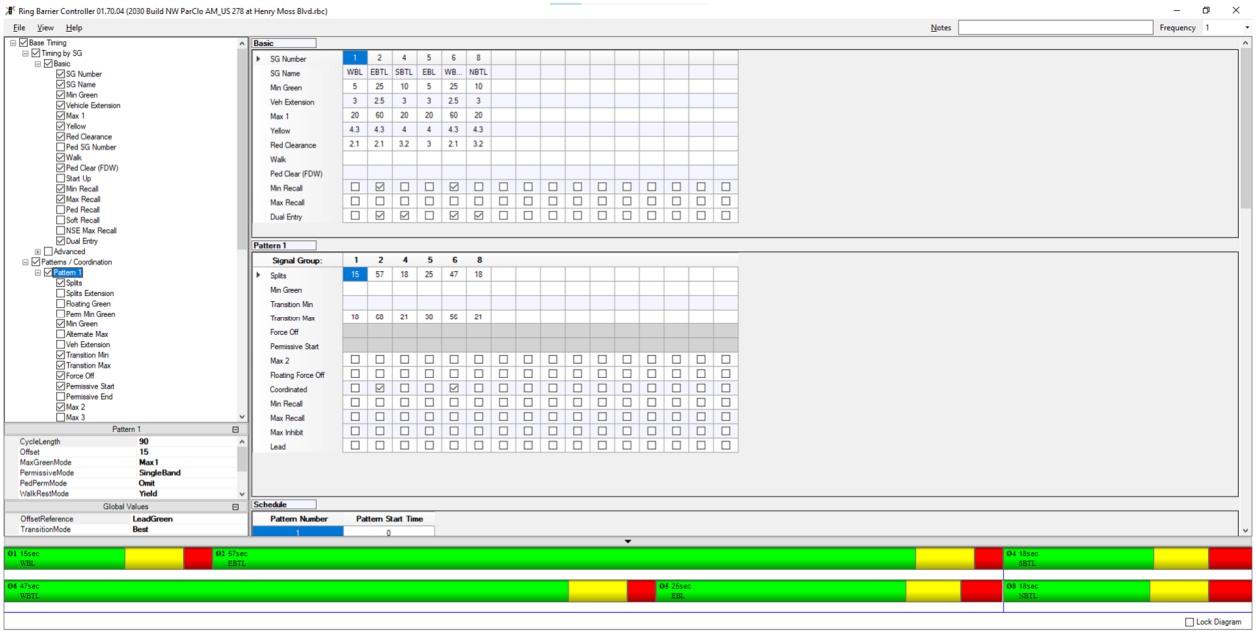


2030 6 lane PM US 278 at US 17

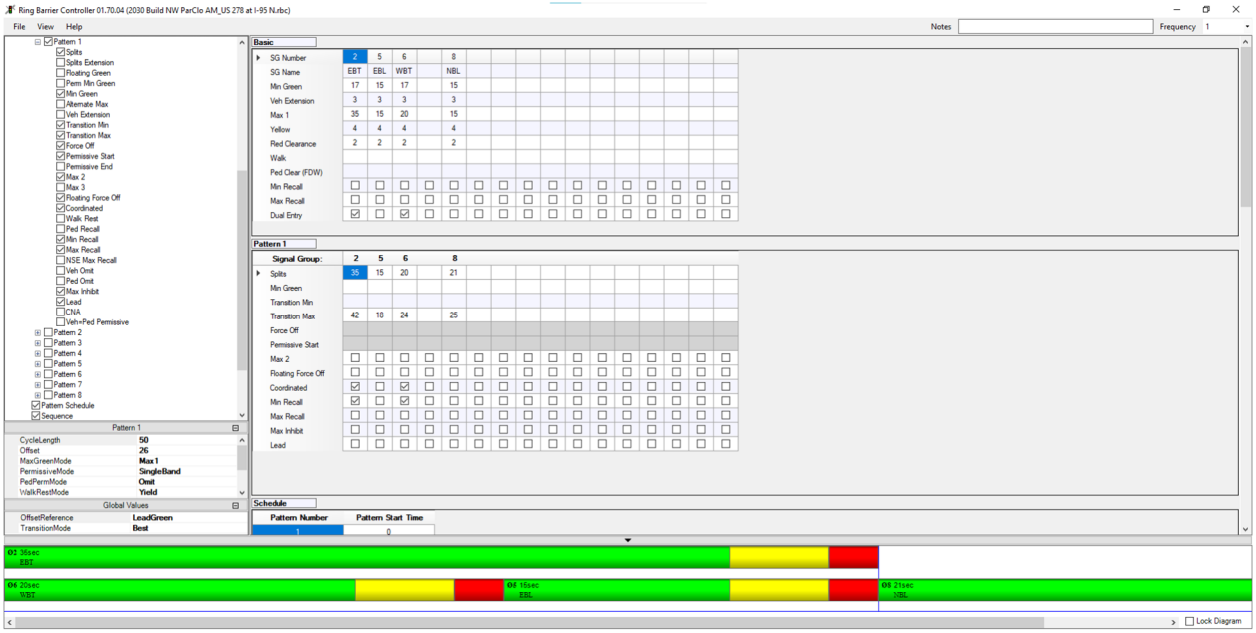


2030 Parclo NW

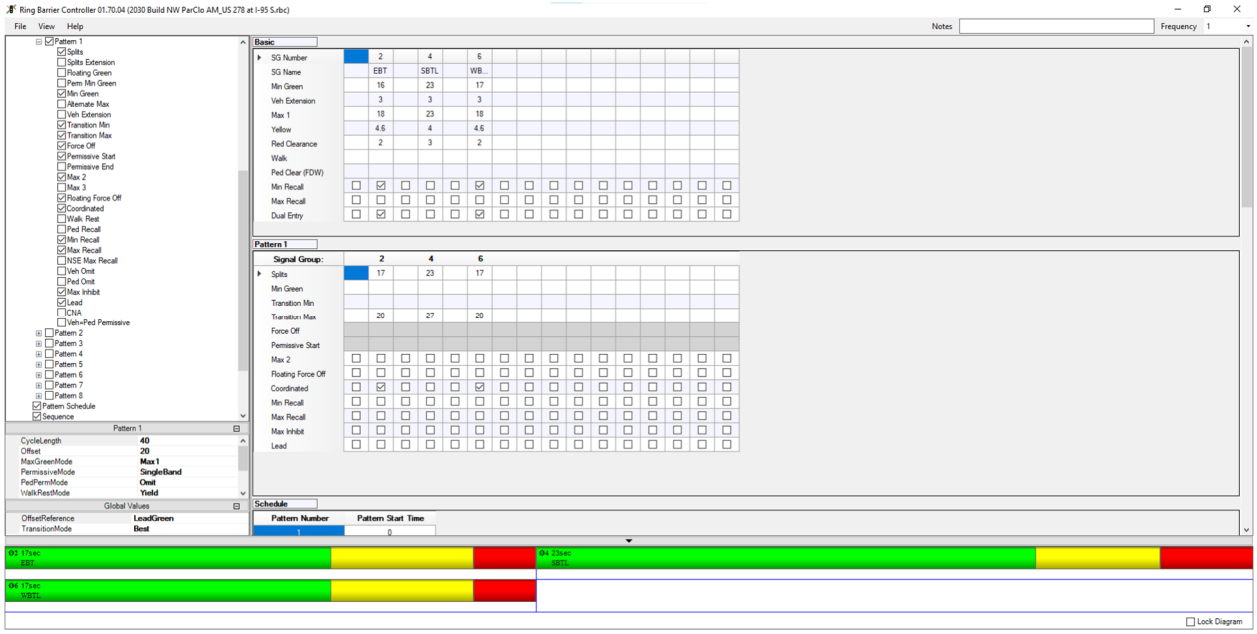
2030 NW ParClo AM US 278 at Henry Moss Boulevard



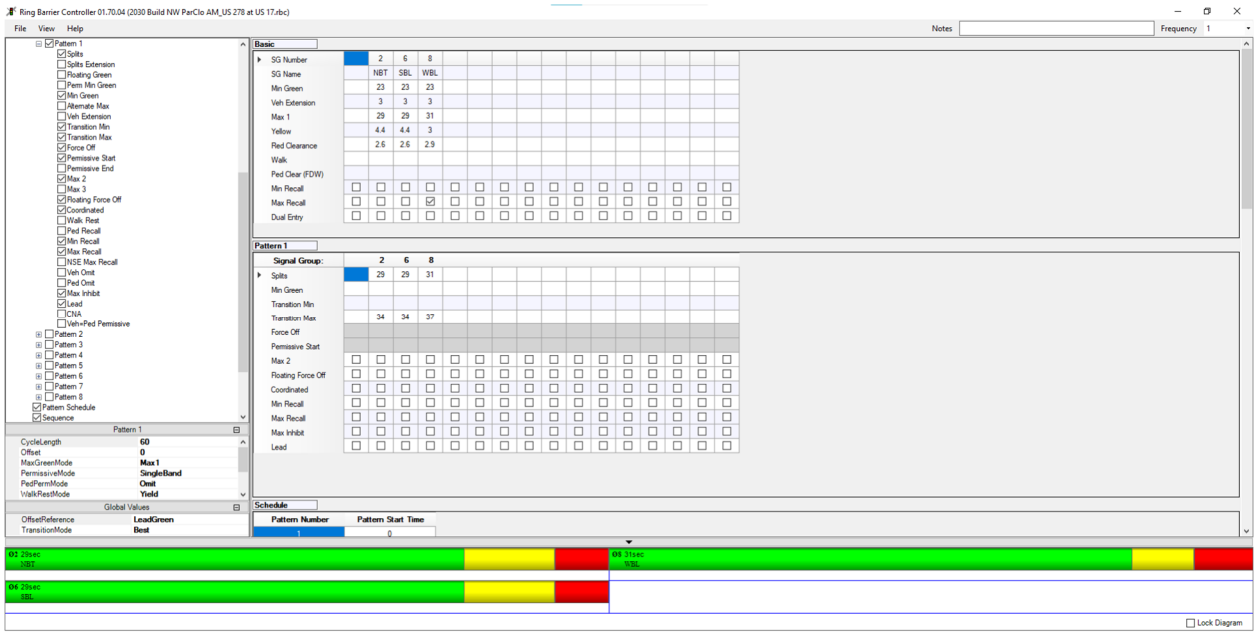
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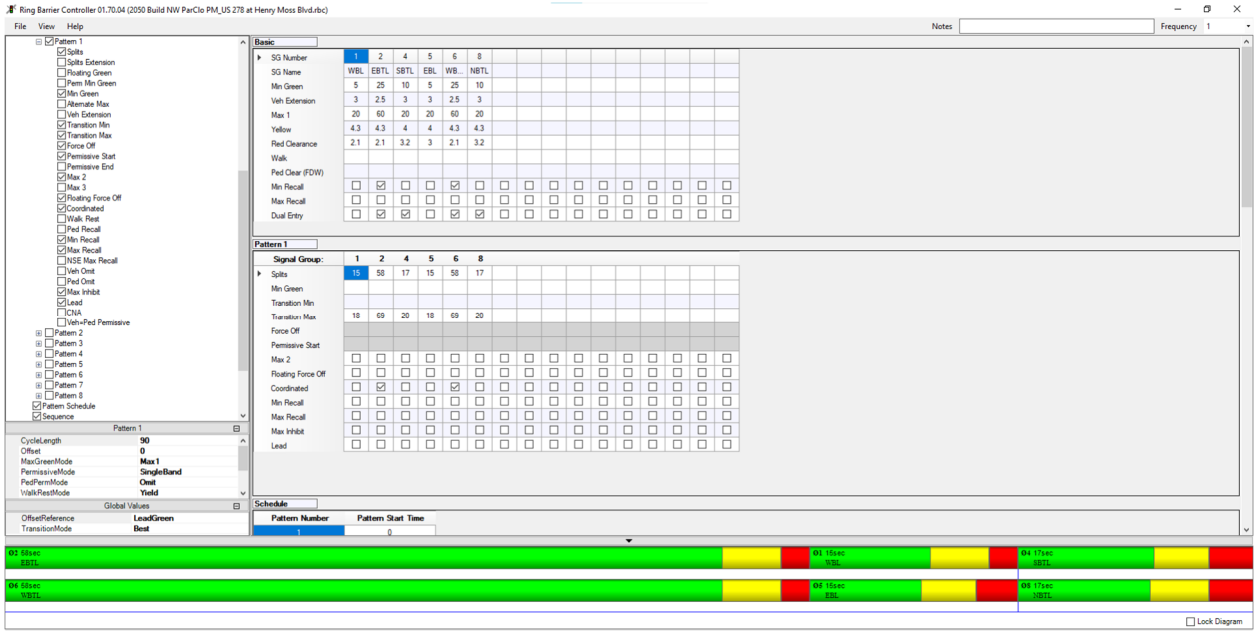
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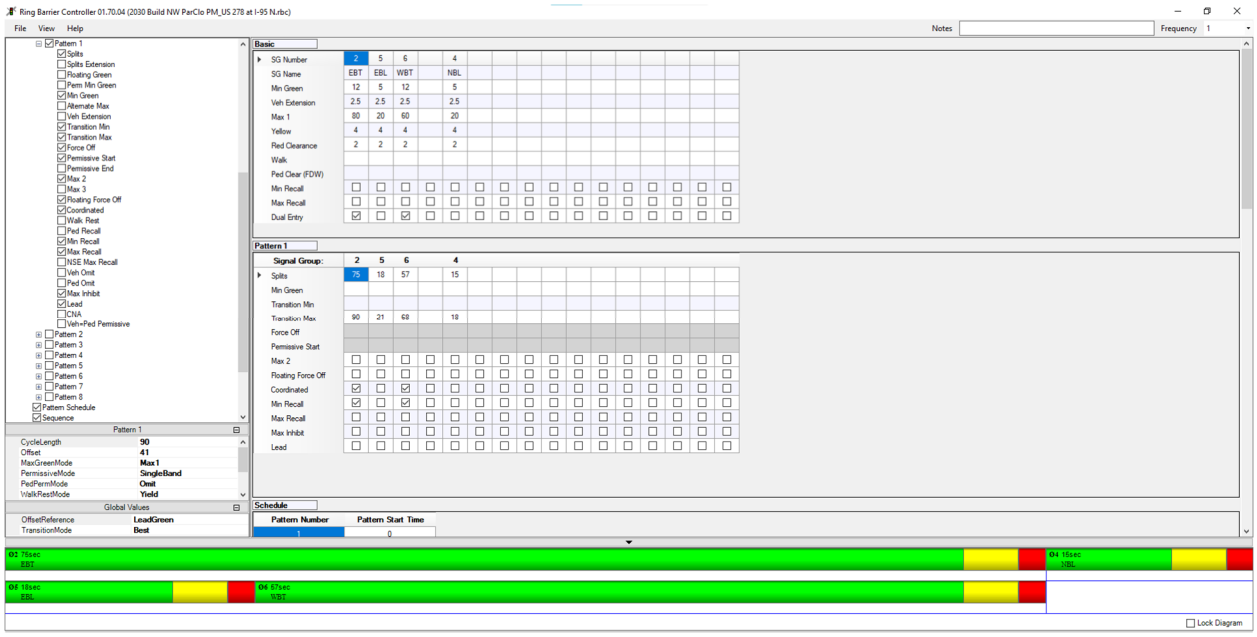
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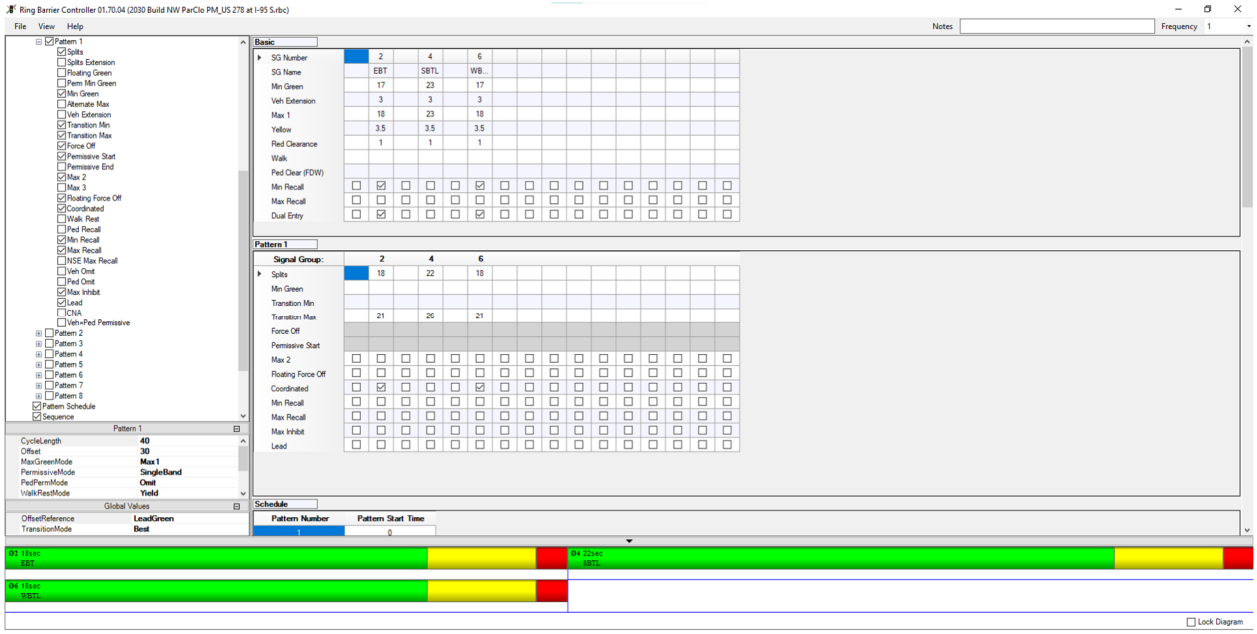
2030 NW ParClo PM US 278 at Henry Moss Boulevard



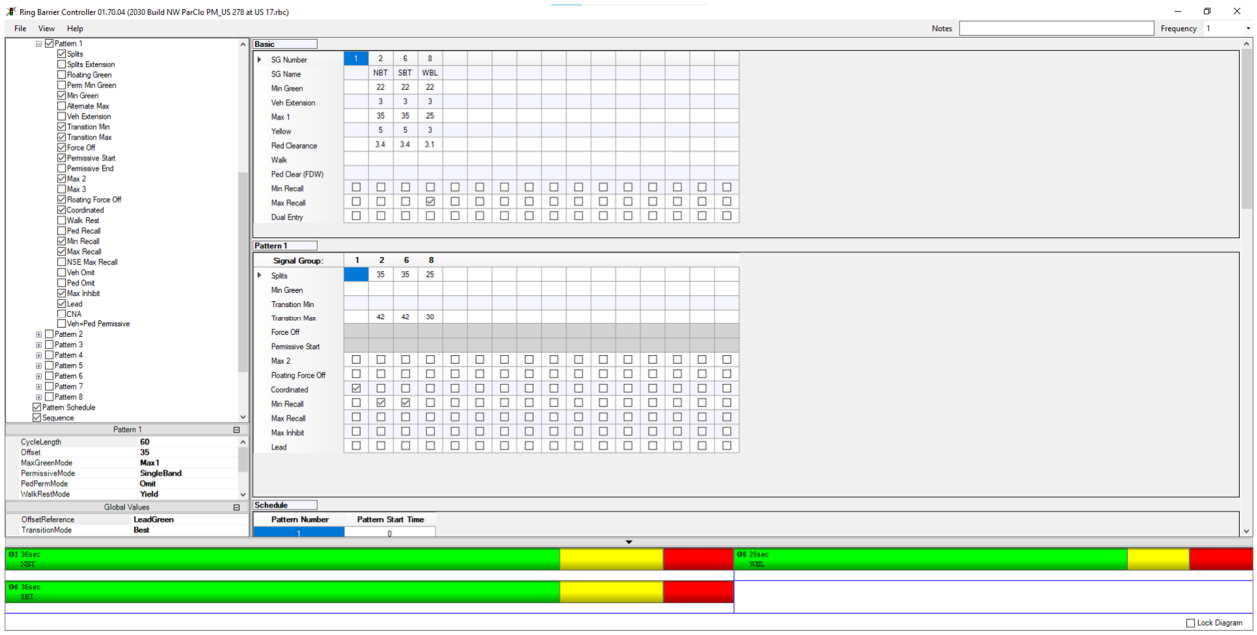
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2030 NW ParClo PM US 278 at I-95 SB Ramps

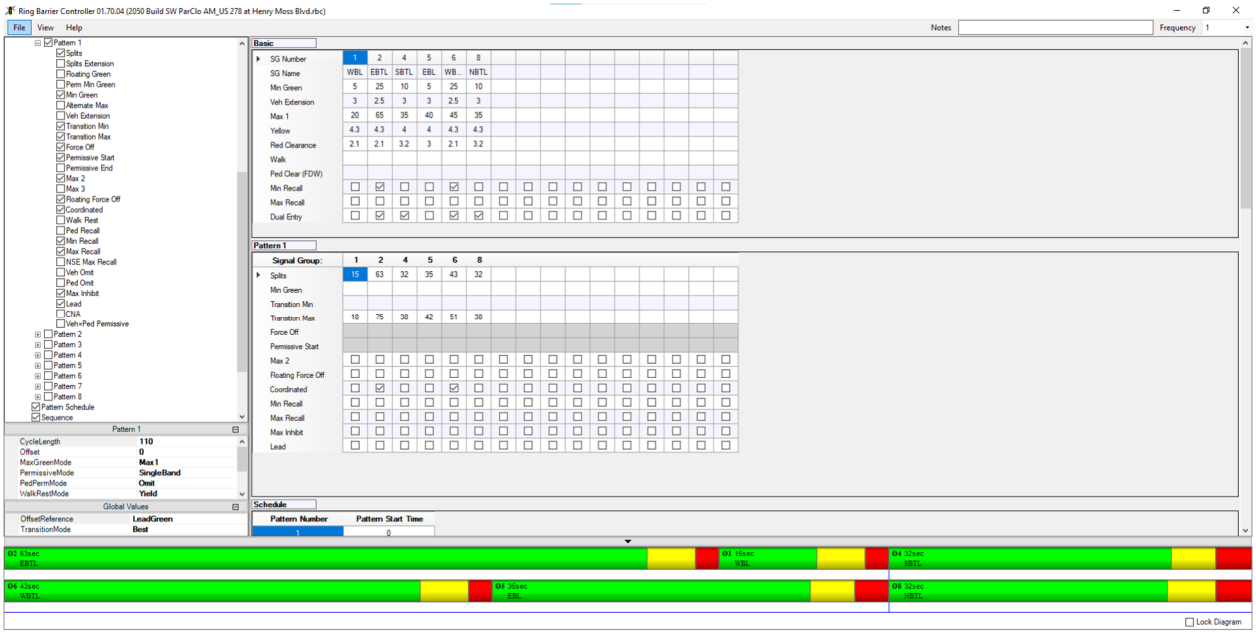


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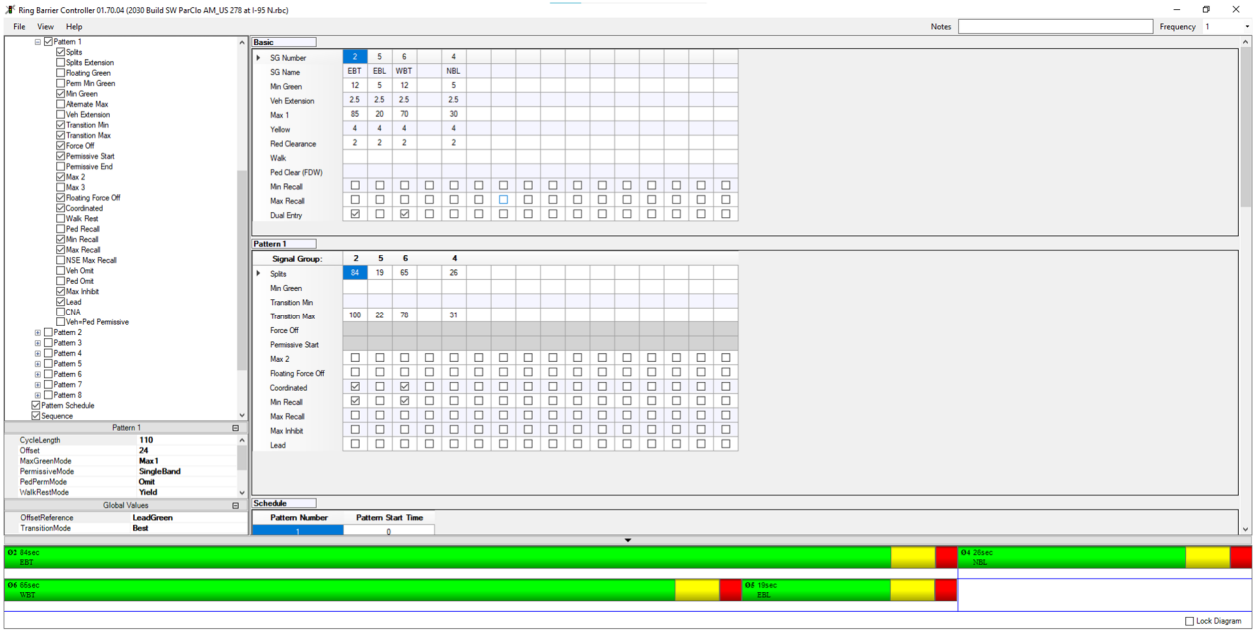


2030 Parclo SW

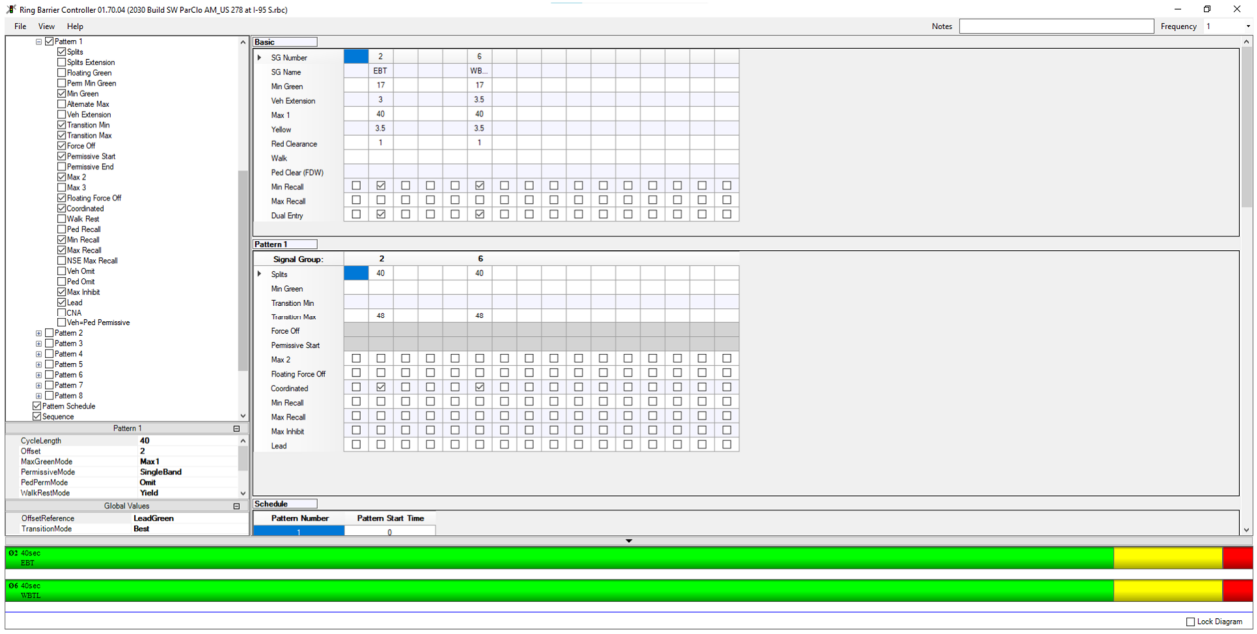
2030 SW ParClo AM US 278 at Henry Moss Boulevard



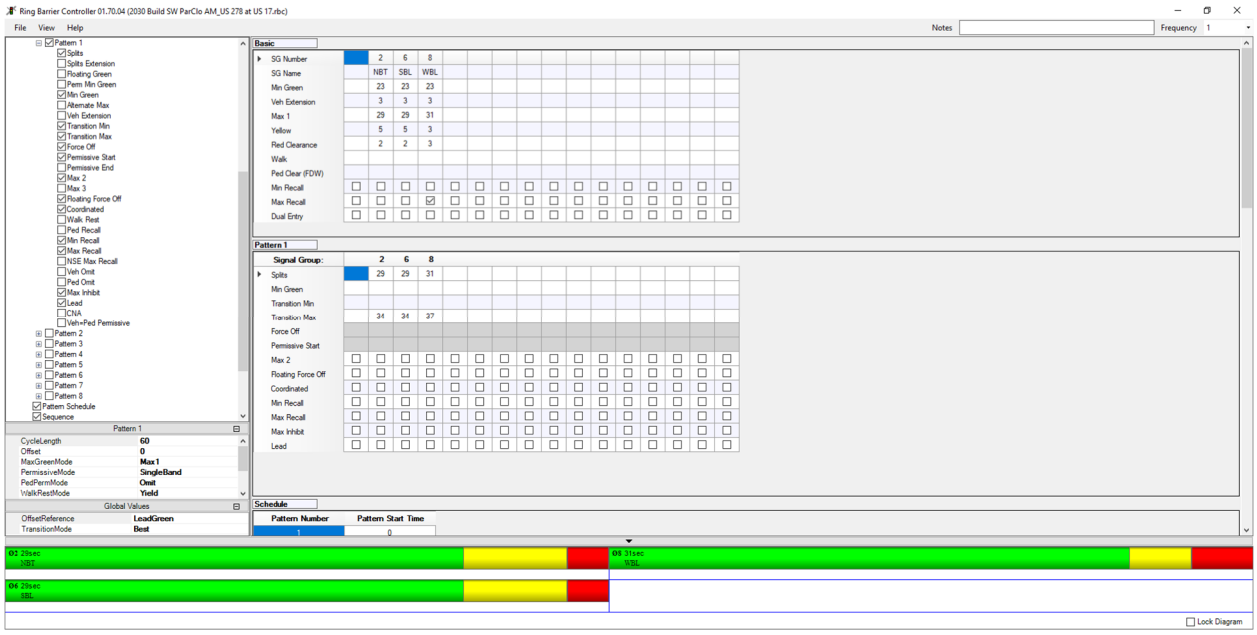
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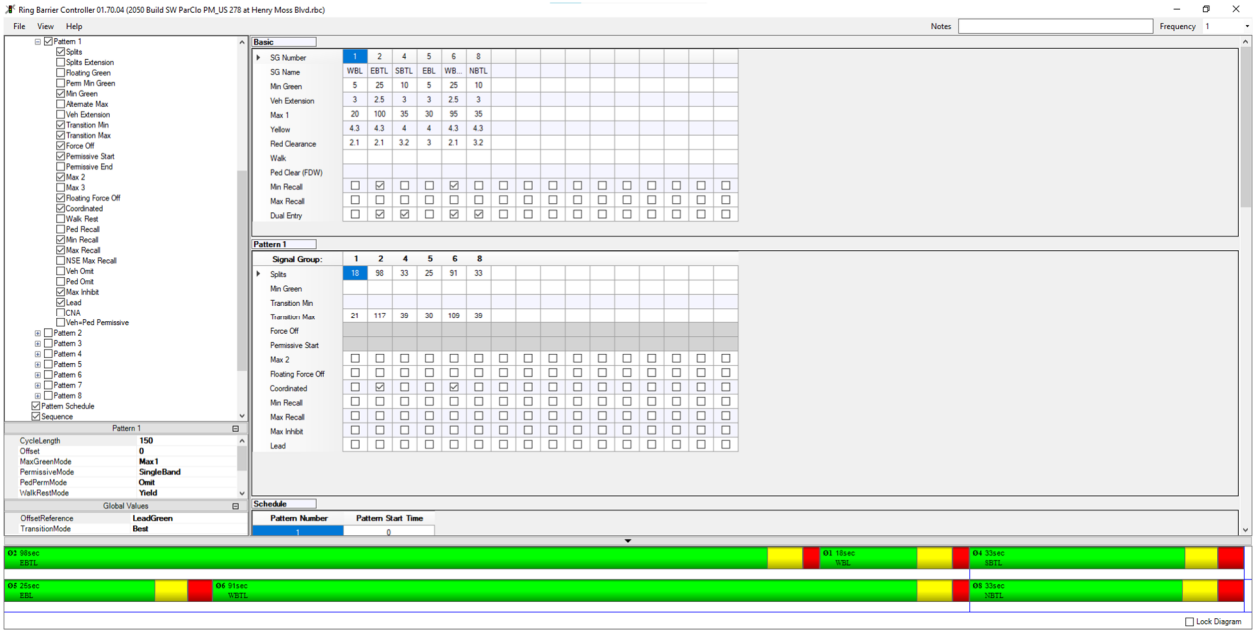
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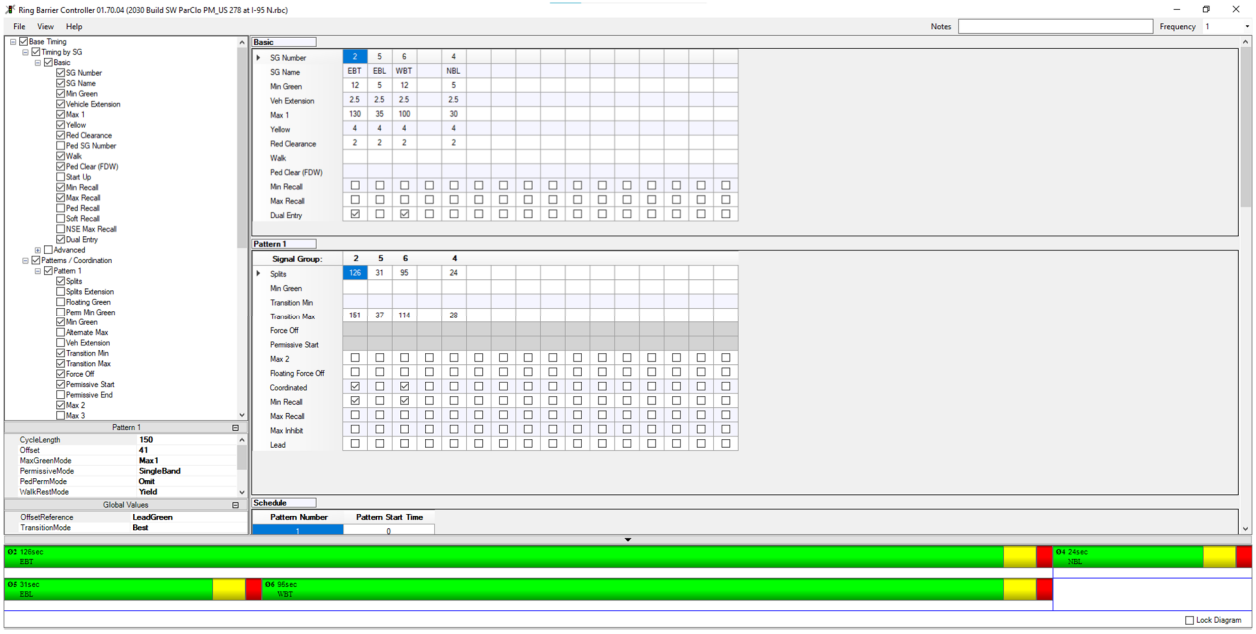
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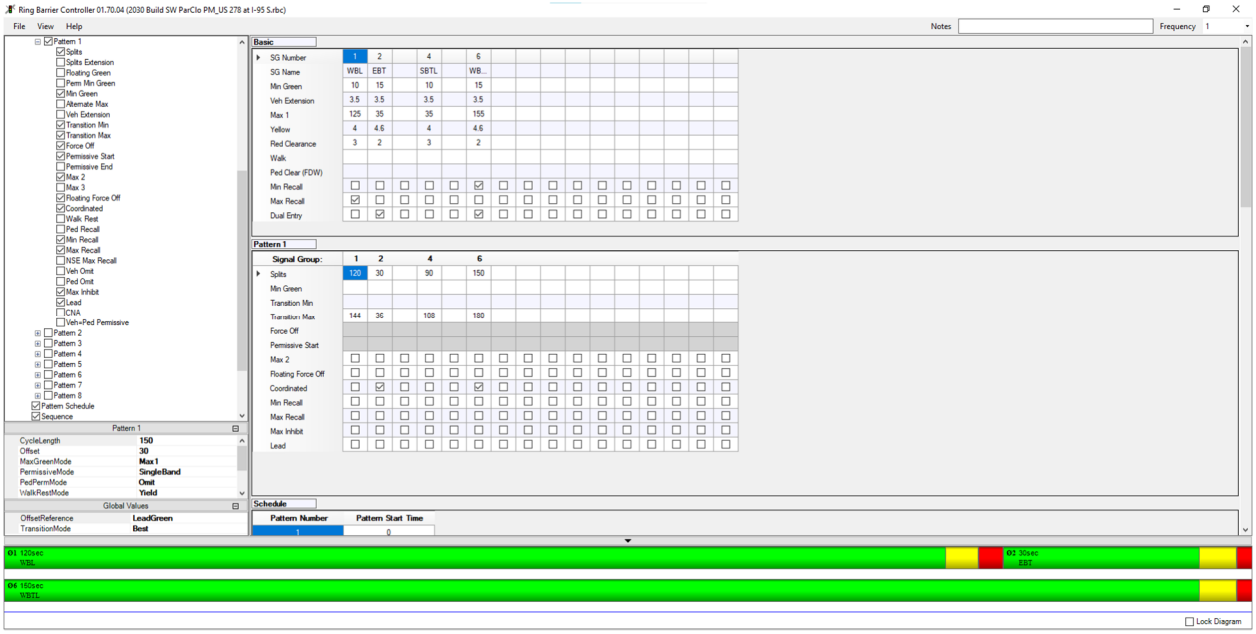
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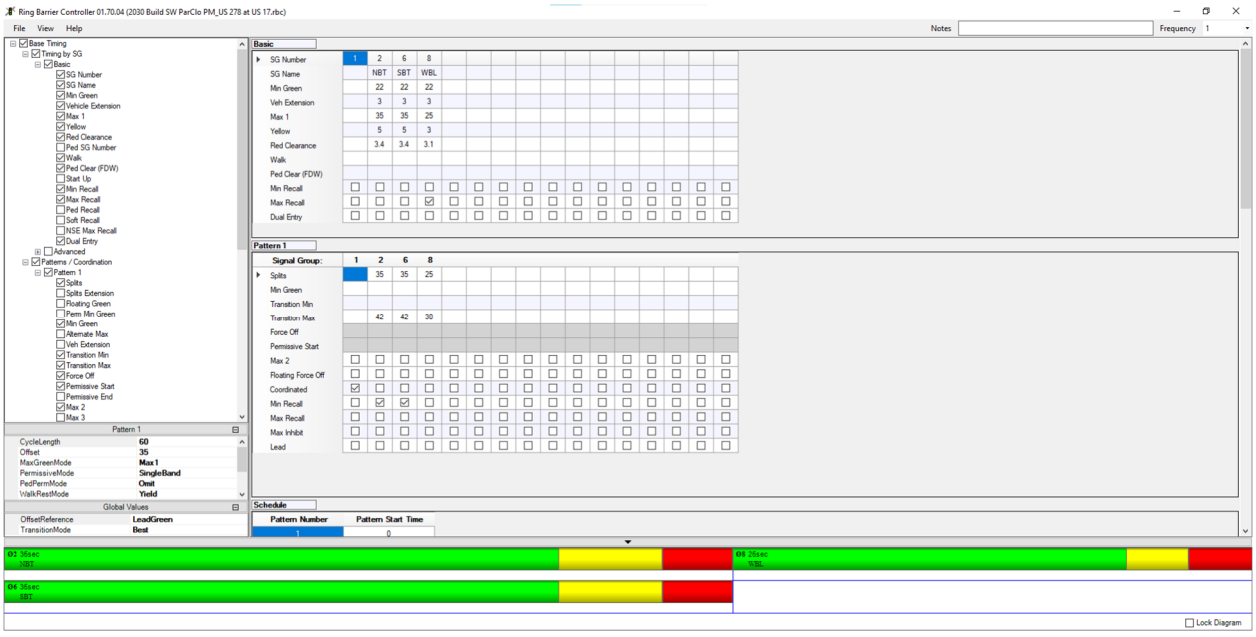
2030 SW ParClo PM US 278 at I-95 NB Ramps



2030 SW ParClo PM US 278 at I-95 SB Ramps

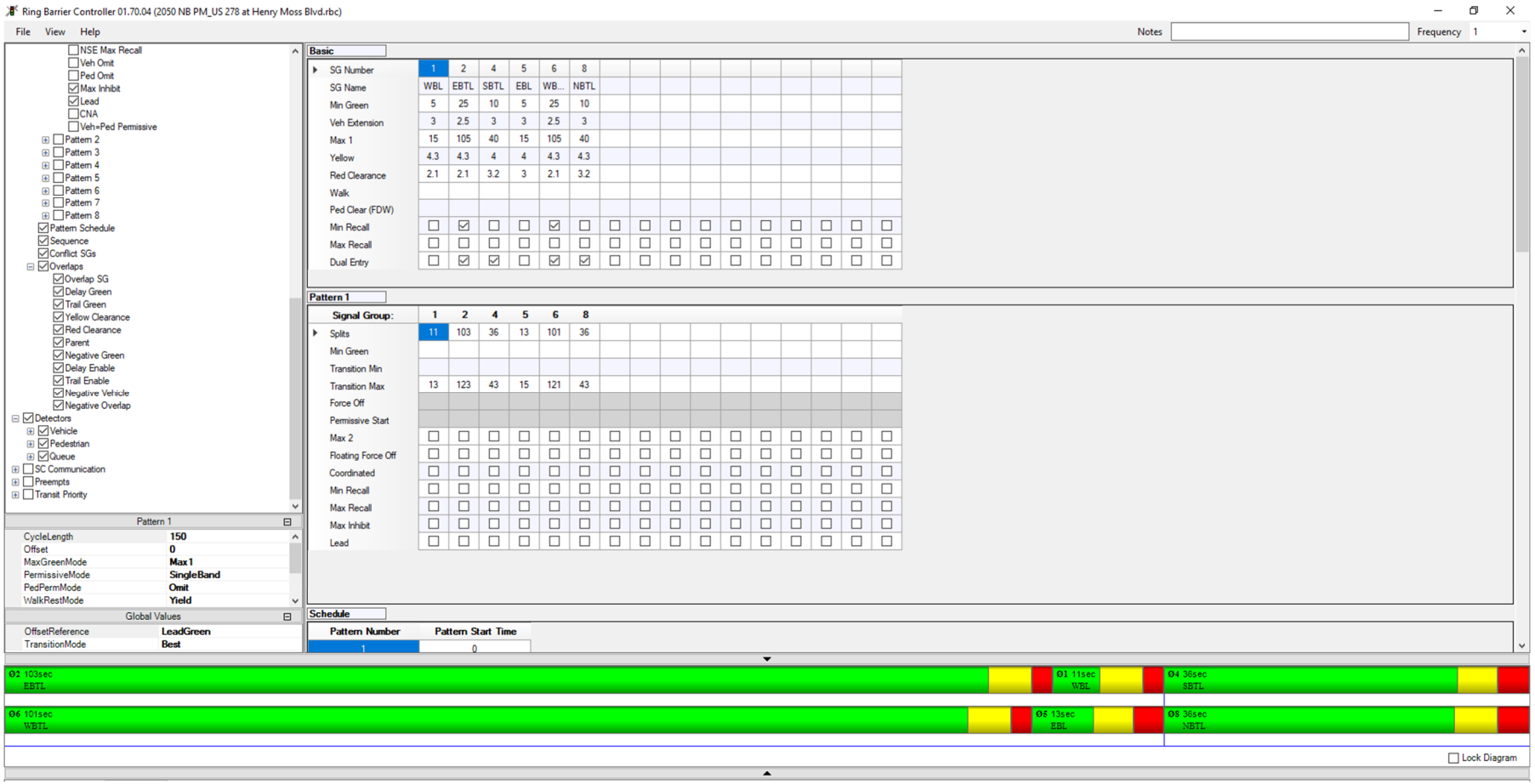


2030 SW ParClo PM US 278 at US 17

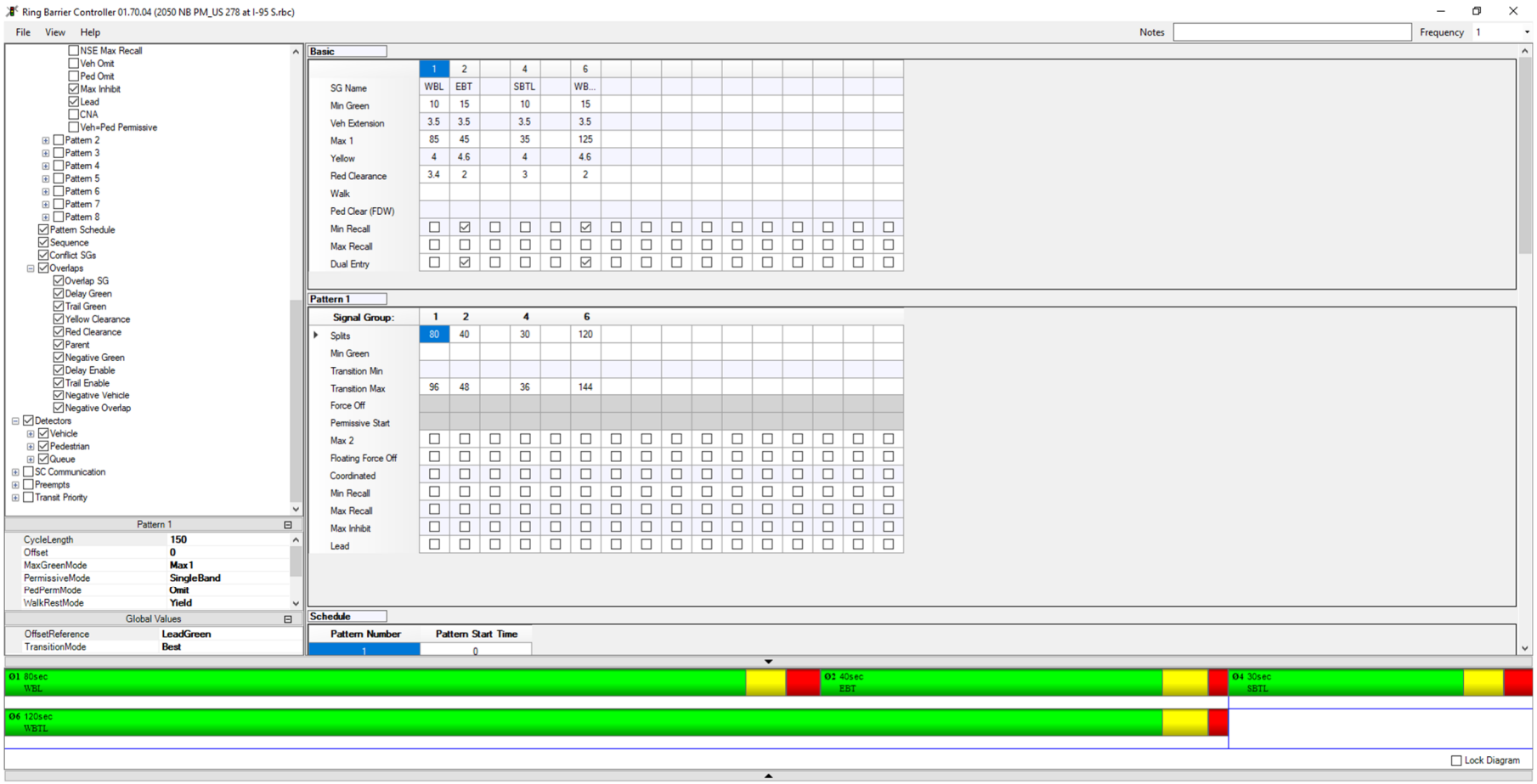


2050 No Build

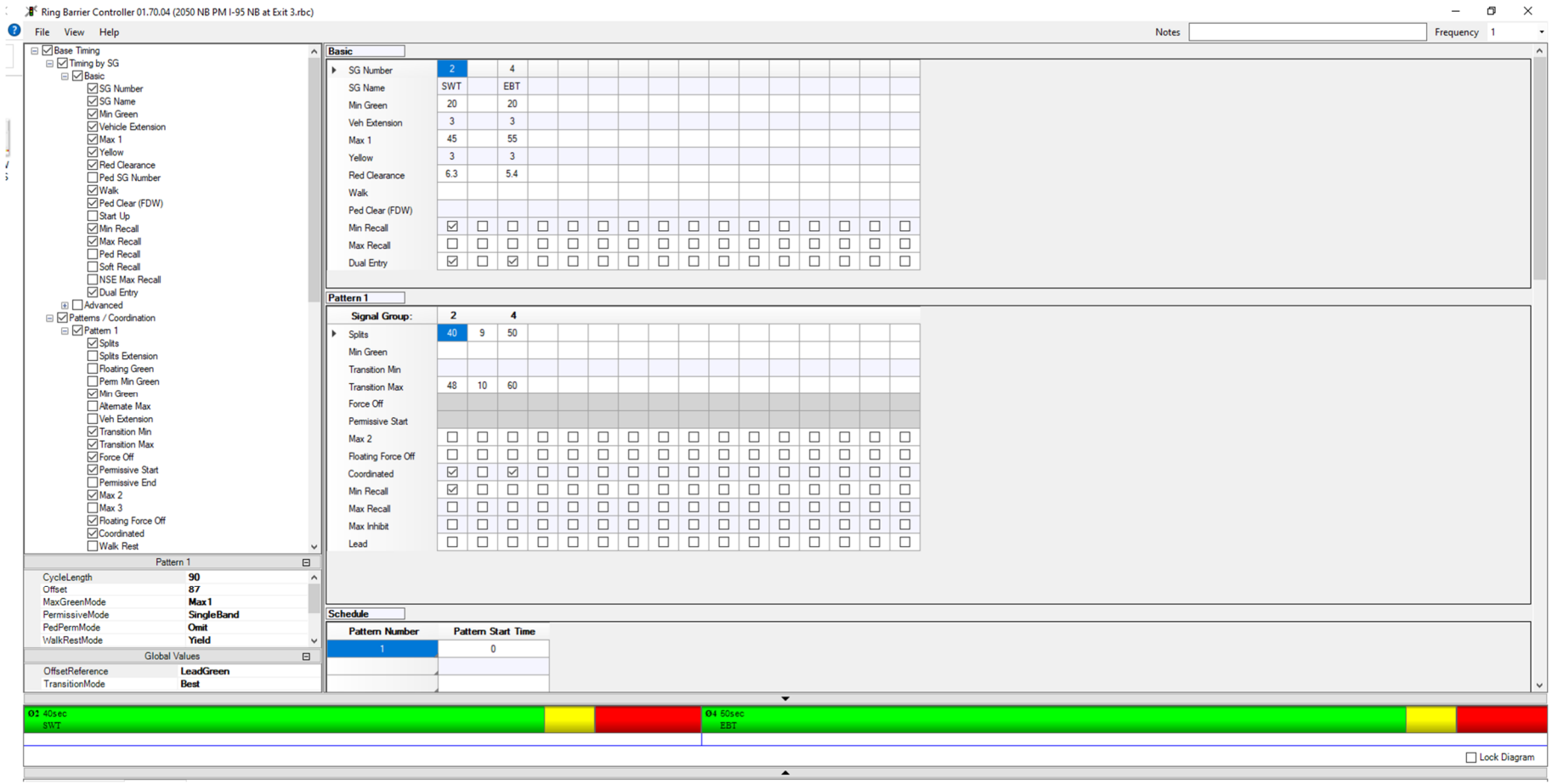
2050 No Build PM US 278 at Henry Moss Boulevard



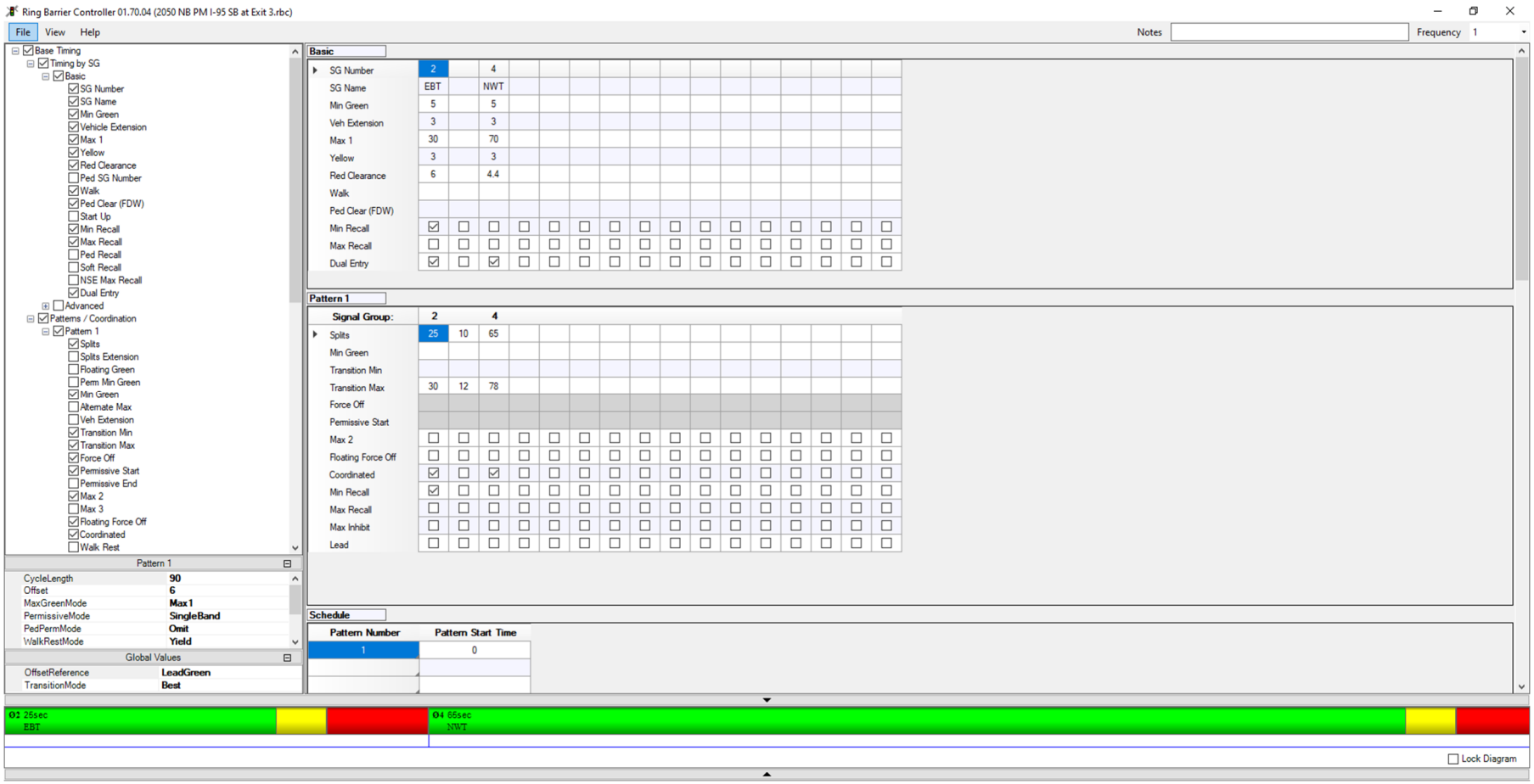
2050 No Build PM US 278 at I-95 SB Ramps



2050 No Build PM I-95 NB at Exit 3 DDI

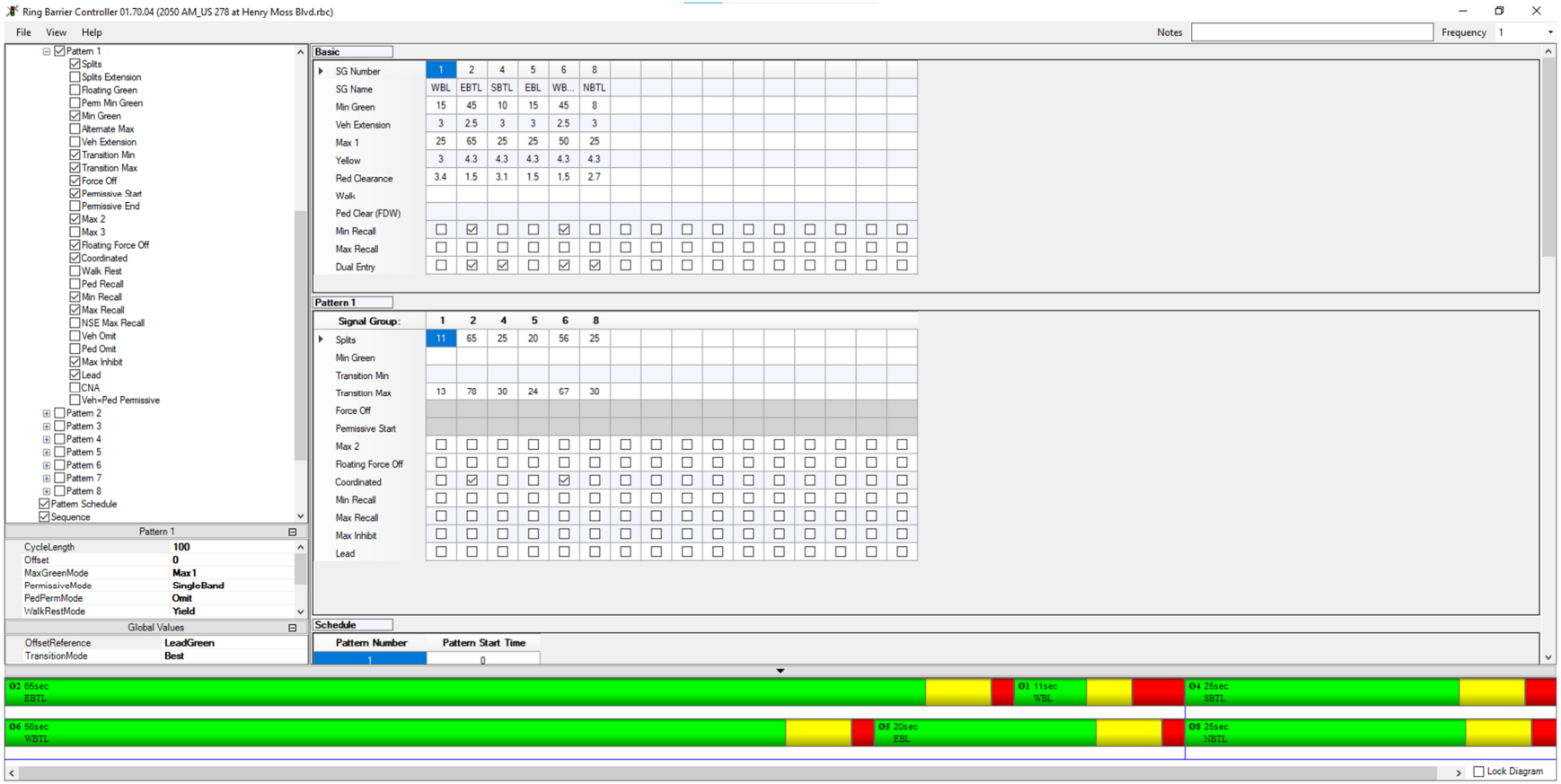


2050 No Build PM I-95 SB at Exit 3 DDI

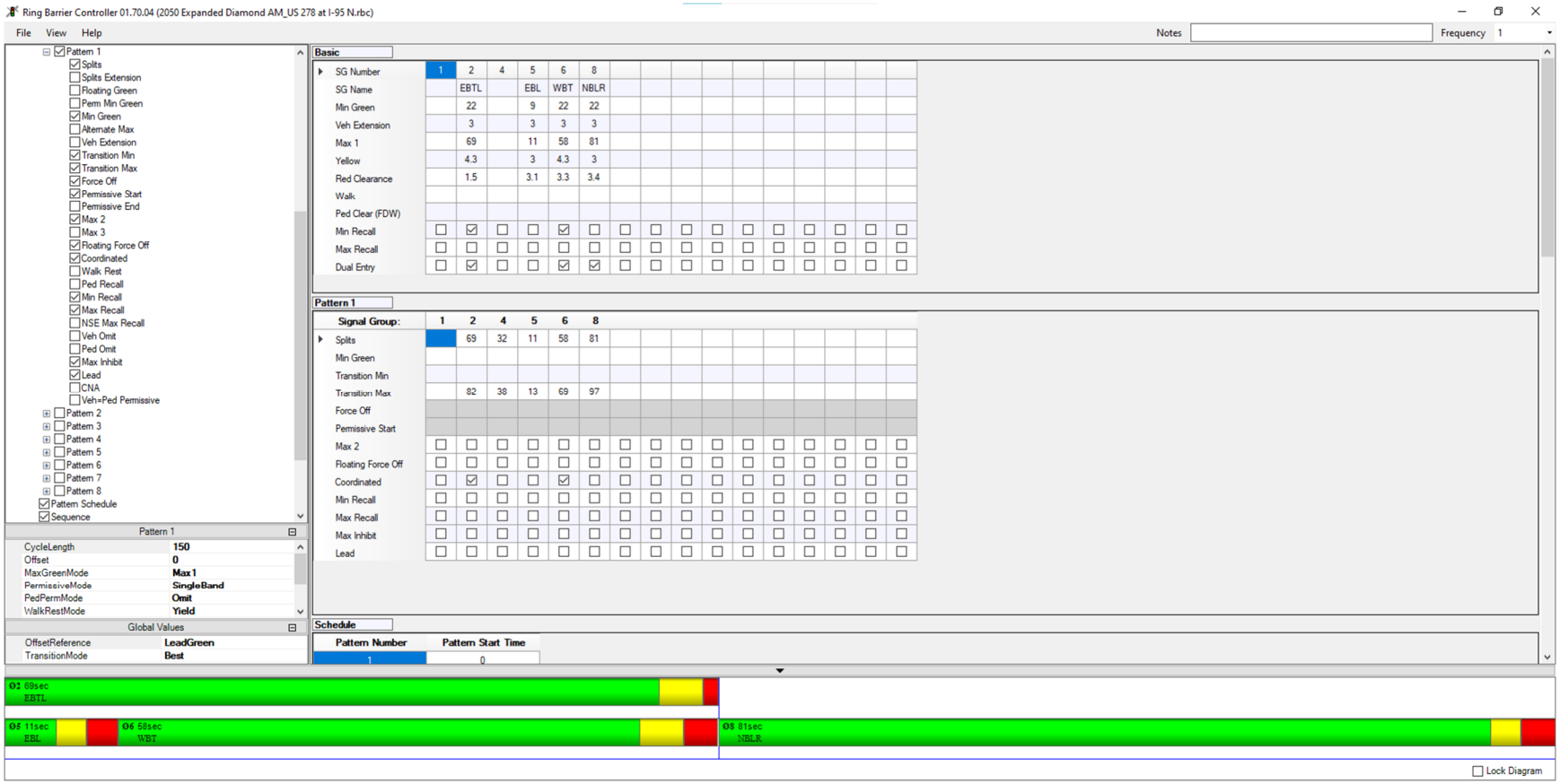


2050 Build

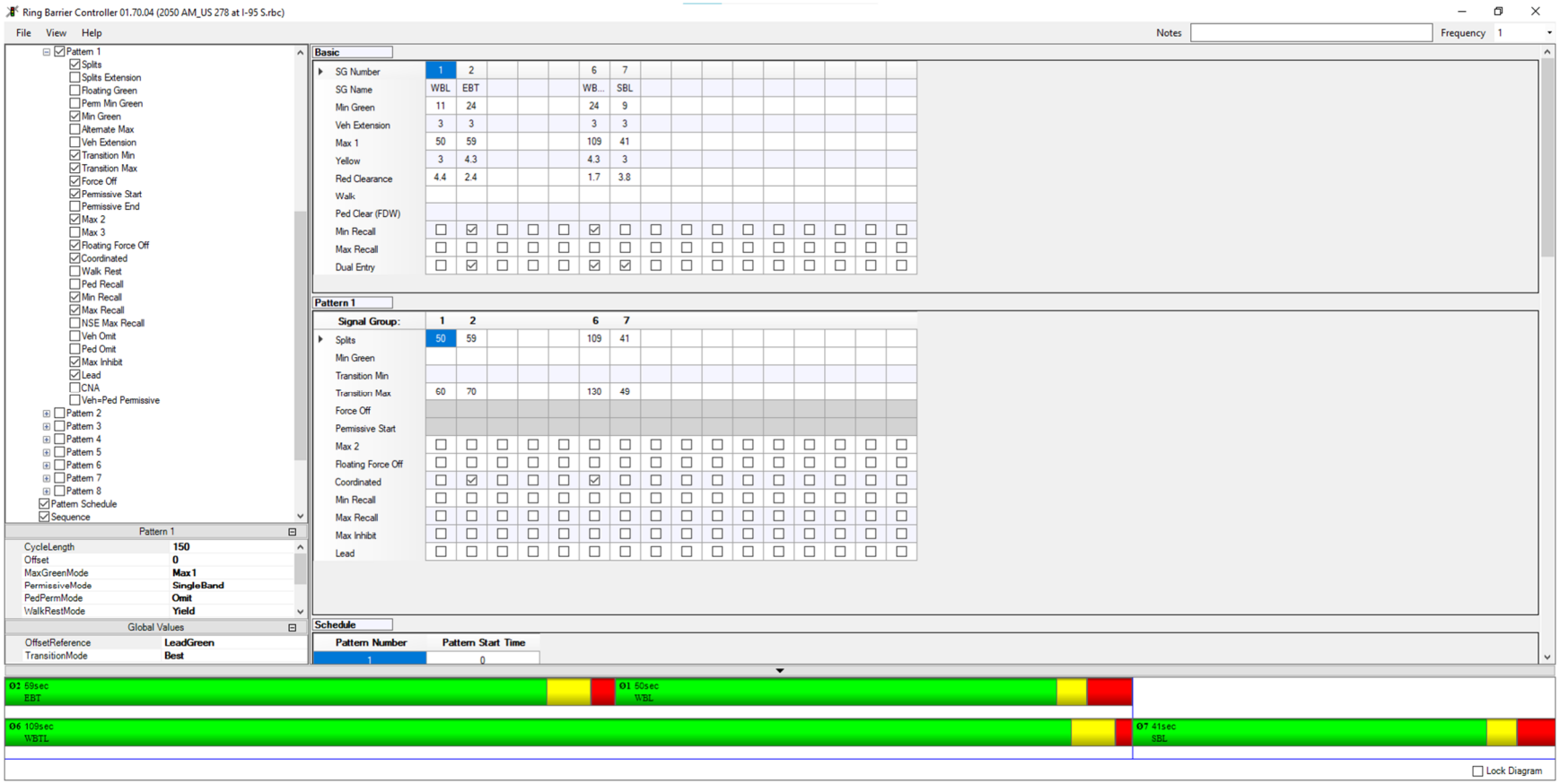
2050 Build AM Expanded US 278 at Henry Moss Boulevard



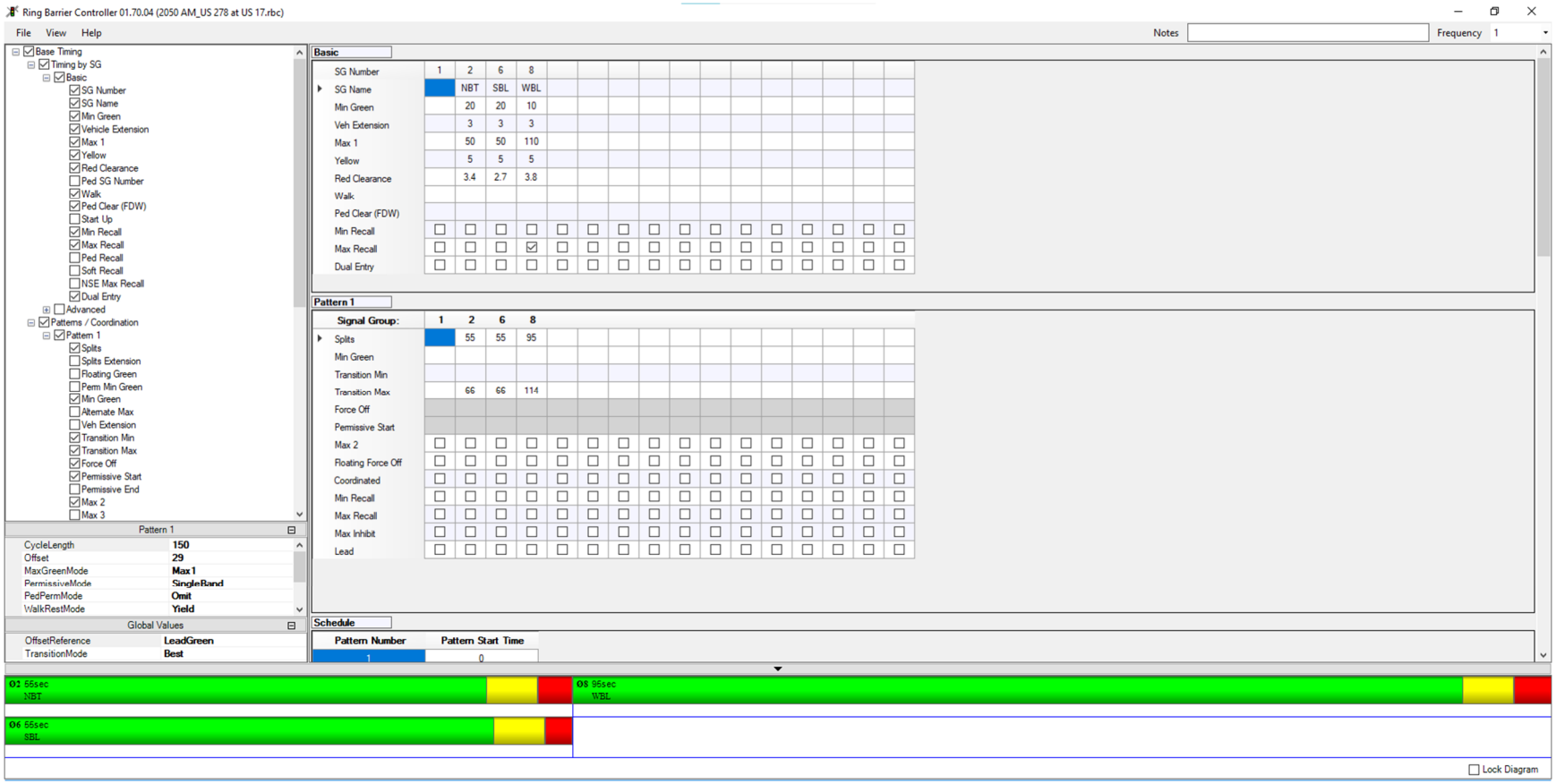
2050 Build AM Expanded US 278 at I-95 NB Ramps



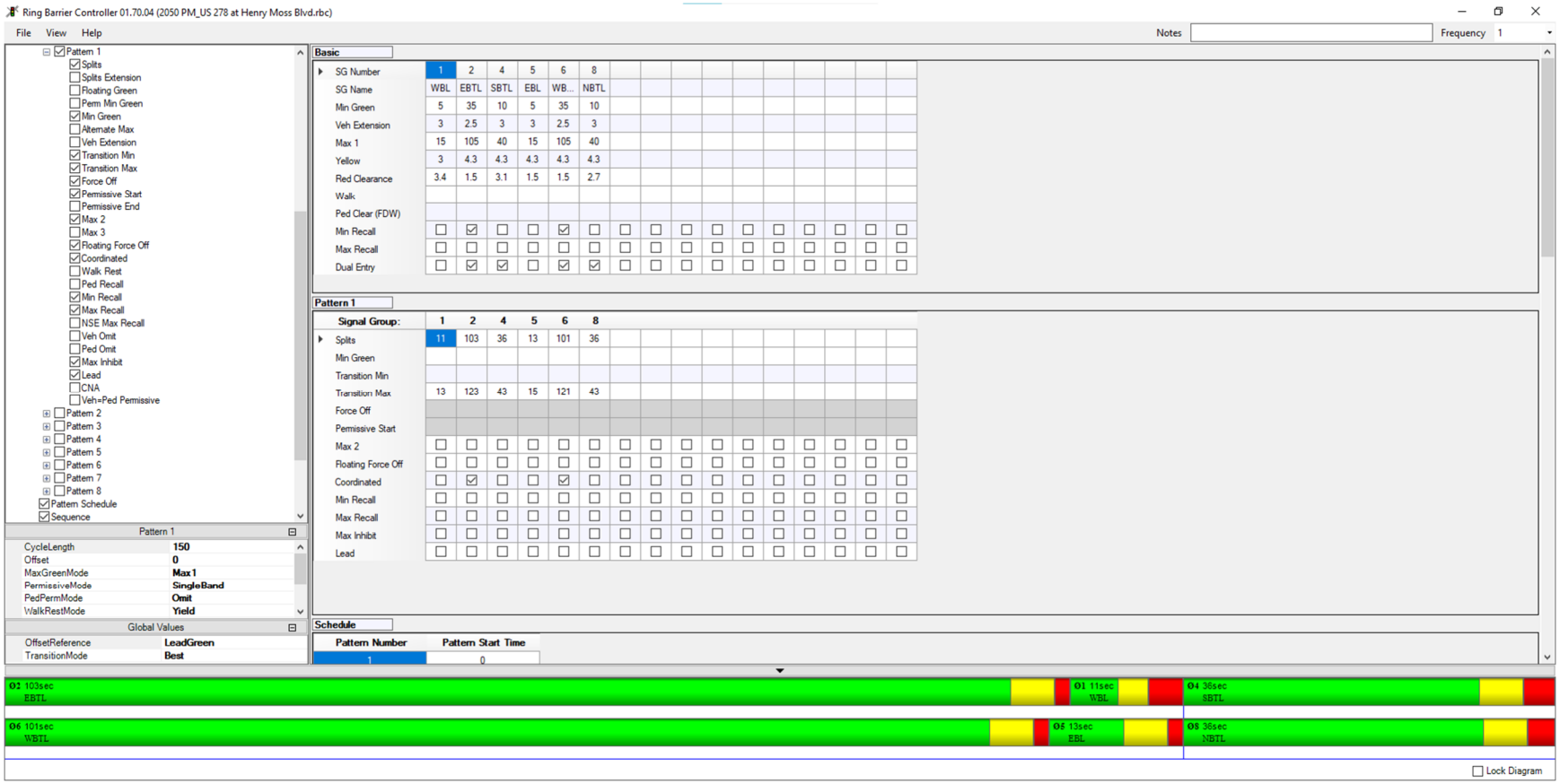
2050 Build AM Expanded US 278 at I-95 SB Ramps



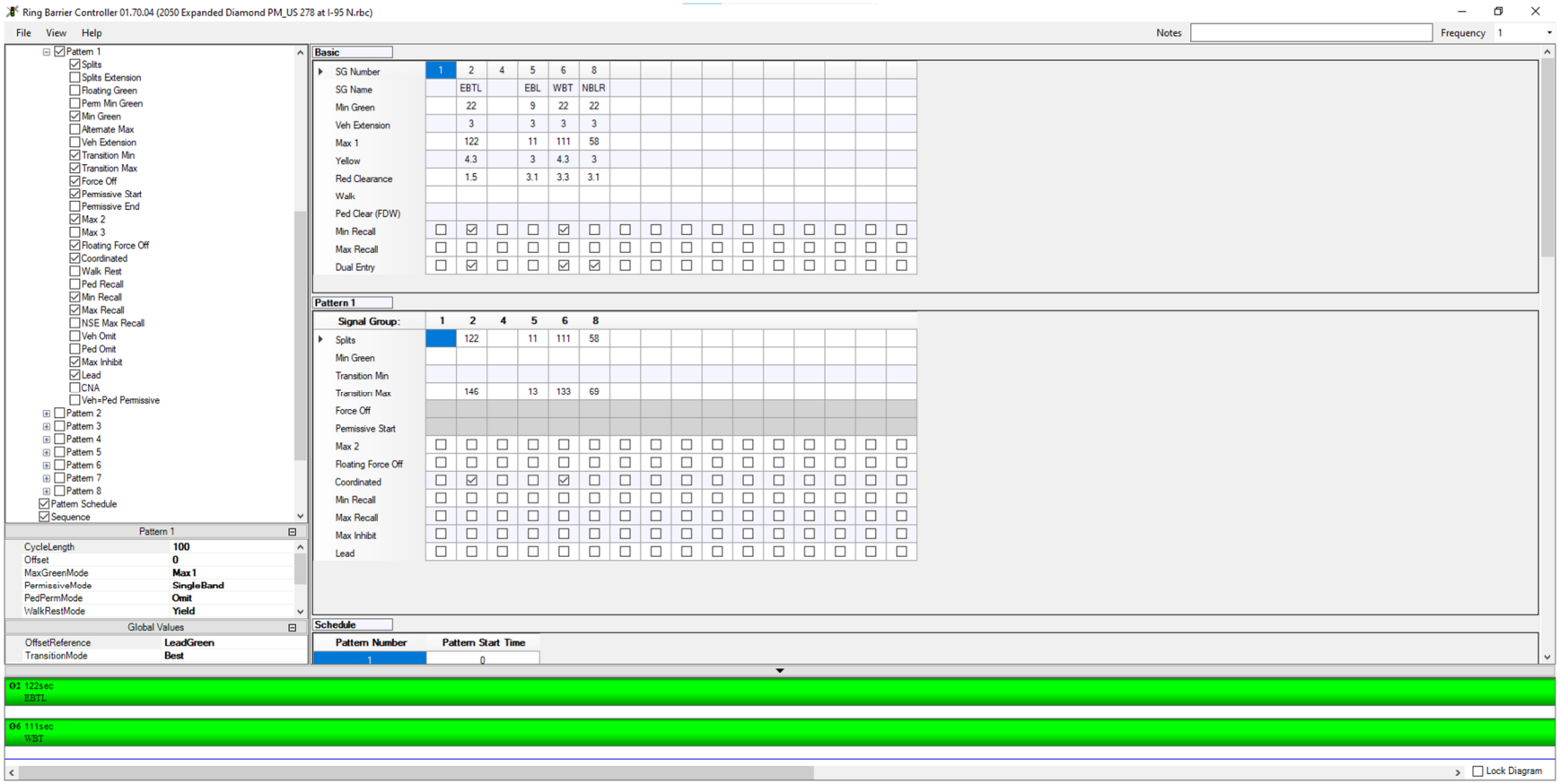
2050 Build AM Expanded US 278 at US17



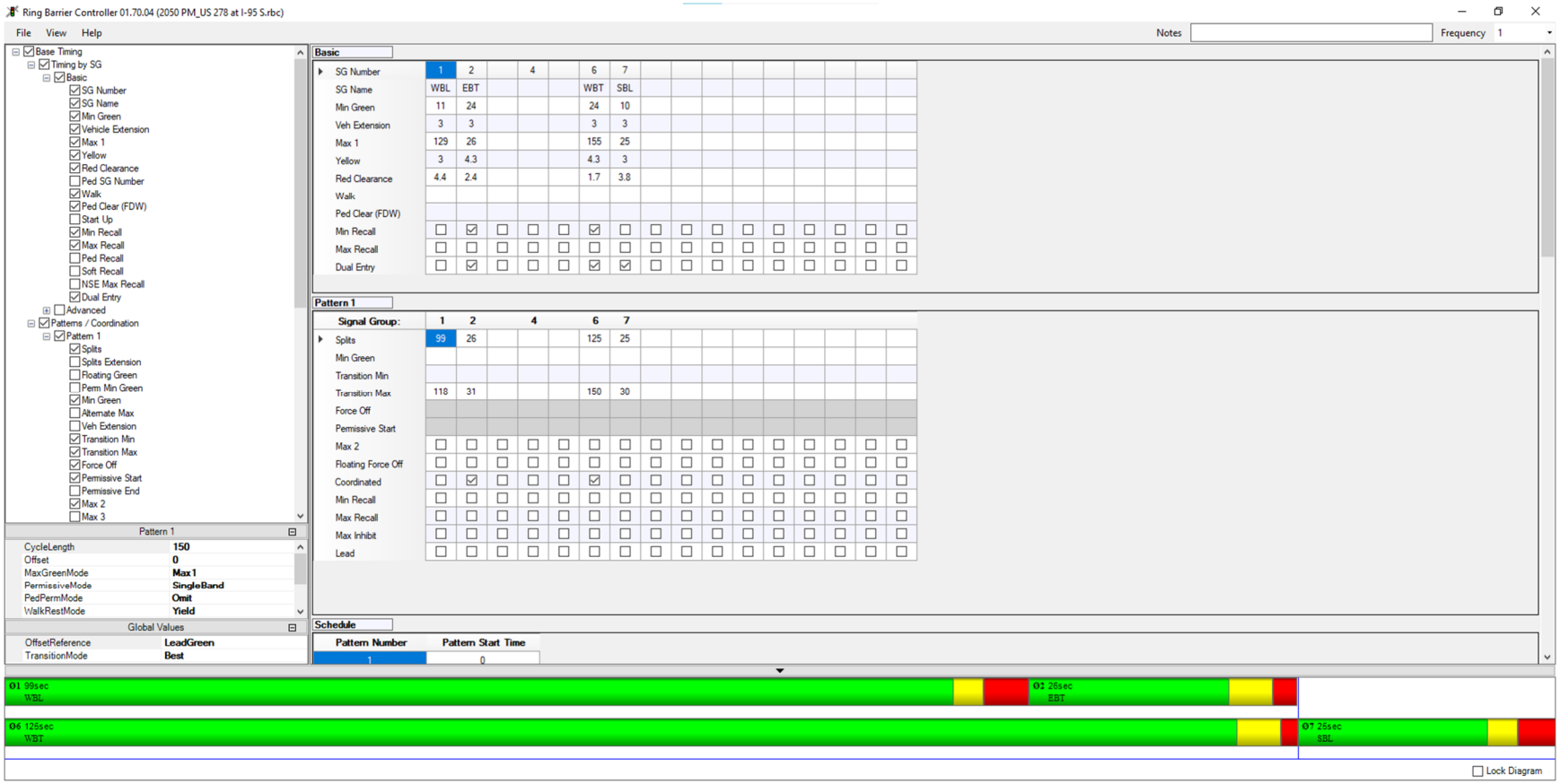
2050 Build PM Expanded US 278 at Henry Moss Boulevard



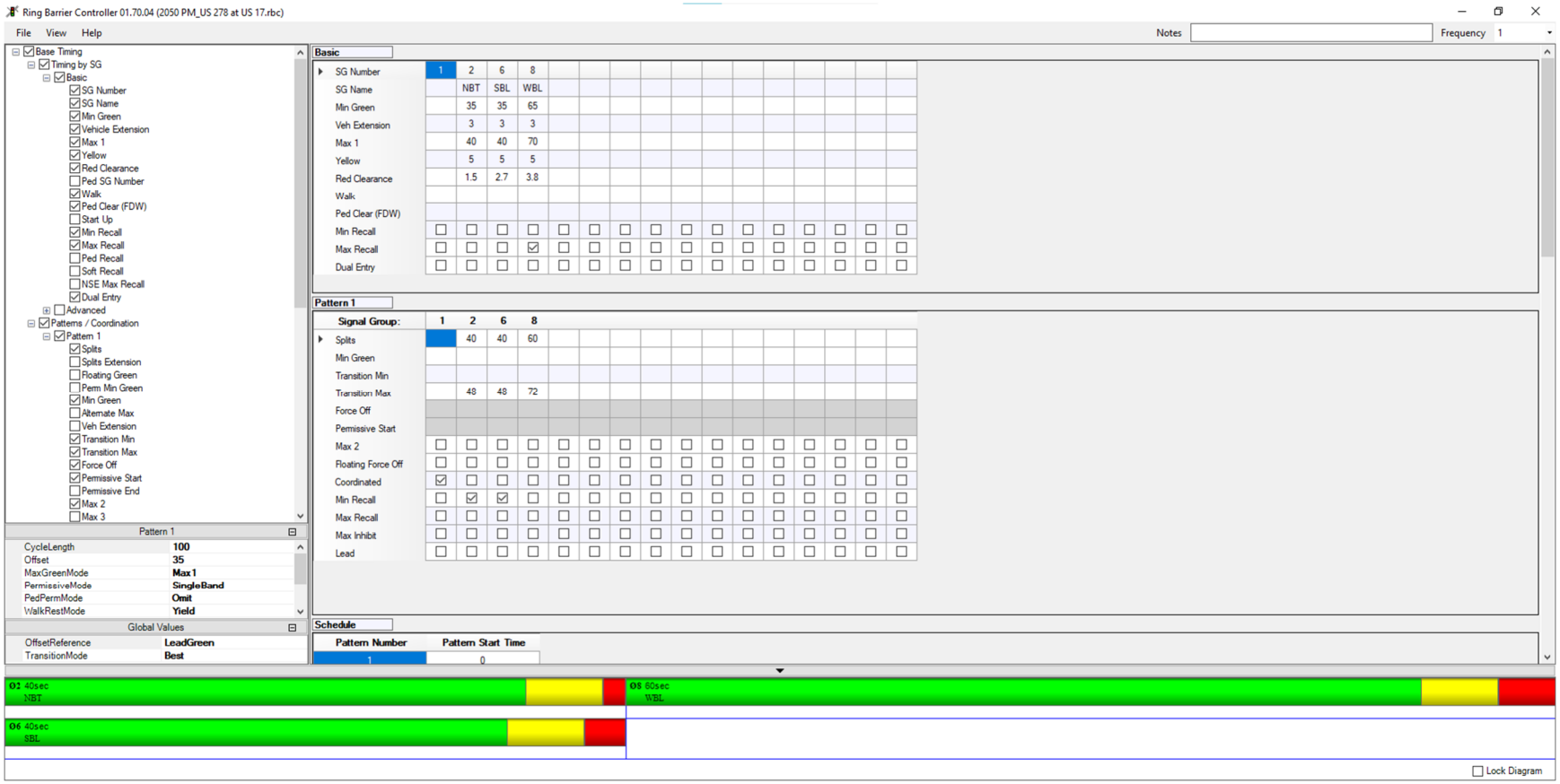
2050 Build PM Expanded US 278 at I-95 NB Ramps



2050 Build PM Expanded US 278 at I-95 SB Ramps

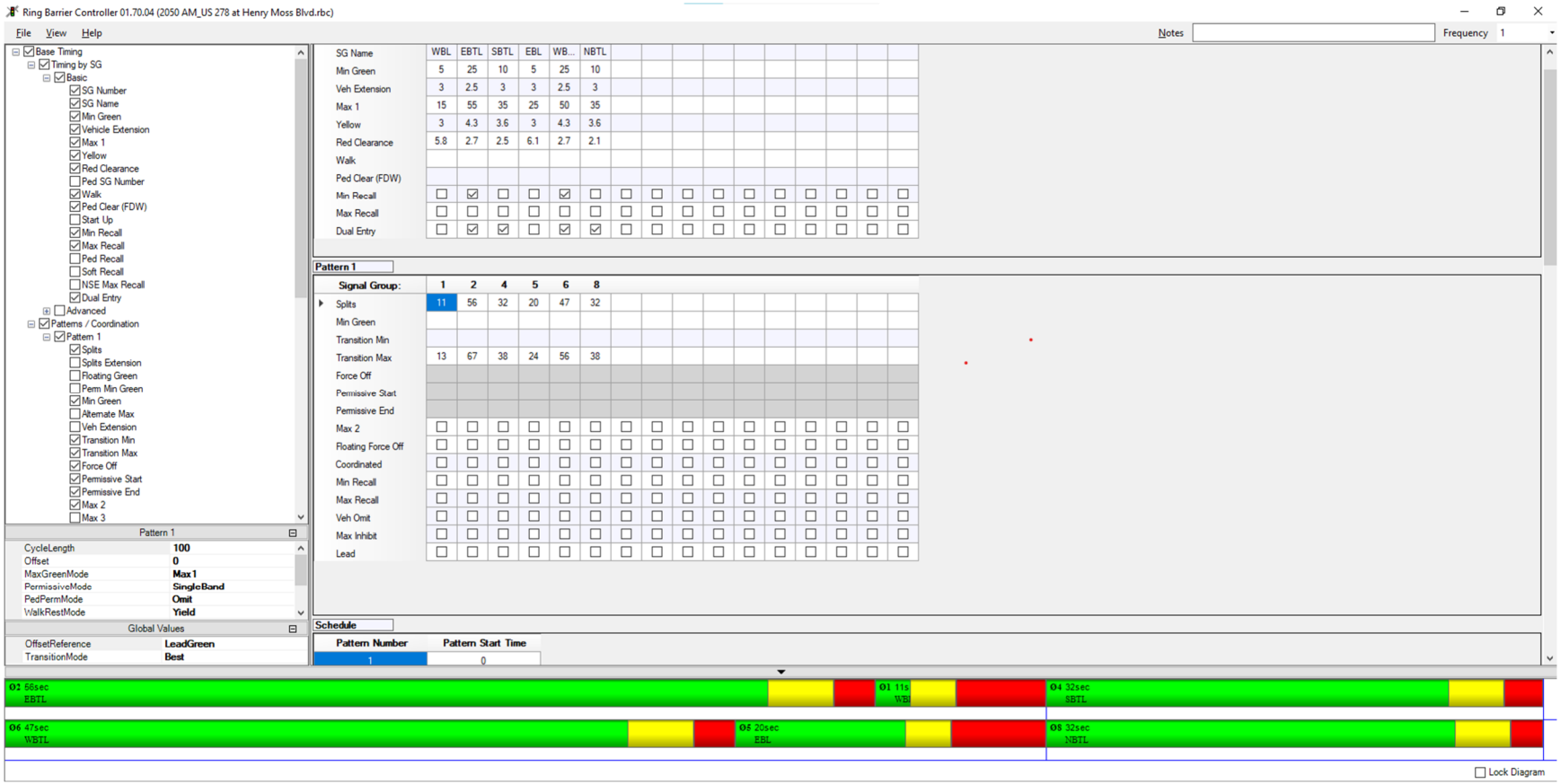


2050 Build PM Expanded US 278 at US17

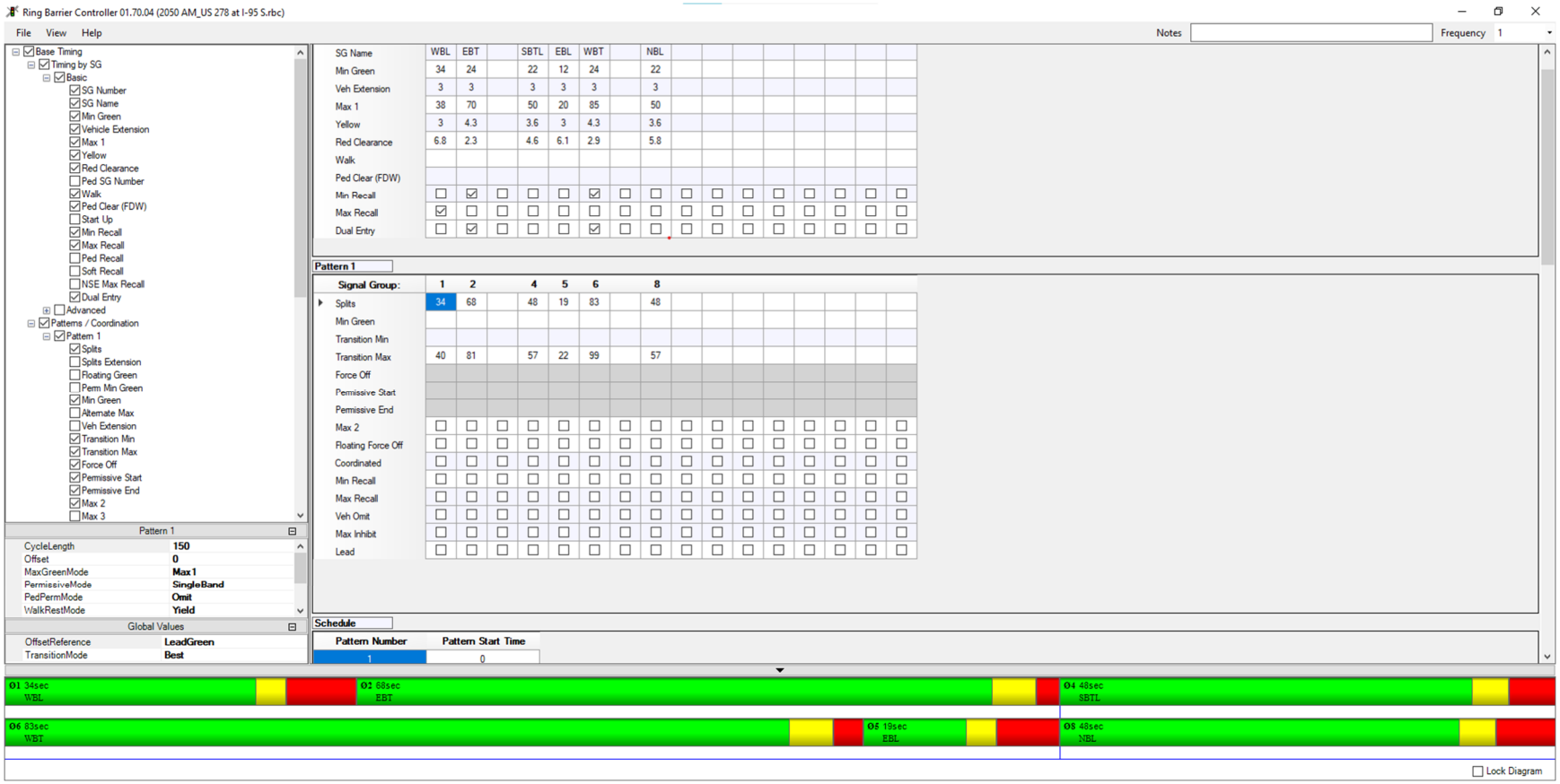


2050 Single Point Urban Interchange at US 278

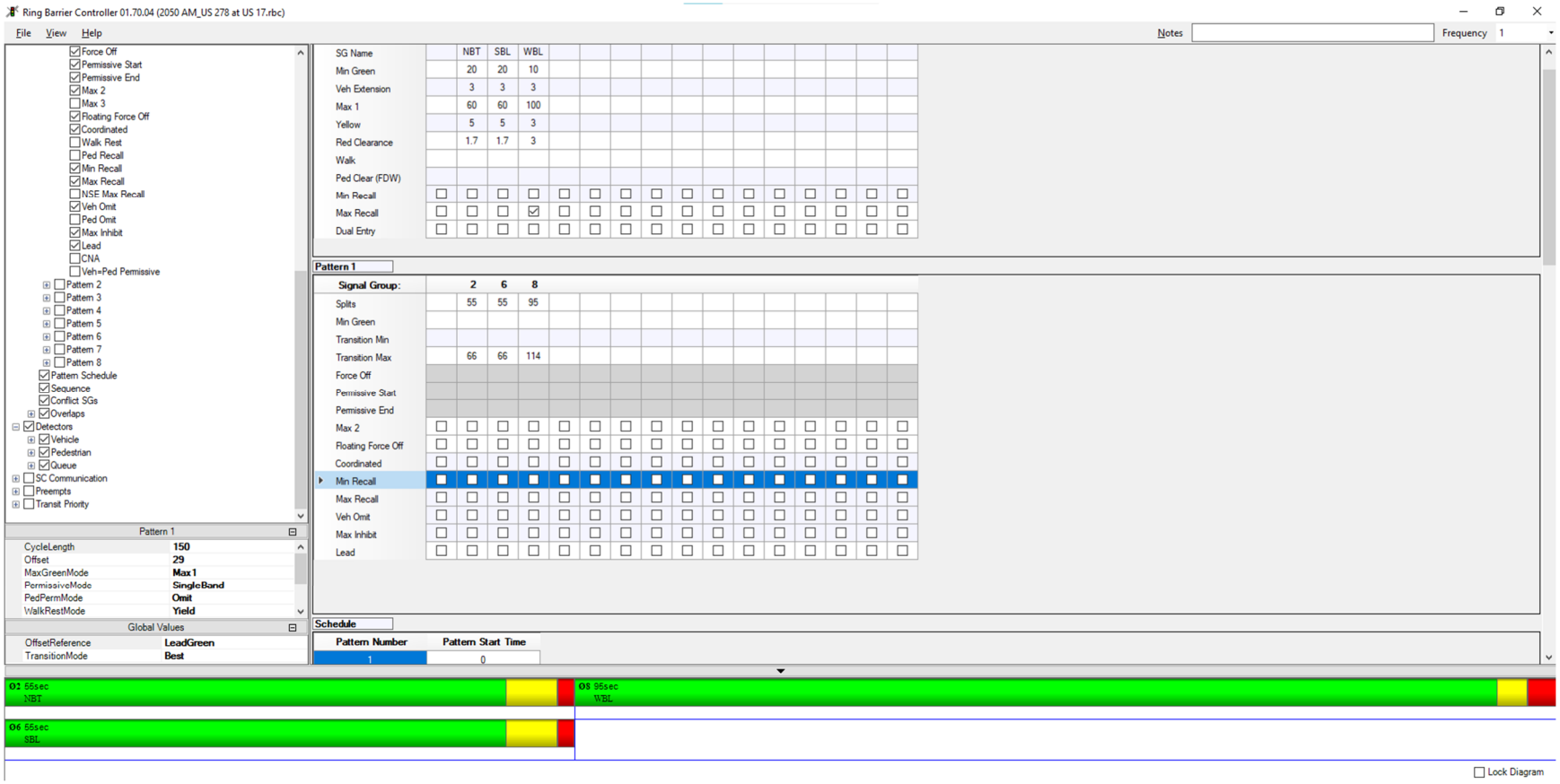
2050 Single Point Urban Interchange AM US 278 at Henry Moss Boulevard



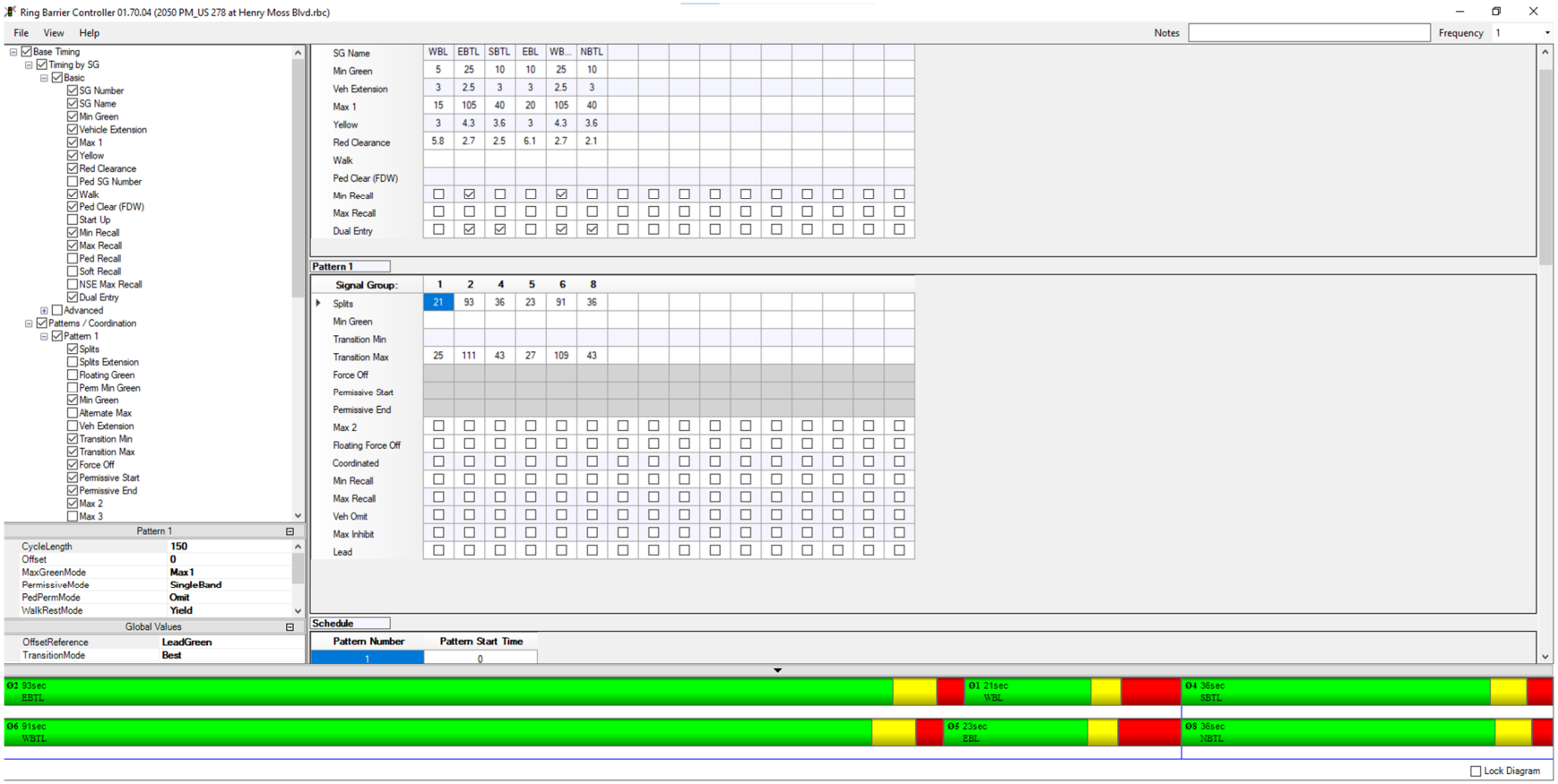
2050 Single Point Urban Interchange AM US 278 at I-95 Ramps



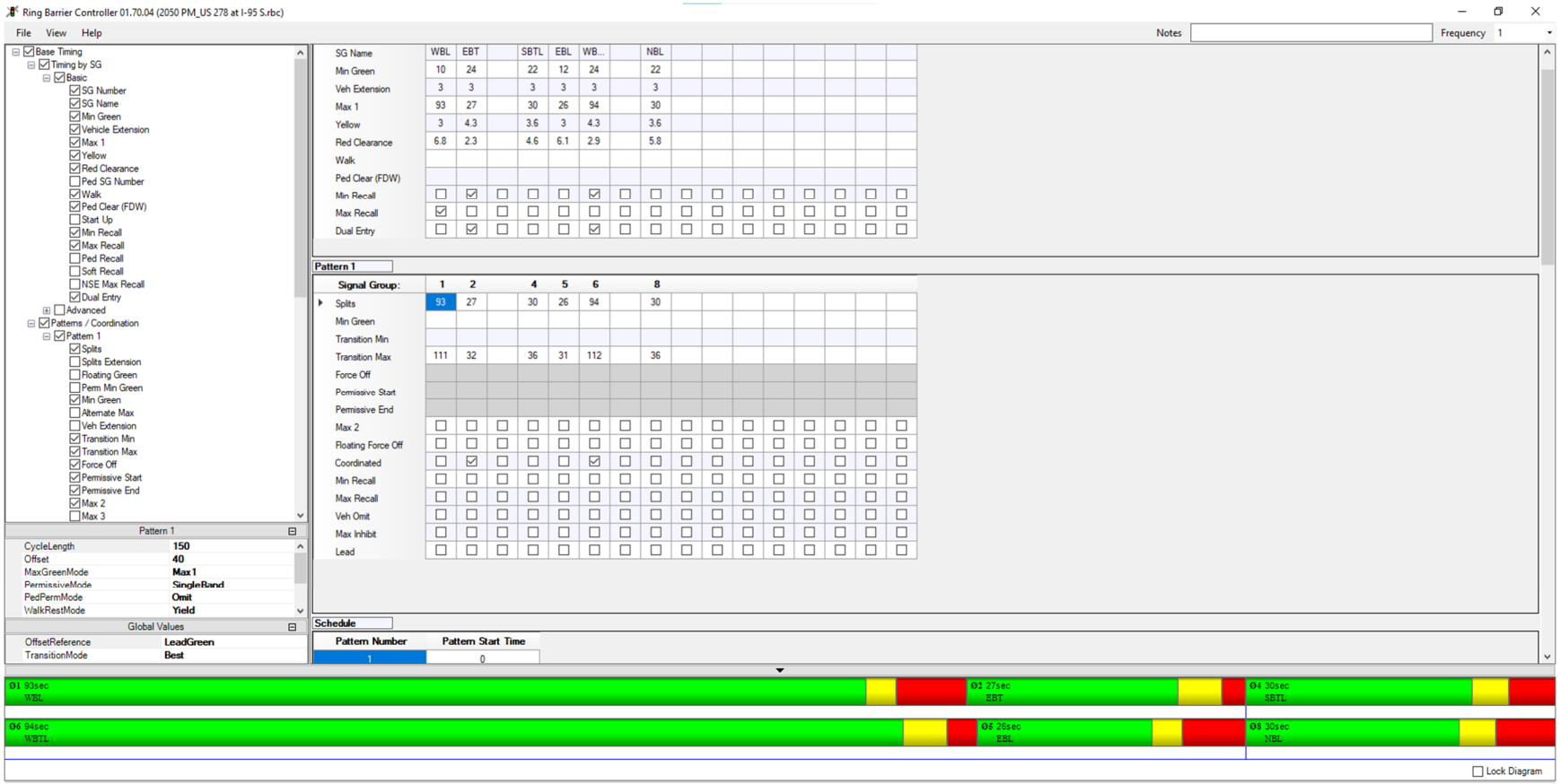
2050 Single Point Urban Interchange AM US 278 at US 17



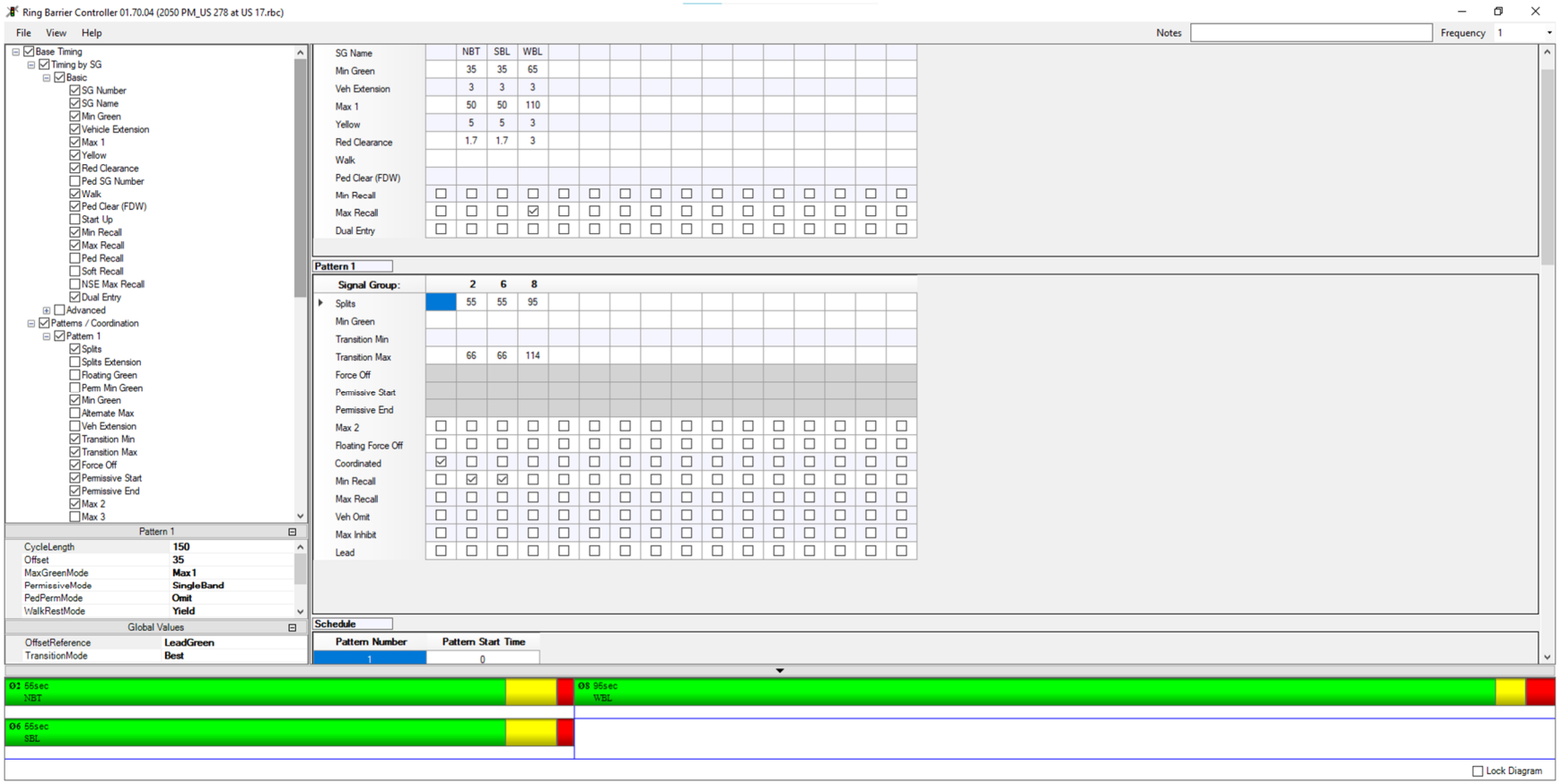
2050 Single Point Urban Interchange PM US 278 at Henry Moss Boulevard



2050 Single Point Urban Interchange PM US 278 at I-95 Ramps

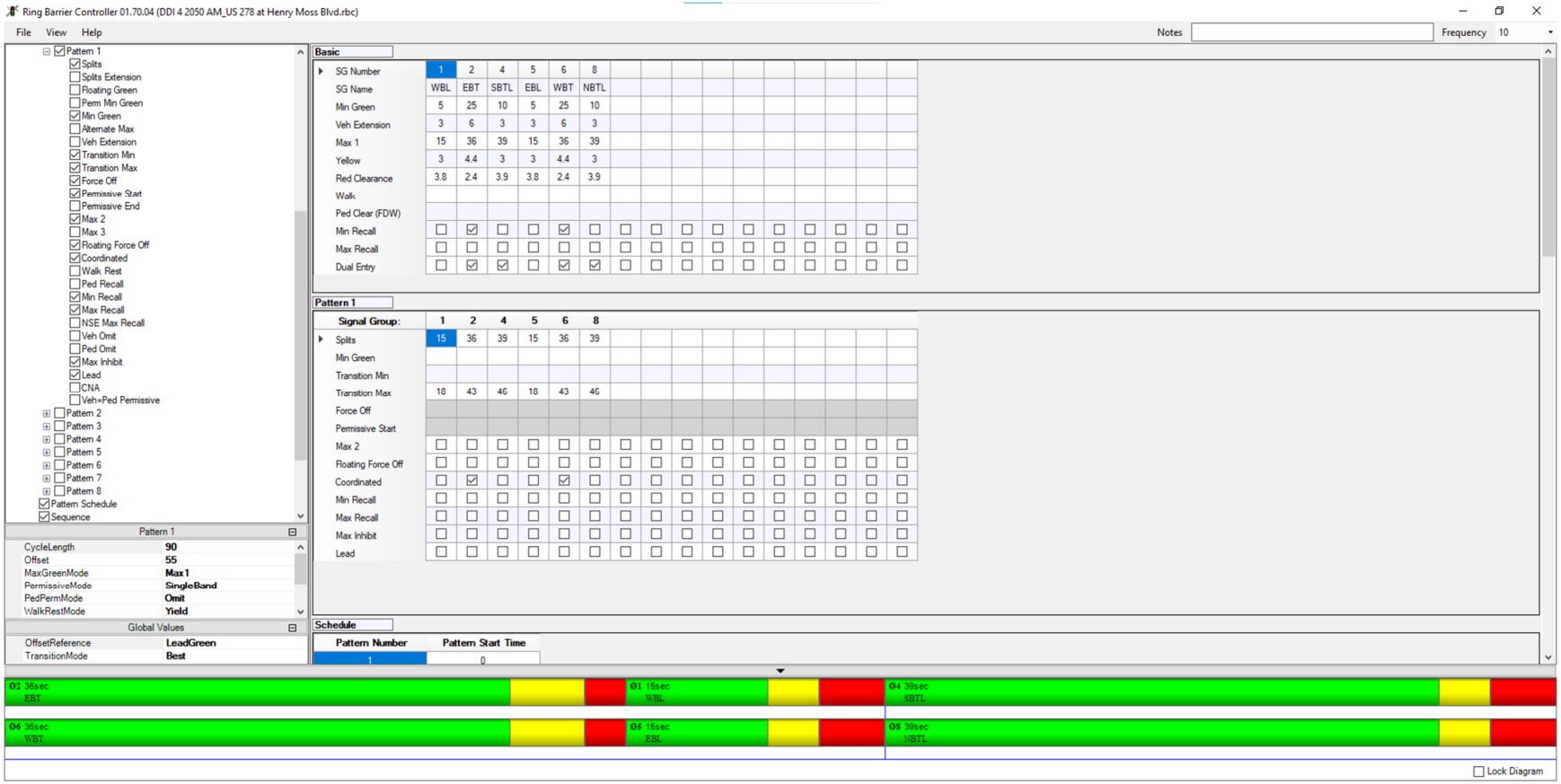


2050 Single Point Urban Interchange PM US 278 at US 17

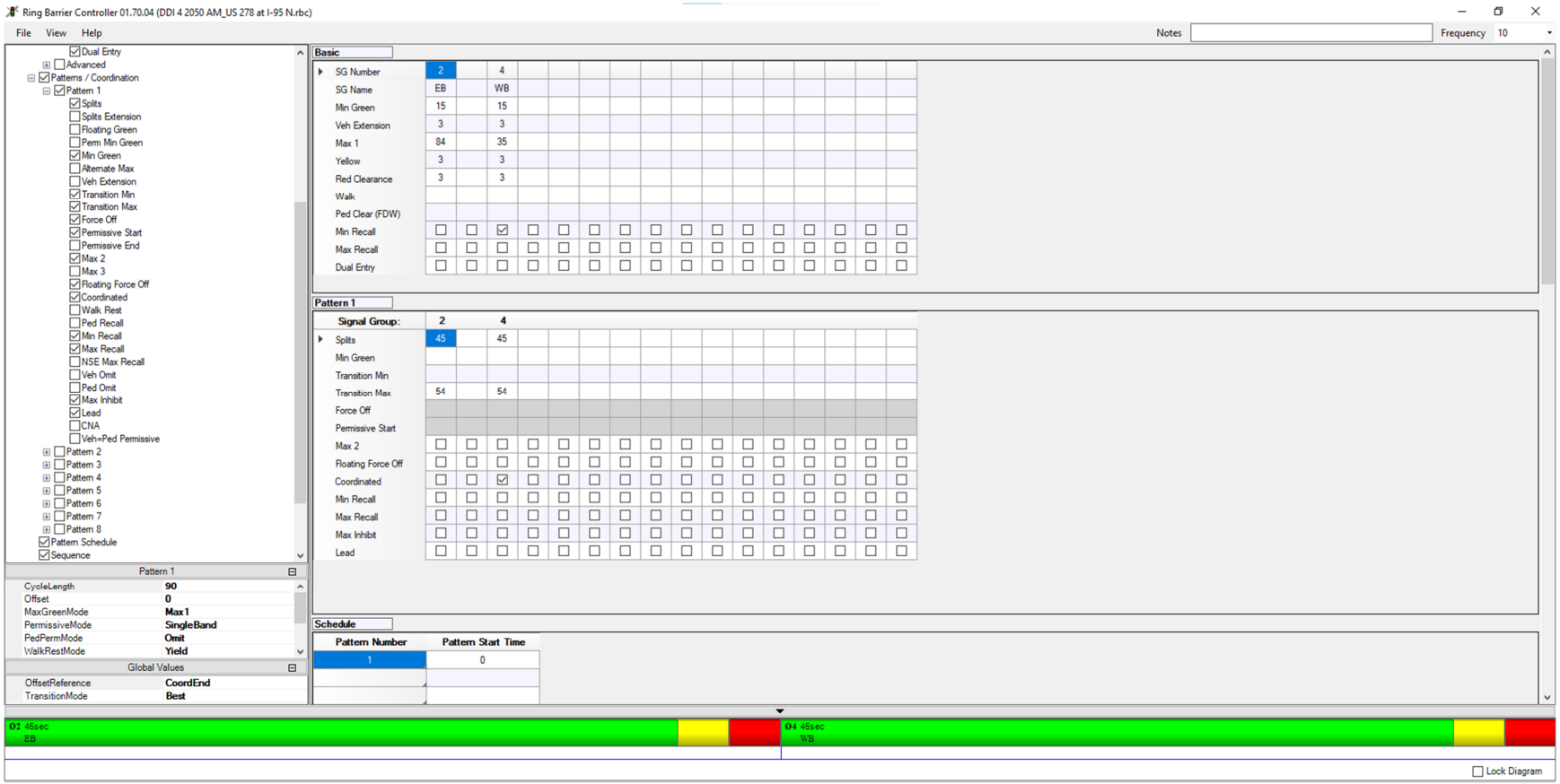


2050 Diverging Diamond Four Lanes at US 278

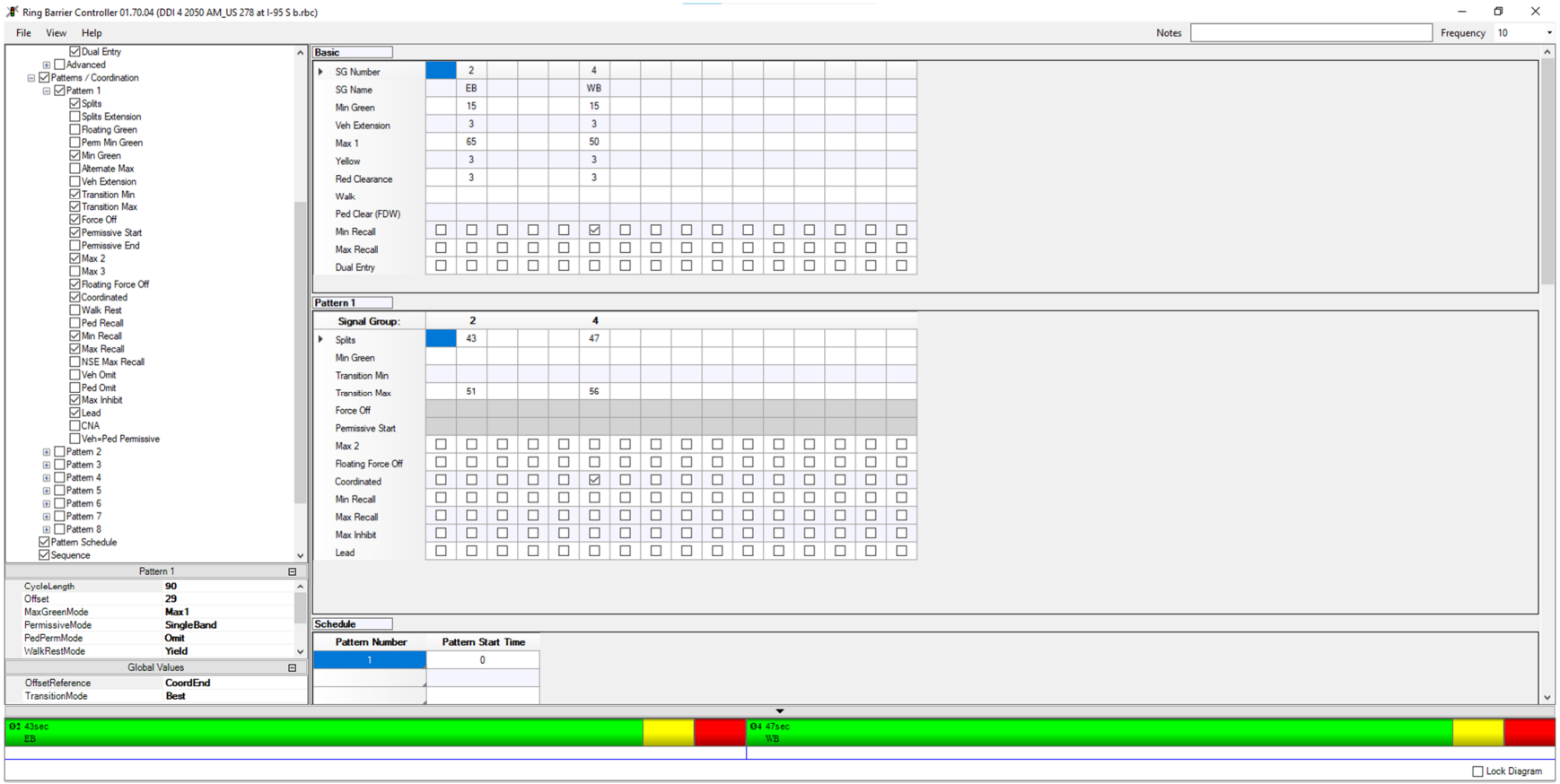
2050 DDI 4 lanes AM US 278 at Henry Moss Boulevard



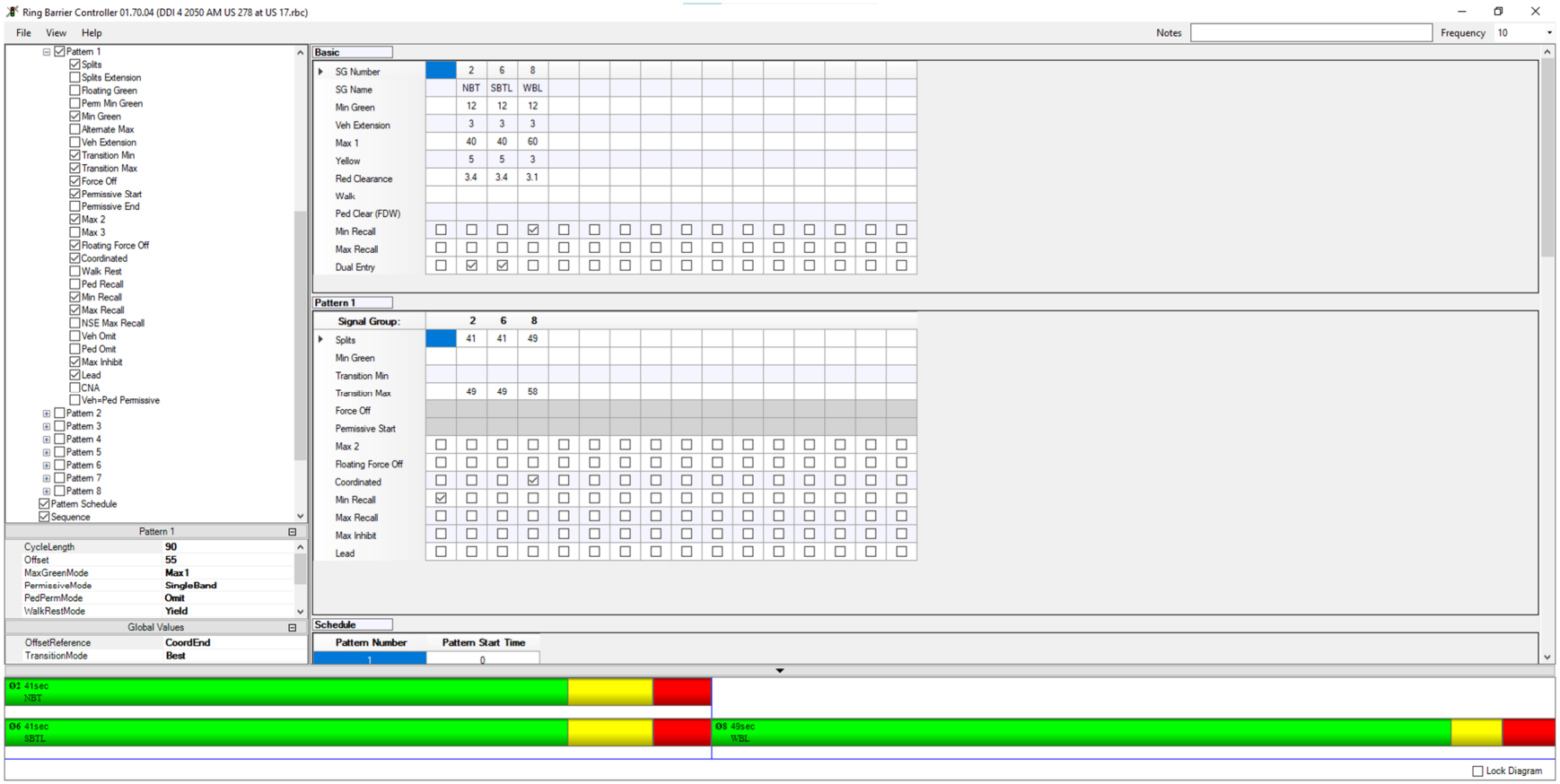
2050 DDI 4 lanes AM US 278 at I-95 NB ramps



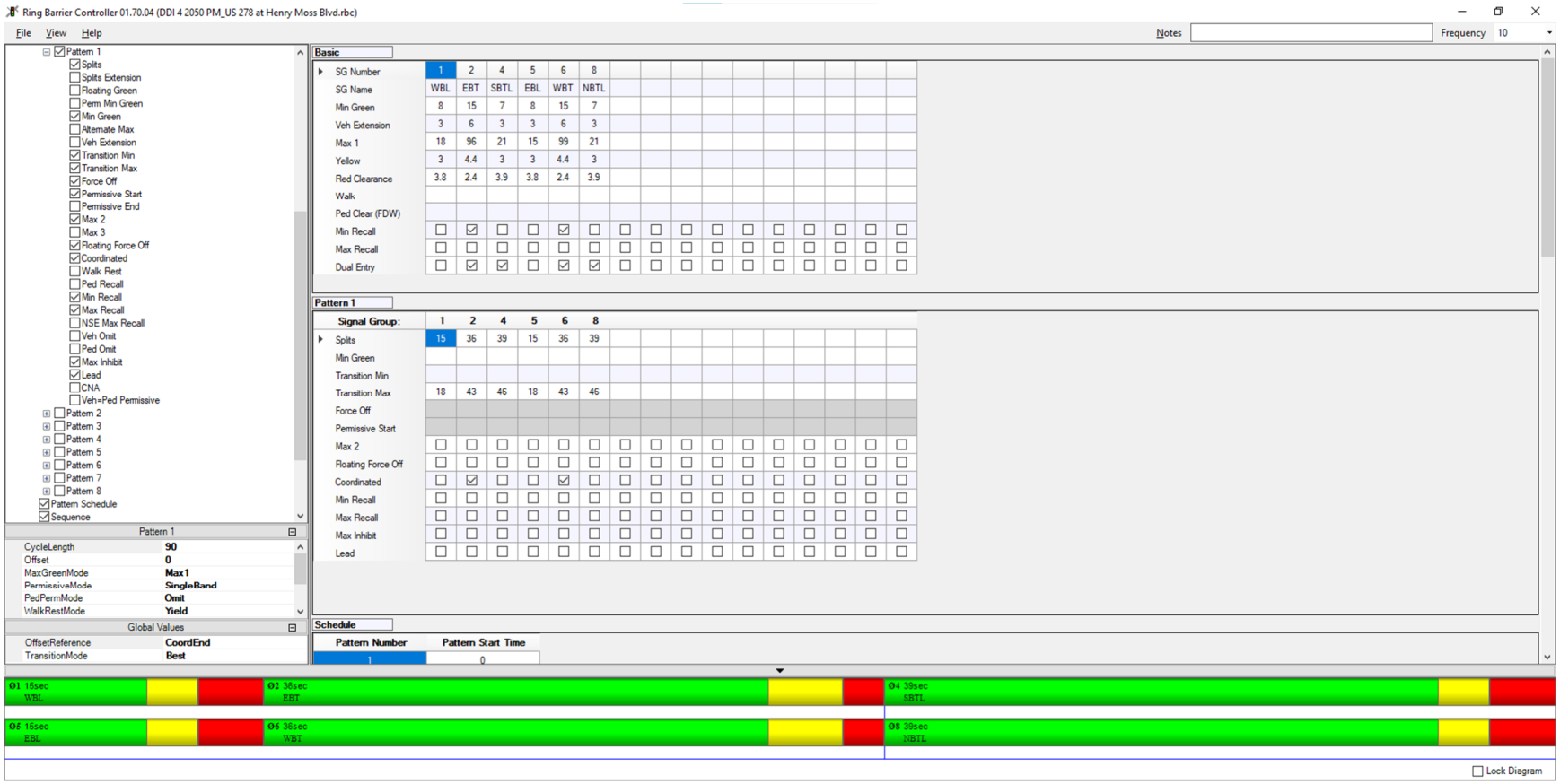
2050 DDI 4 lanes AM US 278 at I-95 SB ramps



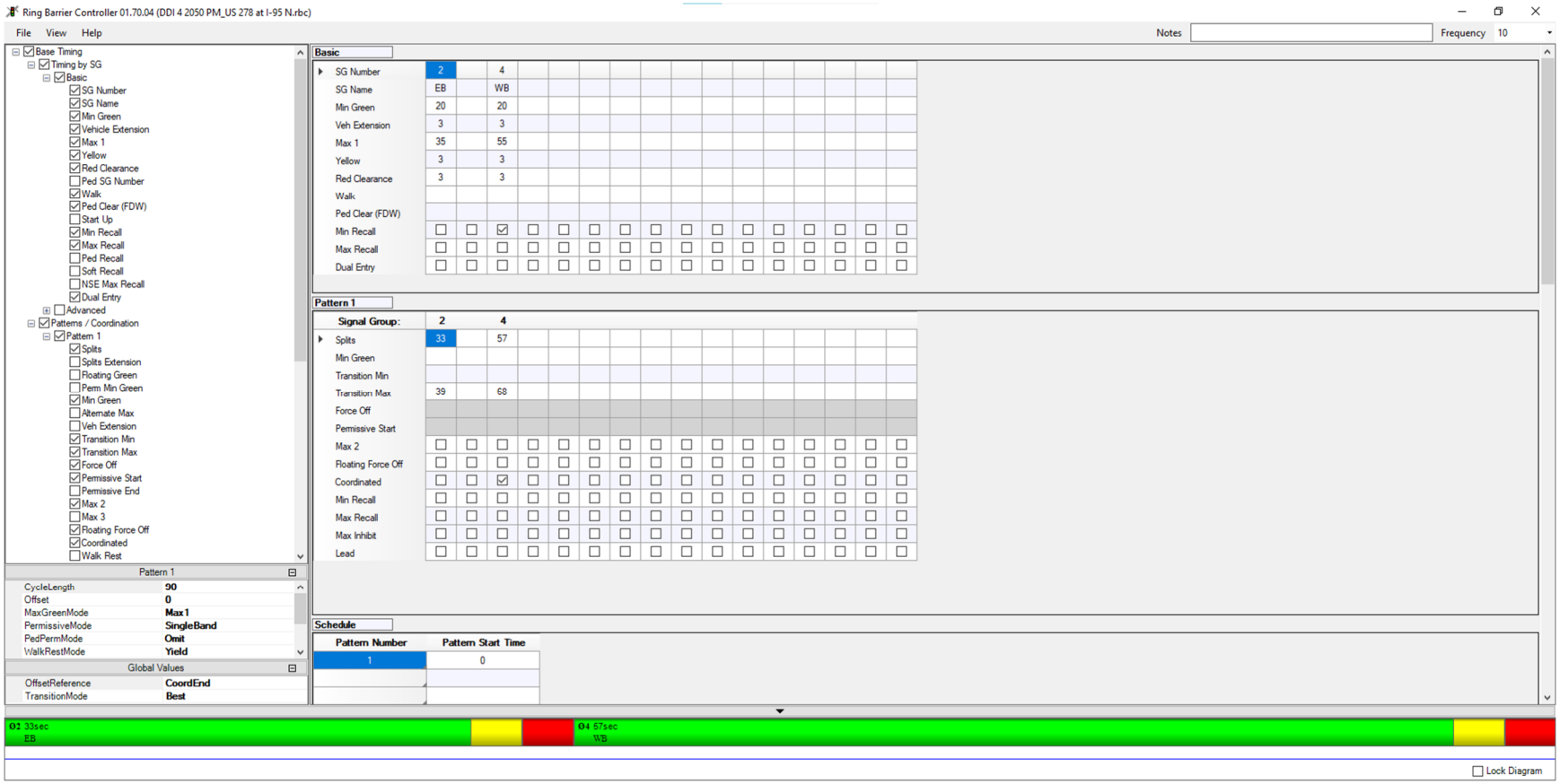
2050 DDI 4 lanes AM US 278 at US 17



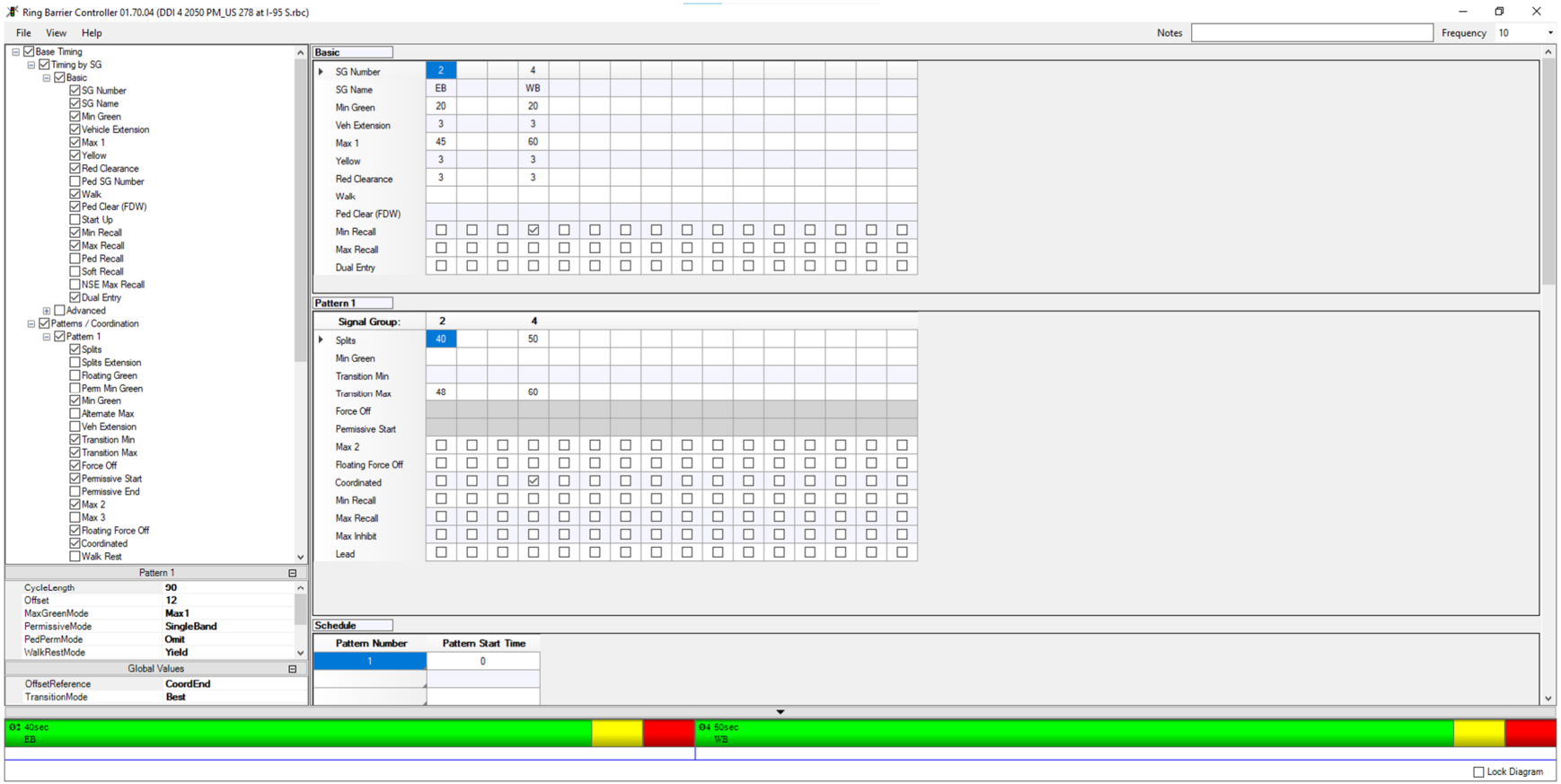
2050 DDI 4 lanes PM US 278 at Henry Moss Boulevard



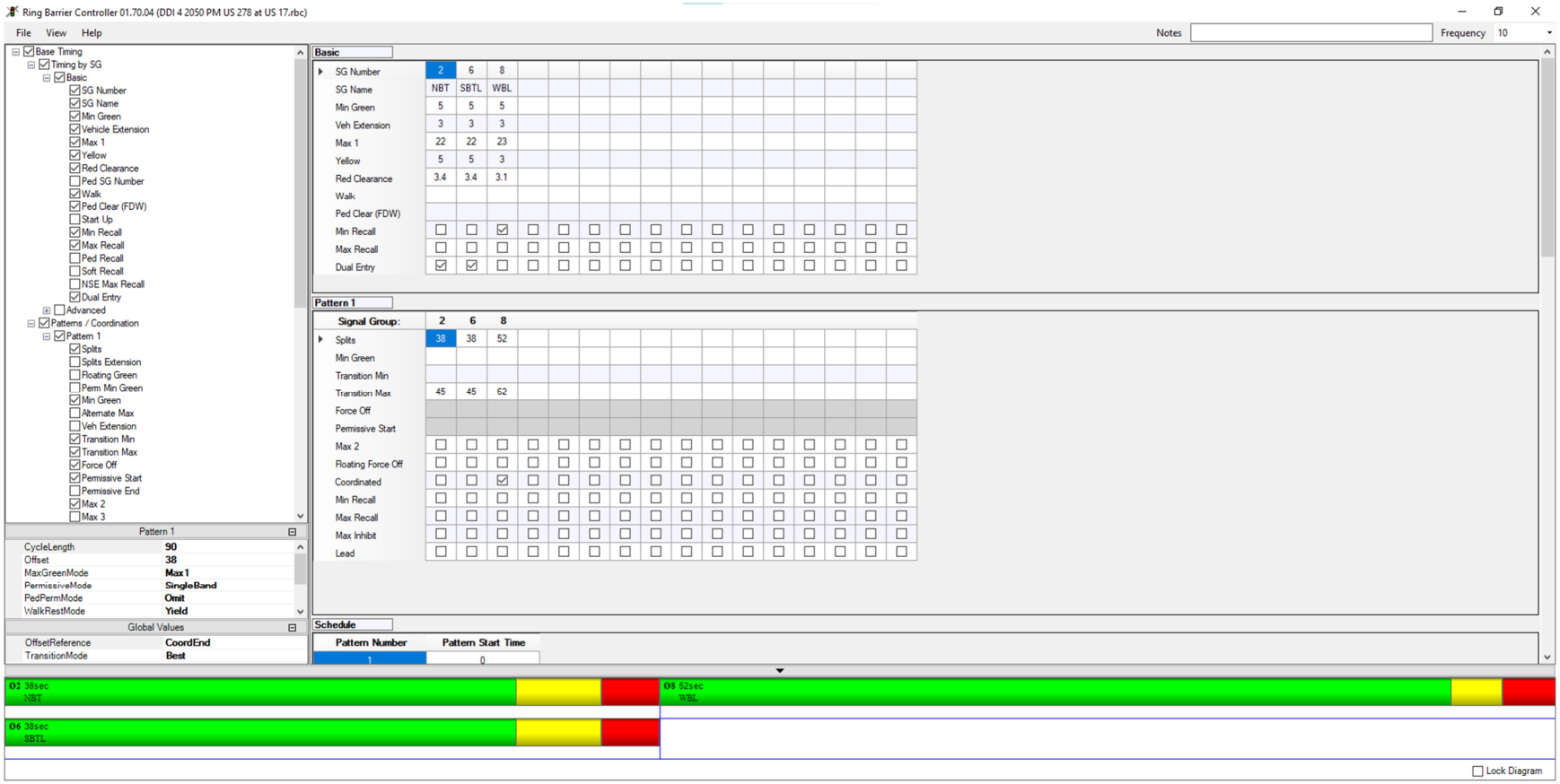
2050 DDI 4 lanes PM US 278 at I-95 NB ramps



2050 DDI 4 lanes PM US 278 at I-95 SB ramps

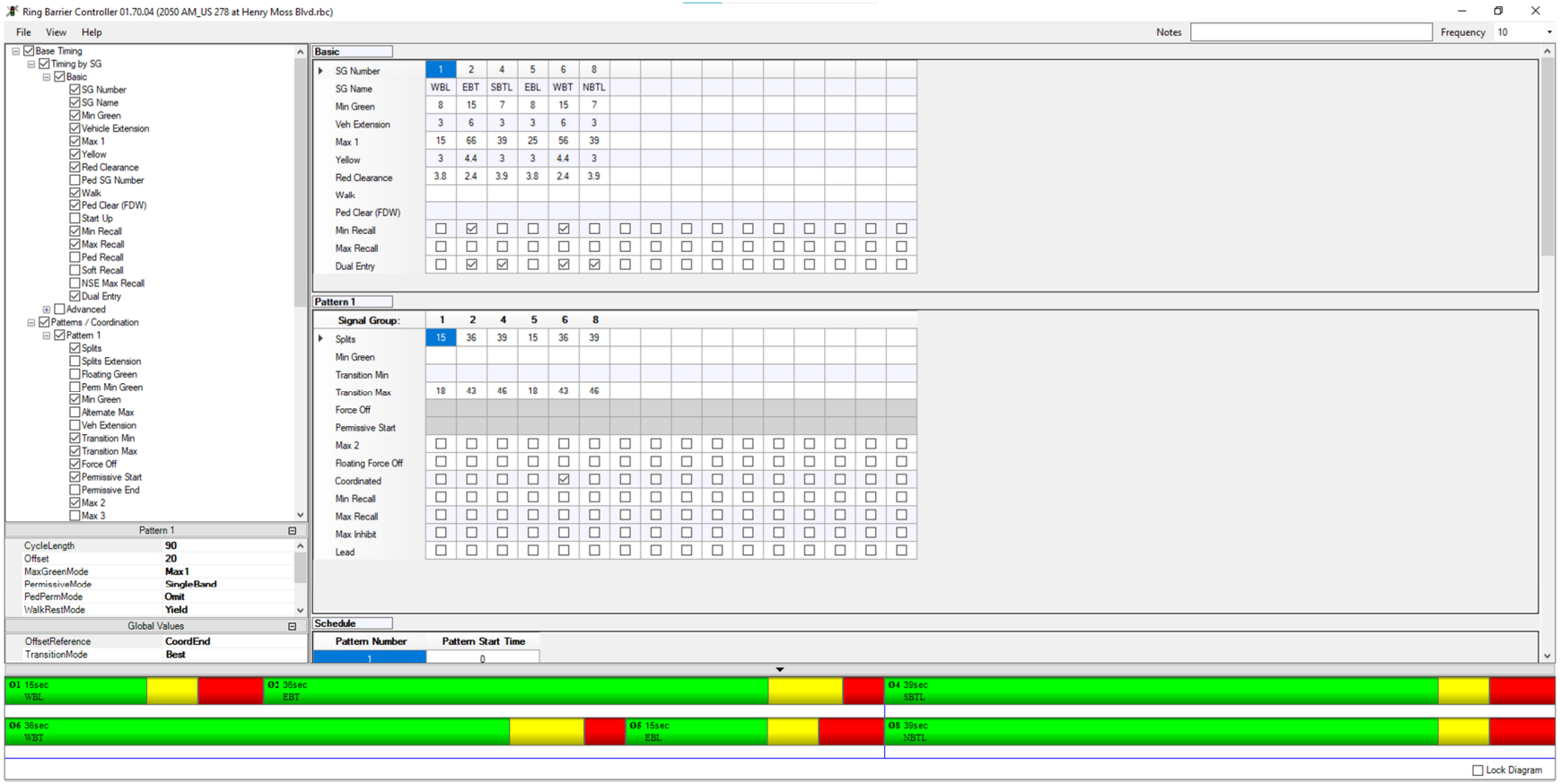


2050 DDI 4 lanes PM US 278 at US 17

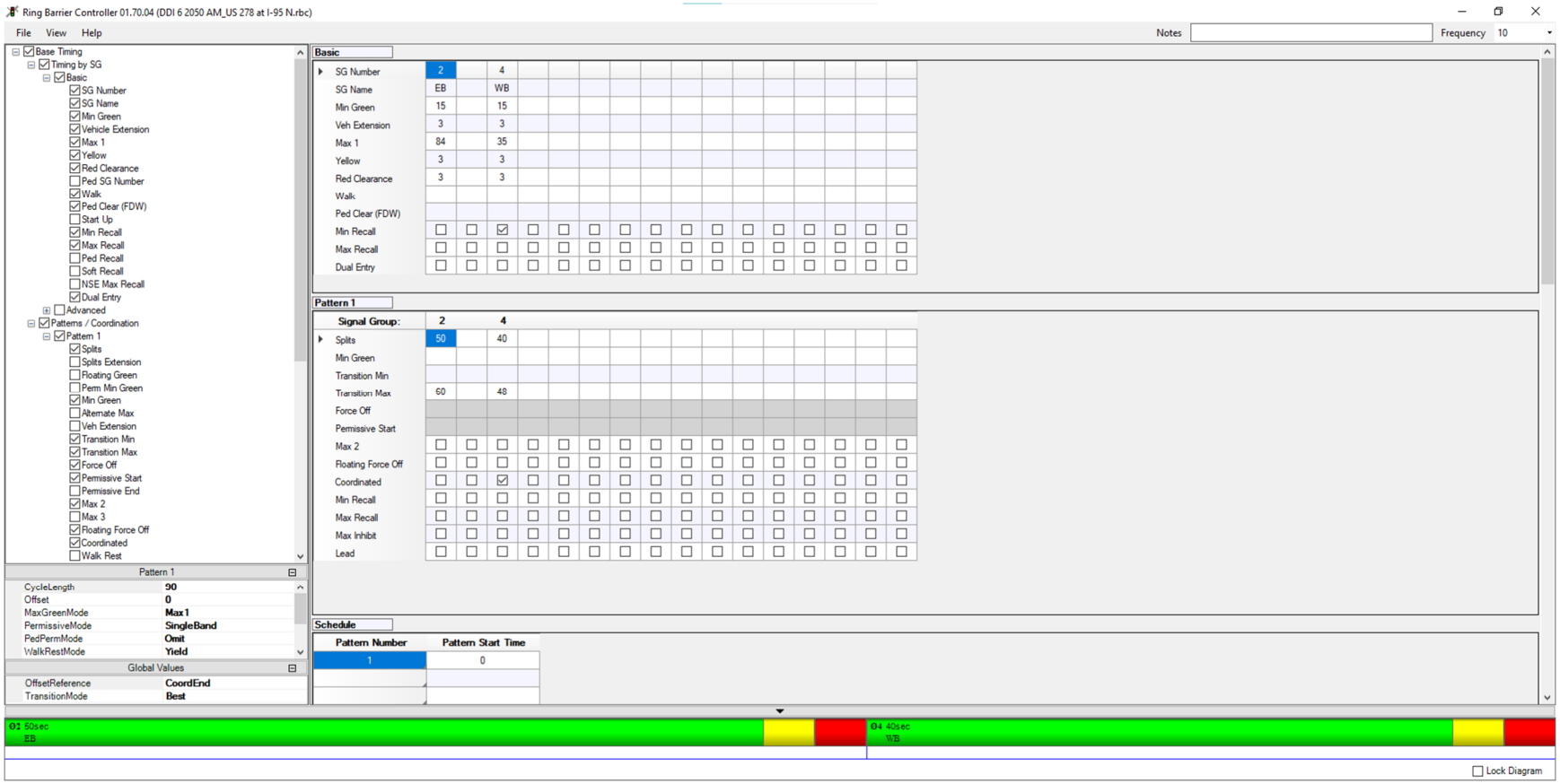


2050 Diverging Diamond Six Lanes at US 278

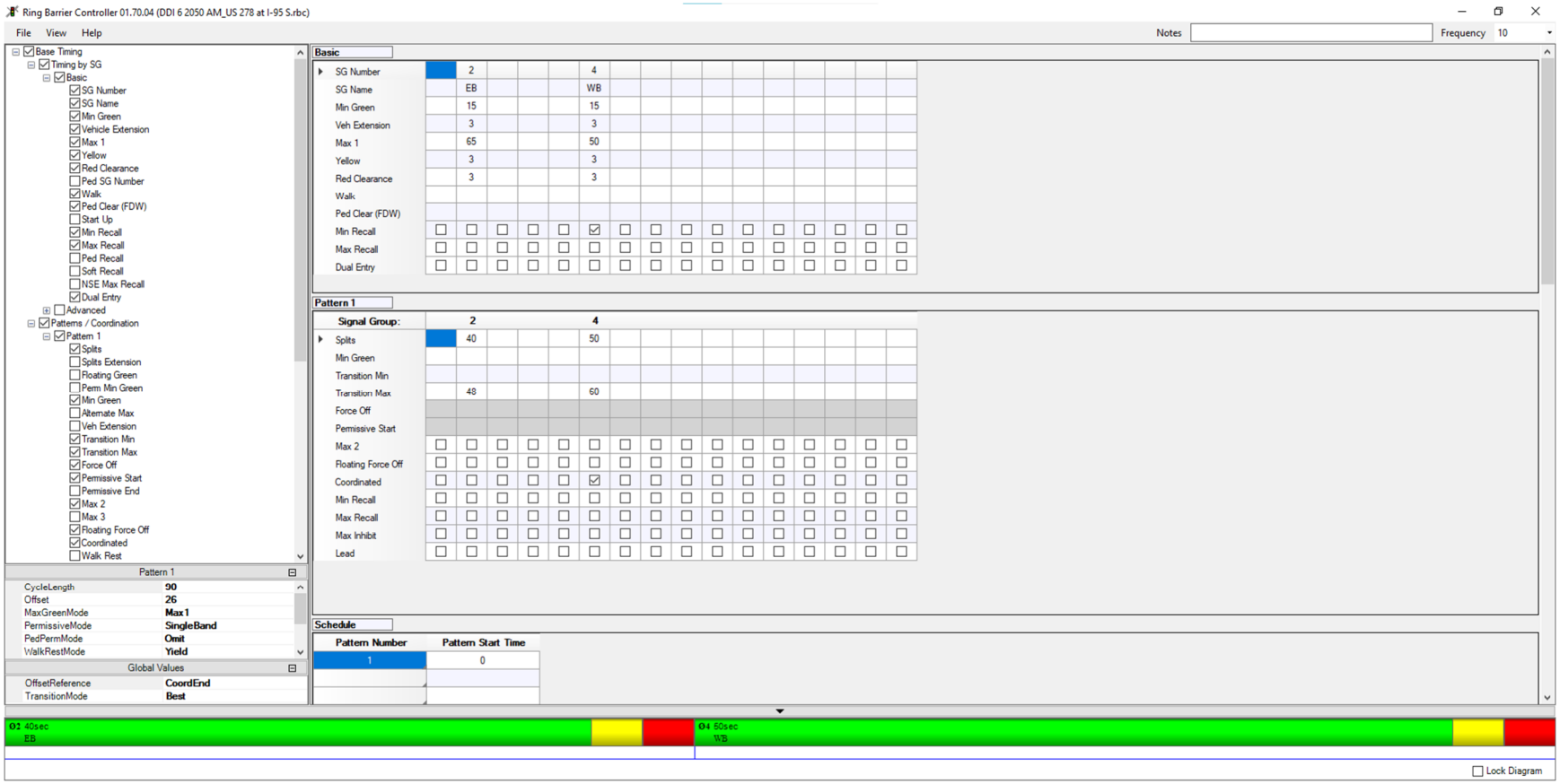
2050 DDI 6 lanes AM US 278 at Henry Moss Boulevard



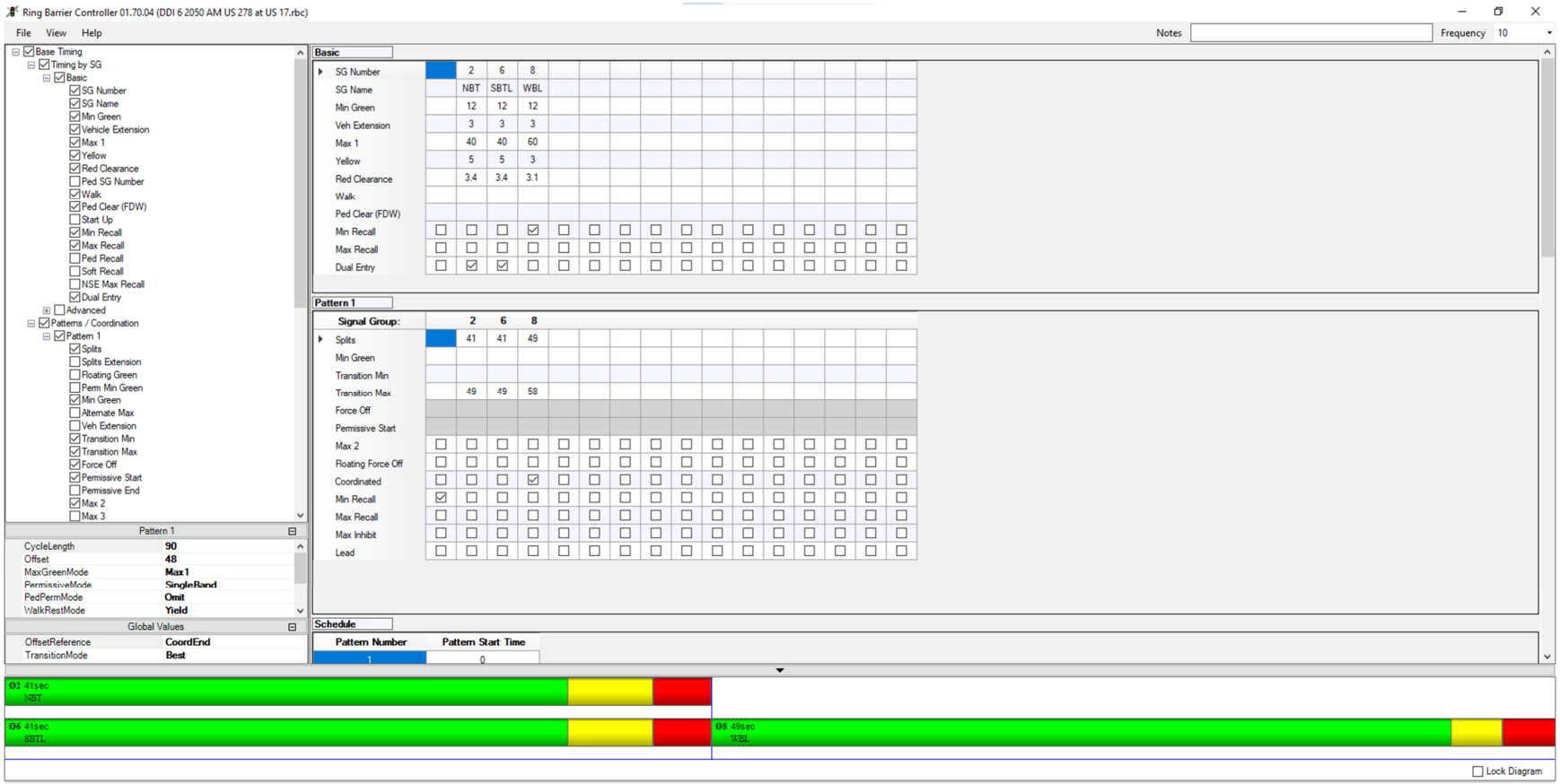
2050 DDI 6 lanes AM US 278 at I-95 NB Ramps



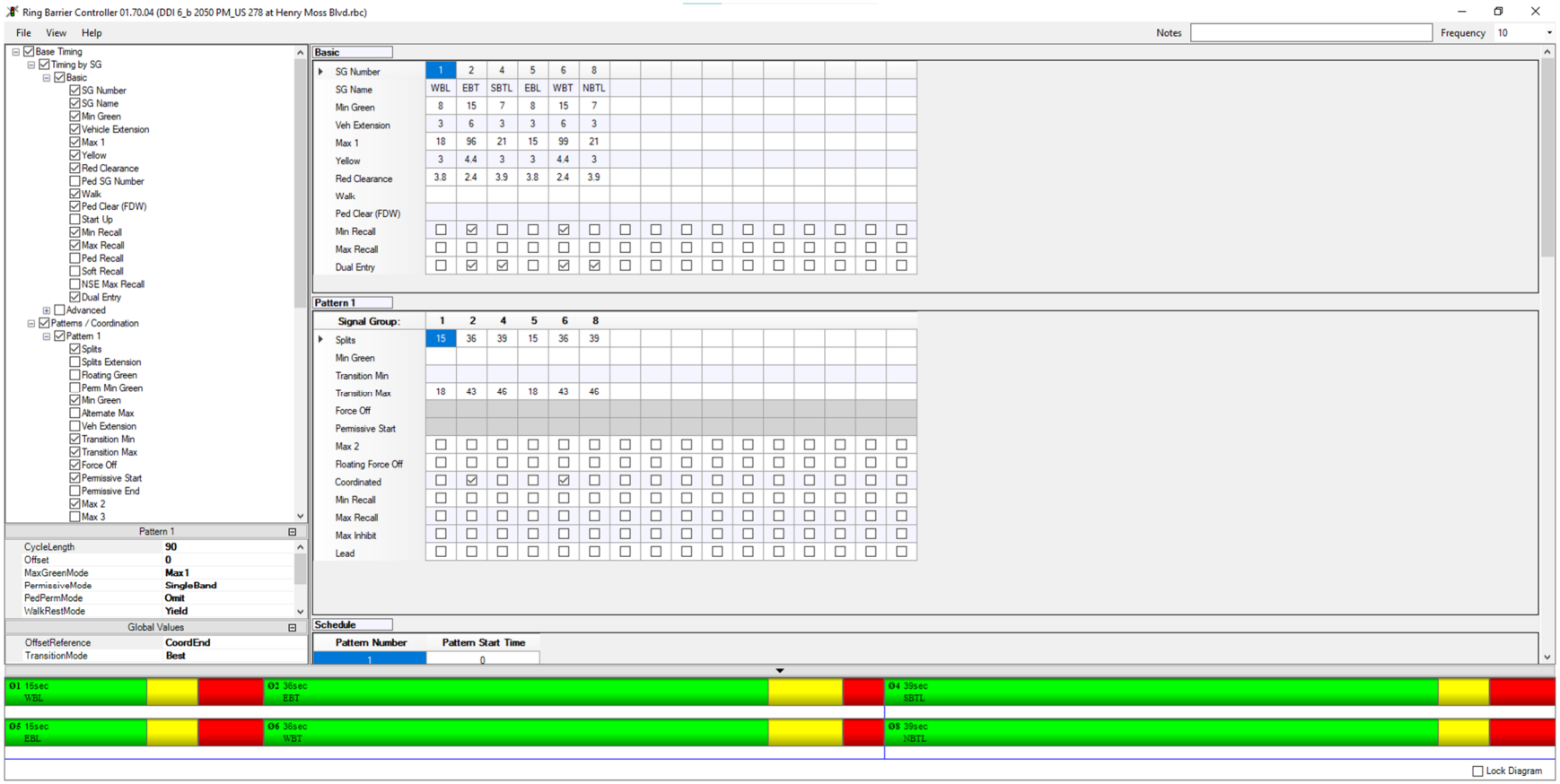
2050 DDI 6 lanes AM US 278 at I-95 SB Ramps



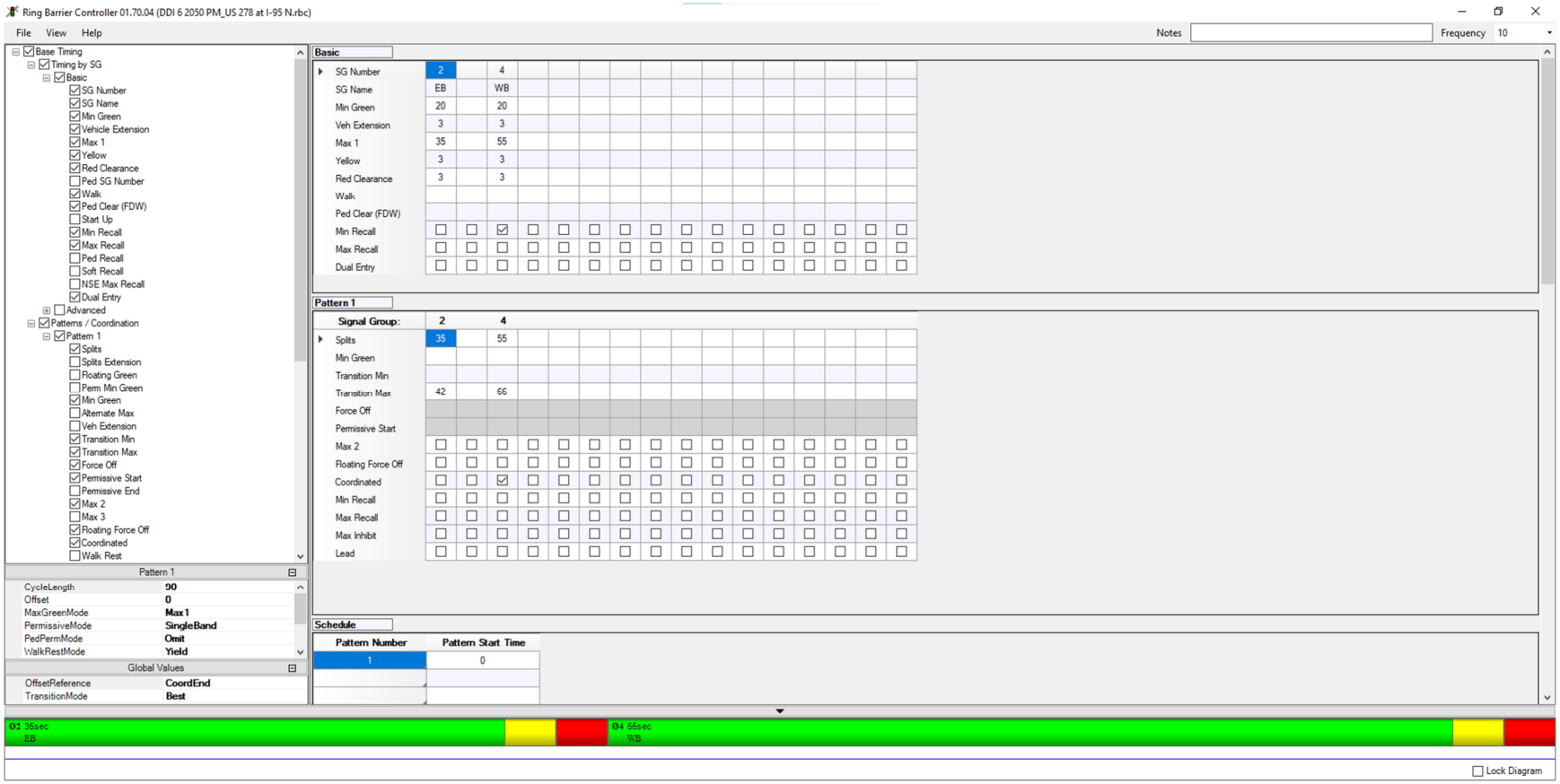
2050 DDI 6 lanes AM US 278 at US 17



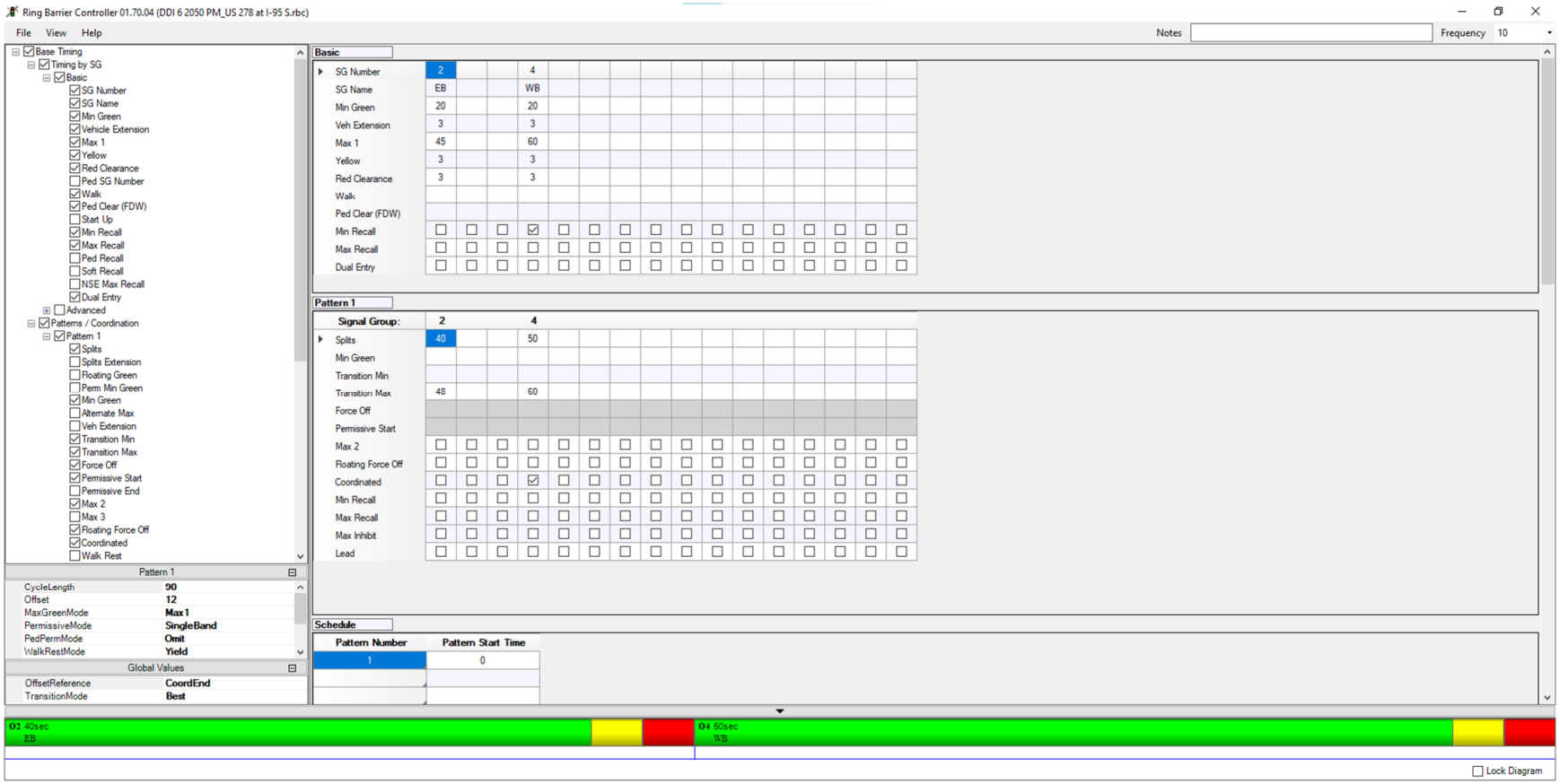
2050 DDI 6 lanes PM US 278 at Henry Moss Boulevard



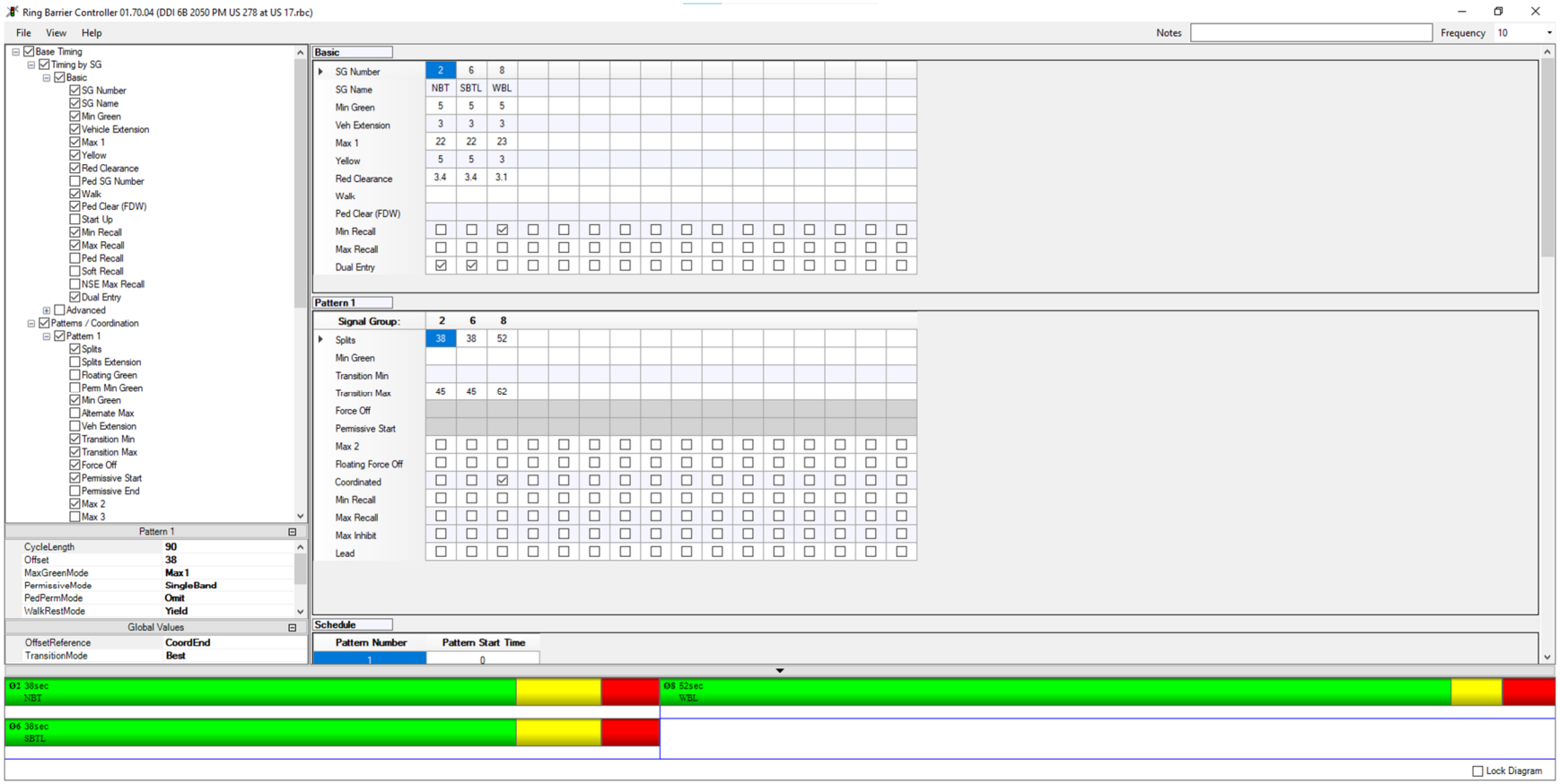
2050 DDI 6 lanes PM US 278 at I-95 NB Ramps



2050 DDI 6 lanes PM US 278 at I-95 SB Ramps

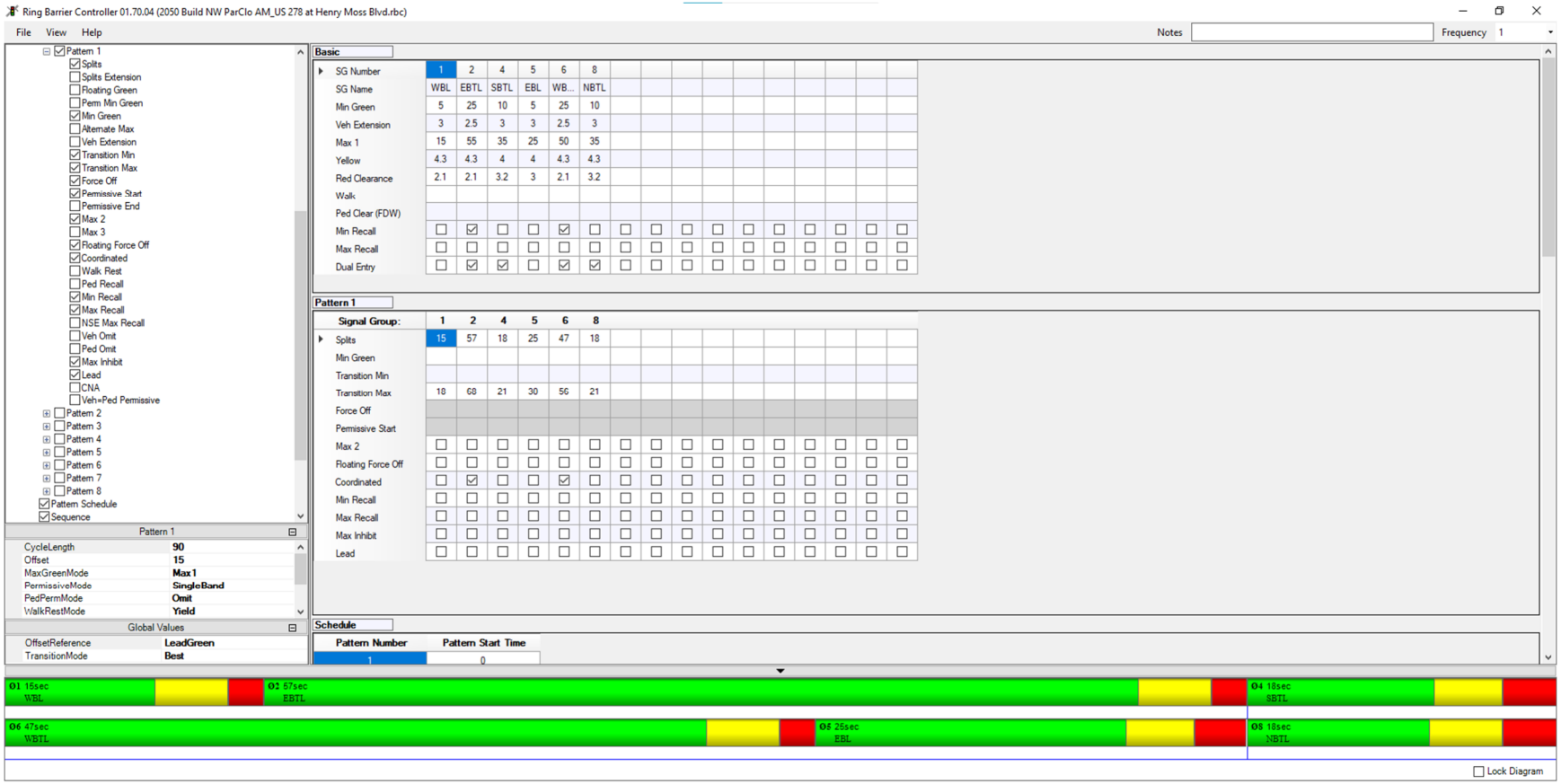


2050 DDI 6 lanes PM US 278 at US 17

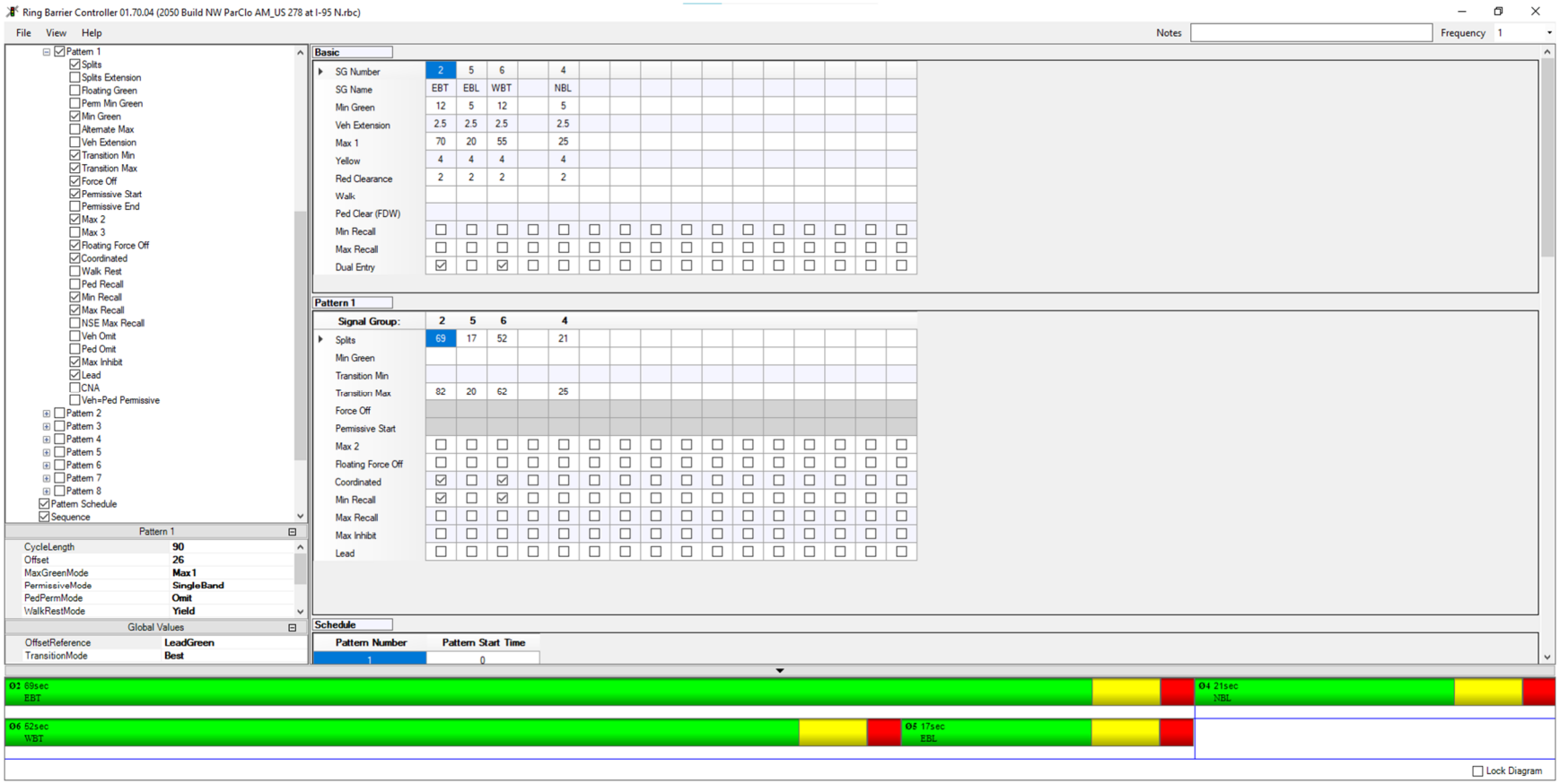


2050 Build North-West Partial Cloverleaf at US 278

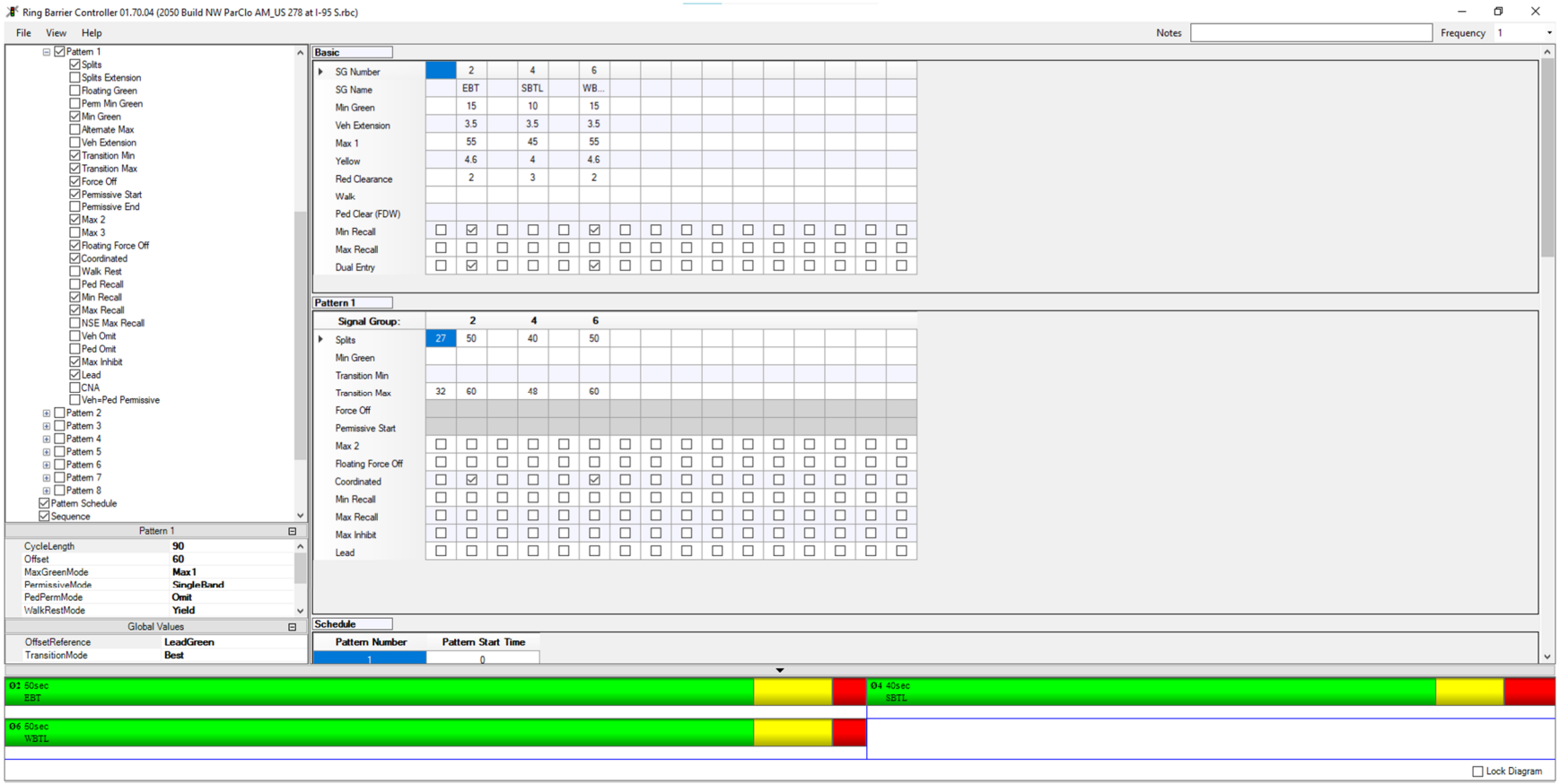
2050 NW ParClo AM US 278 at Henry Moss Boulevard



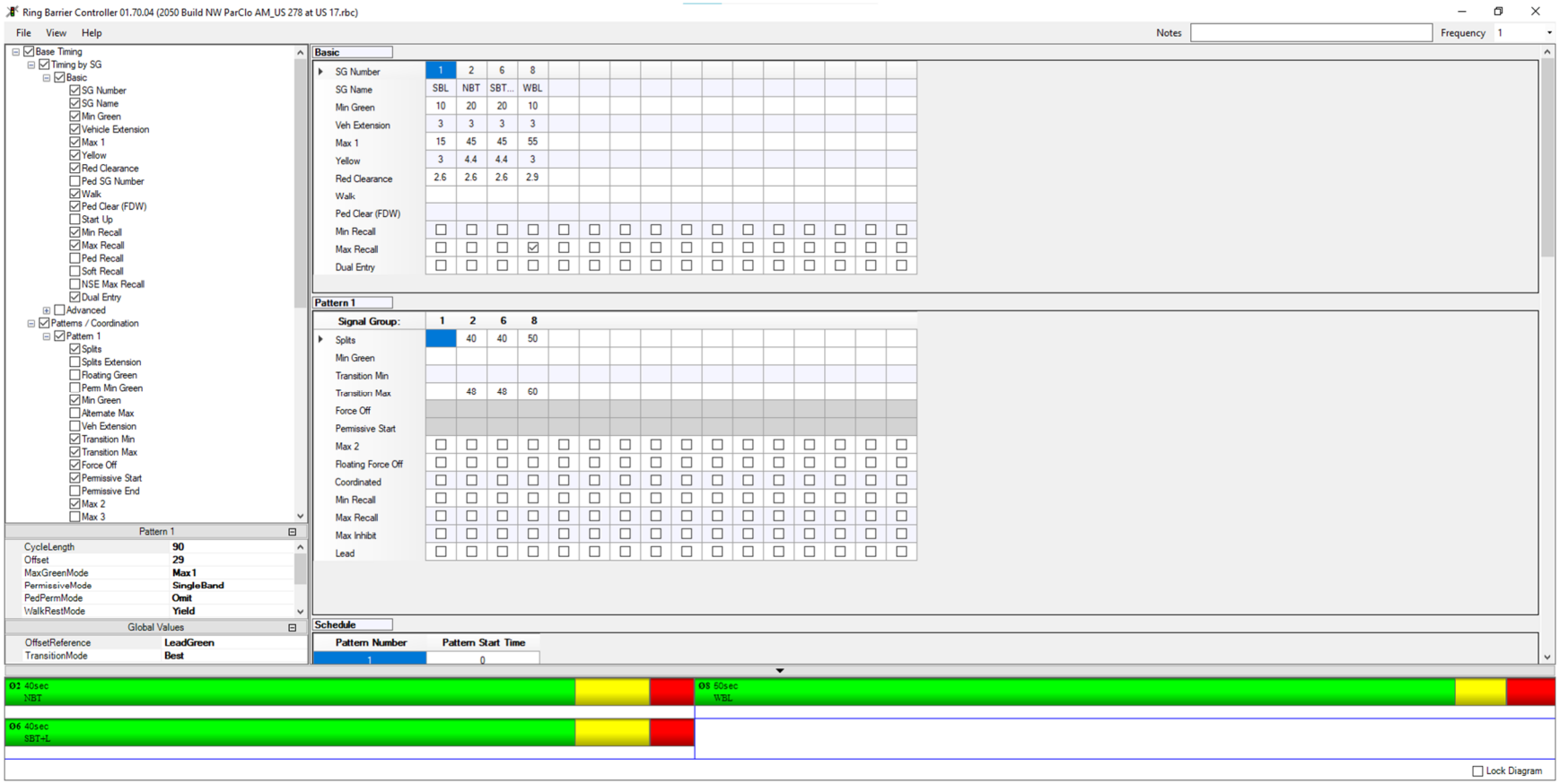
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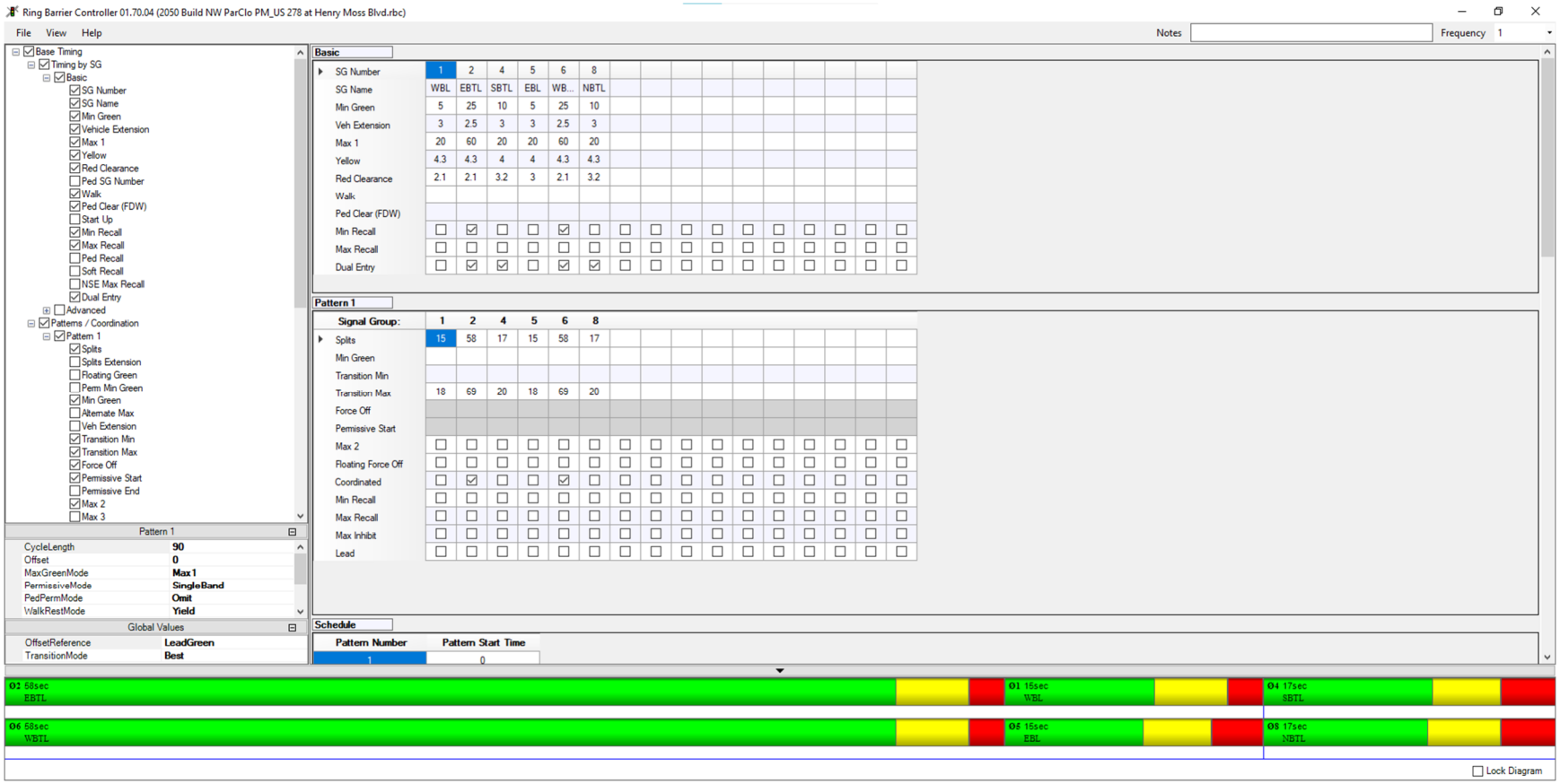
2050 NW ParClo AM US 278 at I-95 SB Ramps



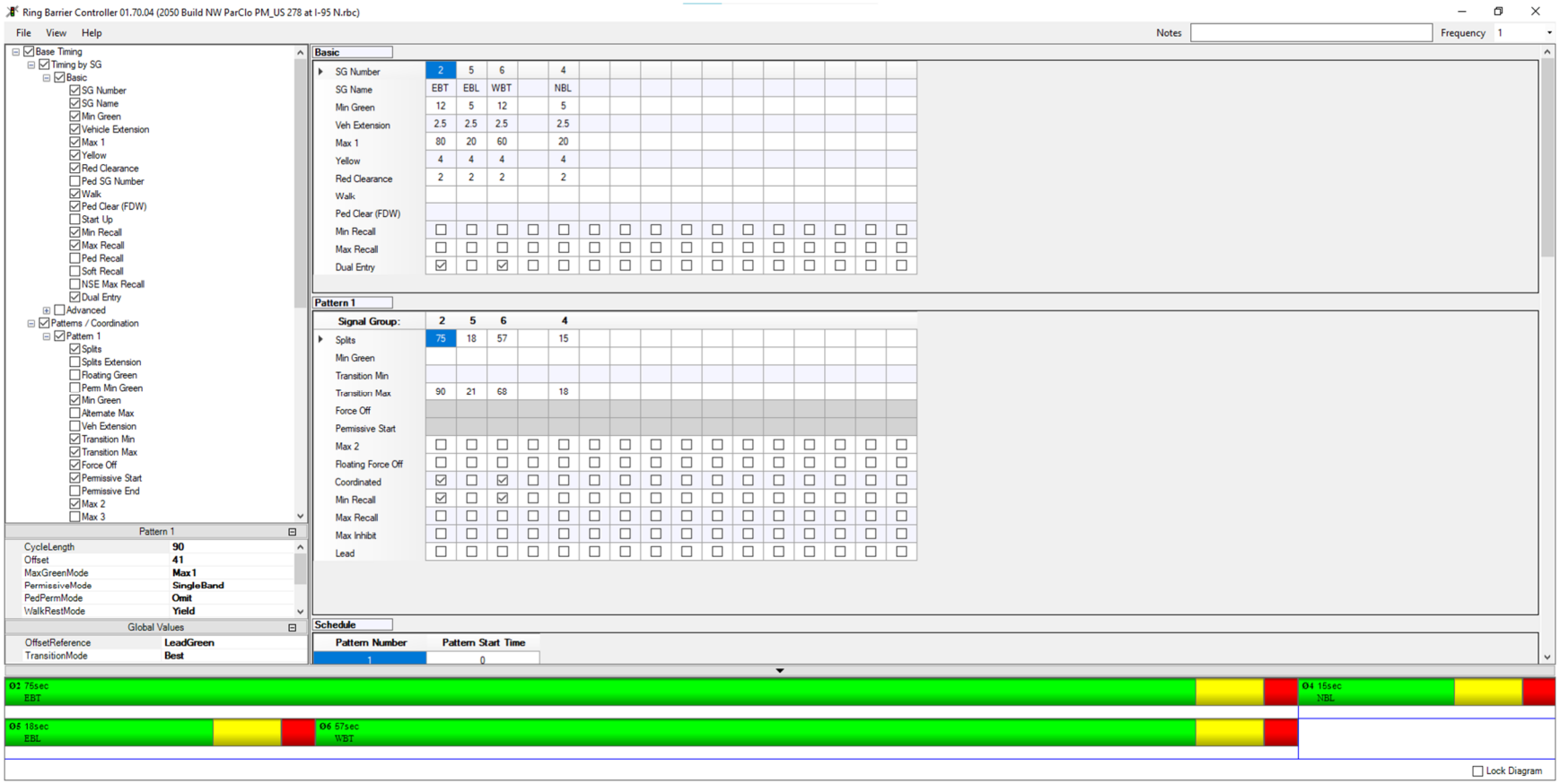
2050 NW ParClo AM US 278 at US 17



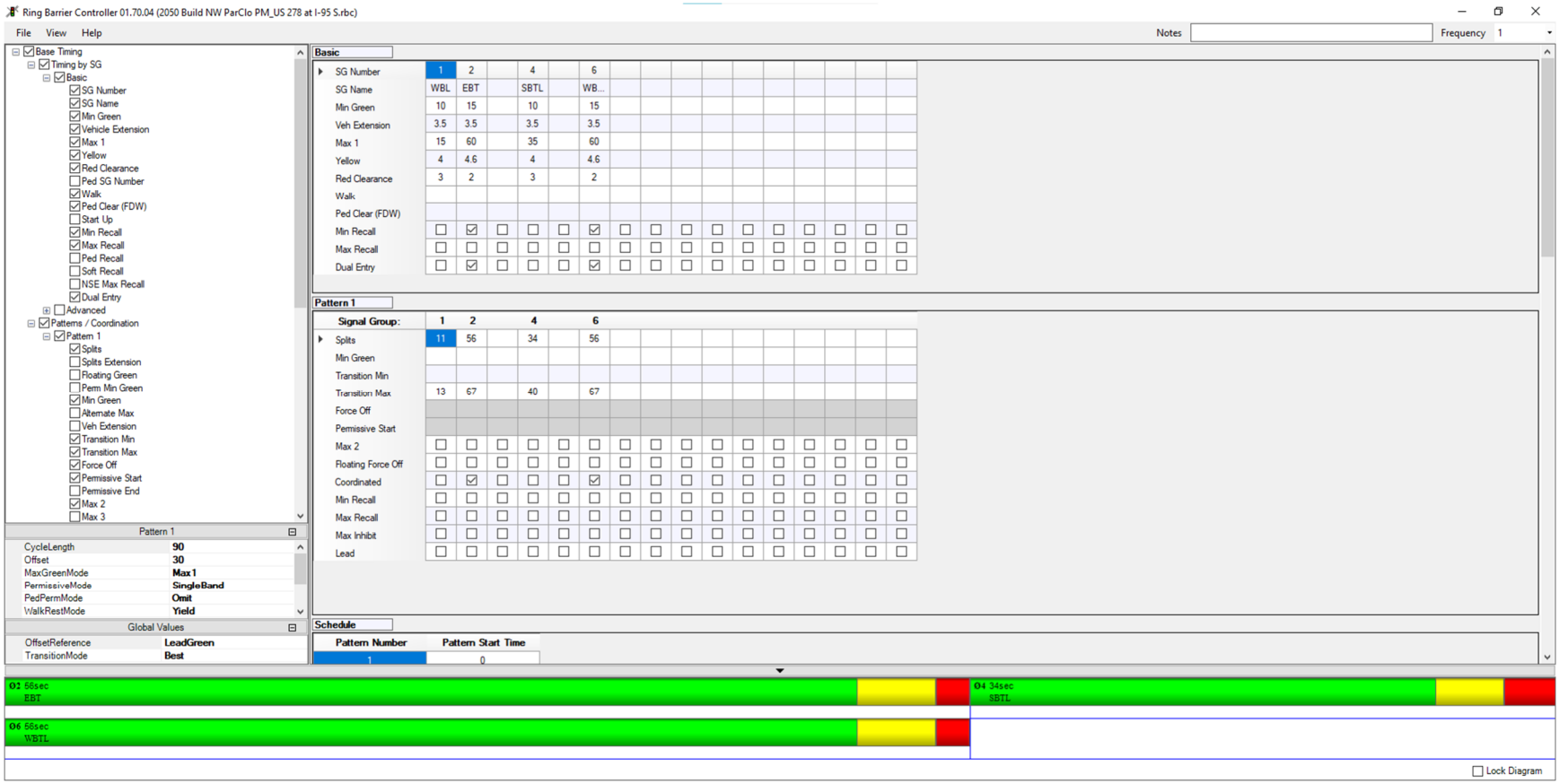
2050 NW ParClo PM US 278 at Henry Moss Boulevard



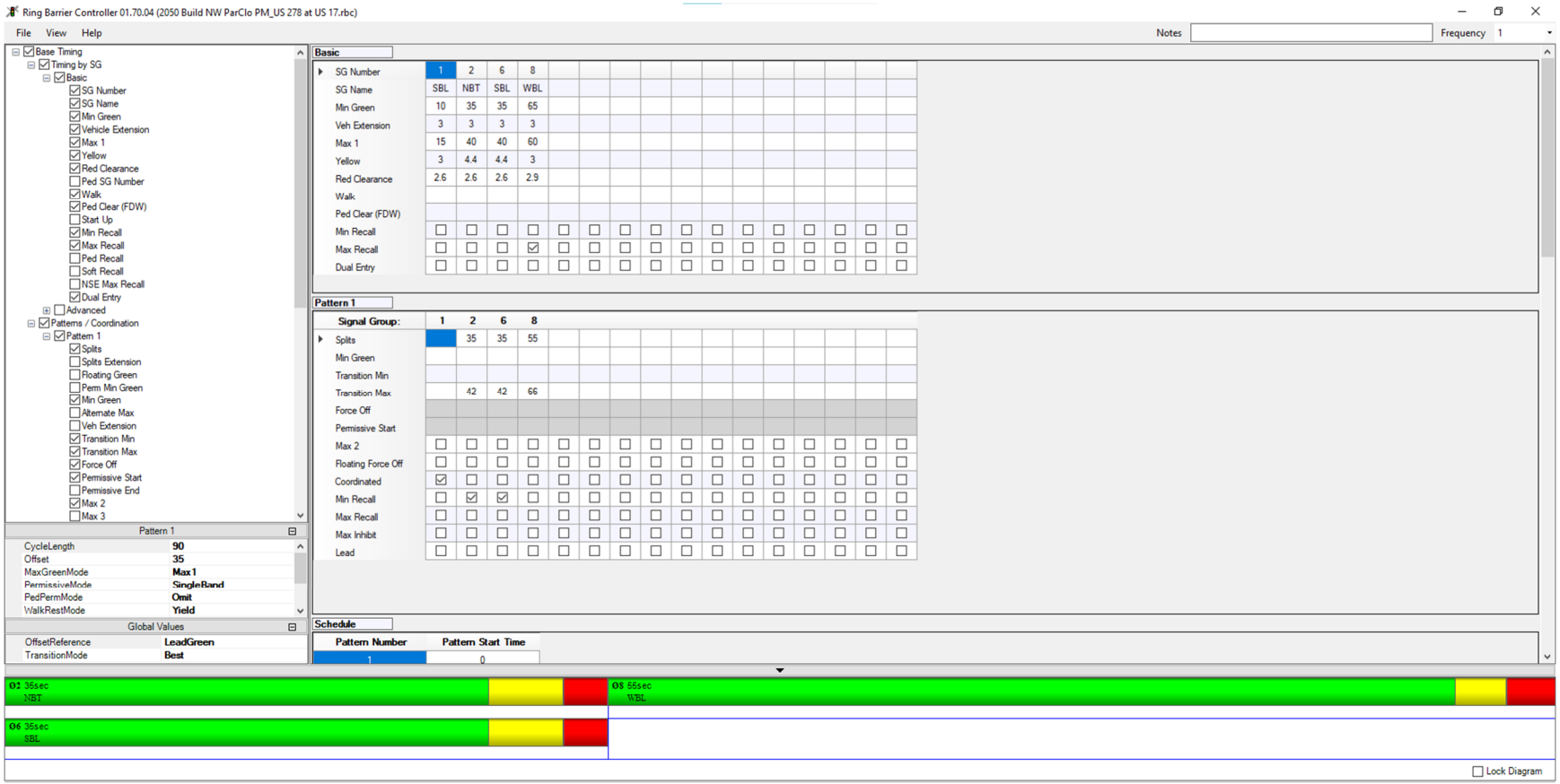
2050 NW ParClo PM US 278 at I-95 NB Ramps



2050 NW ParClo PM US 278 at I-95 SB Ramps

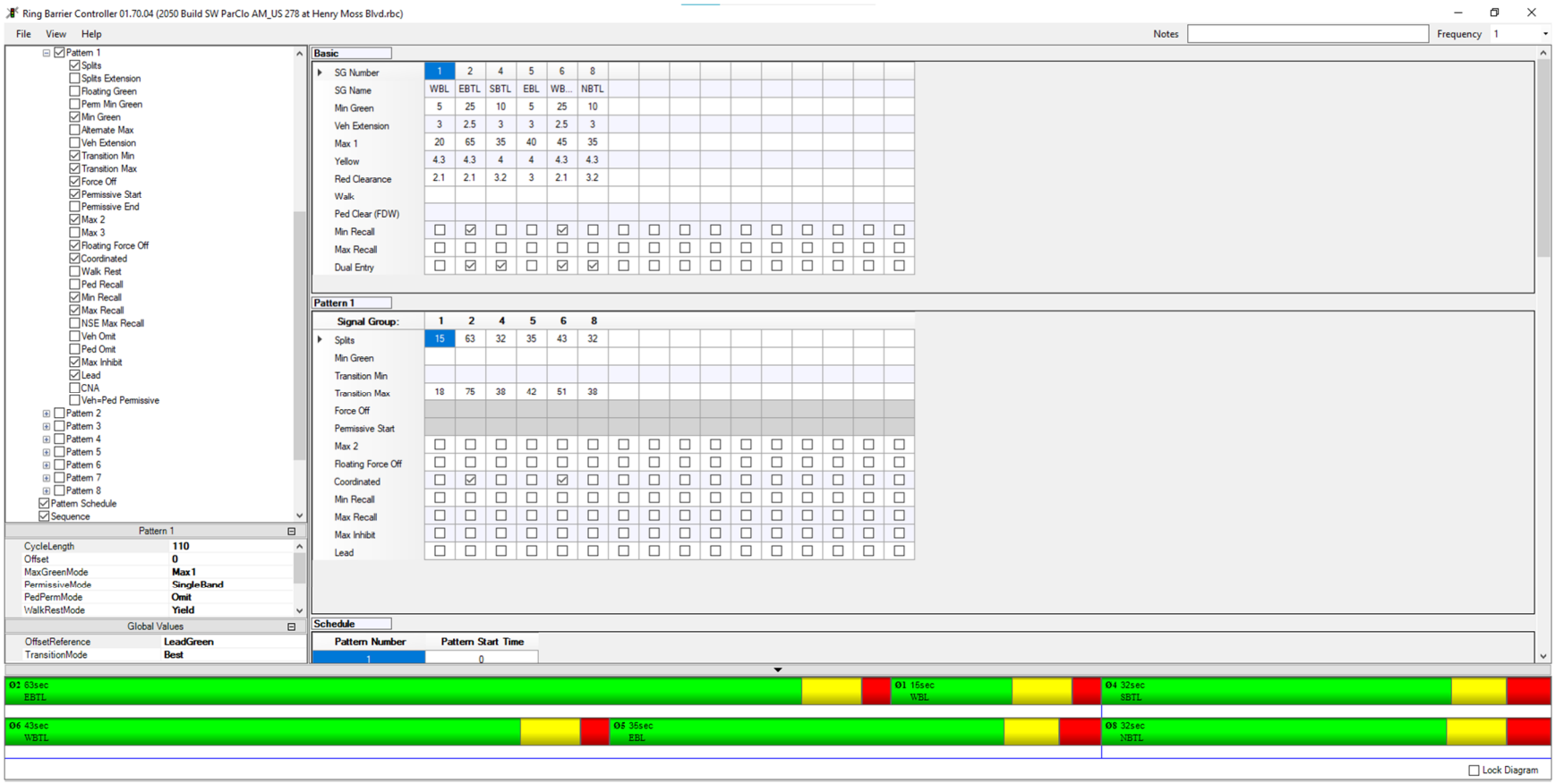


2050 NW ParClo PM US 278 at US 17

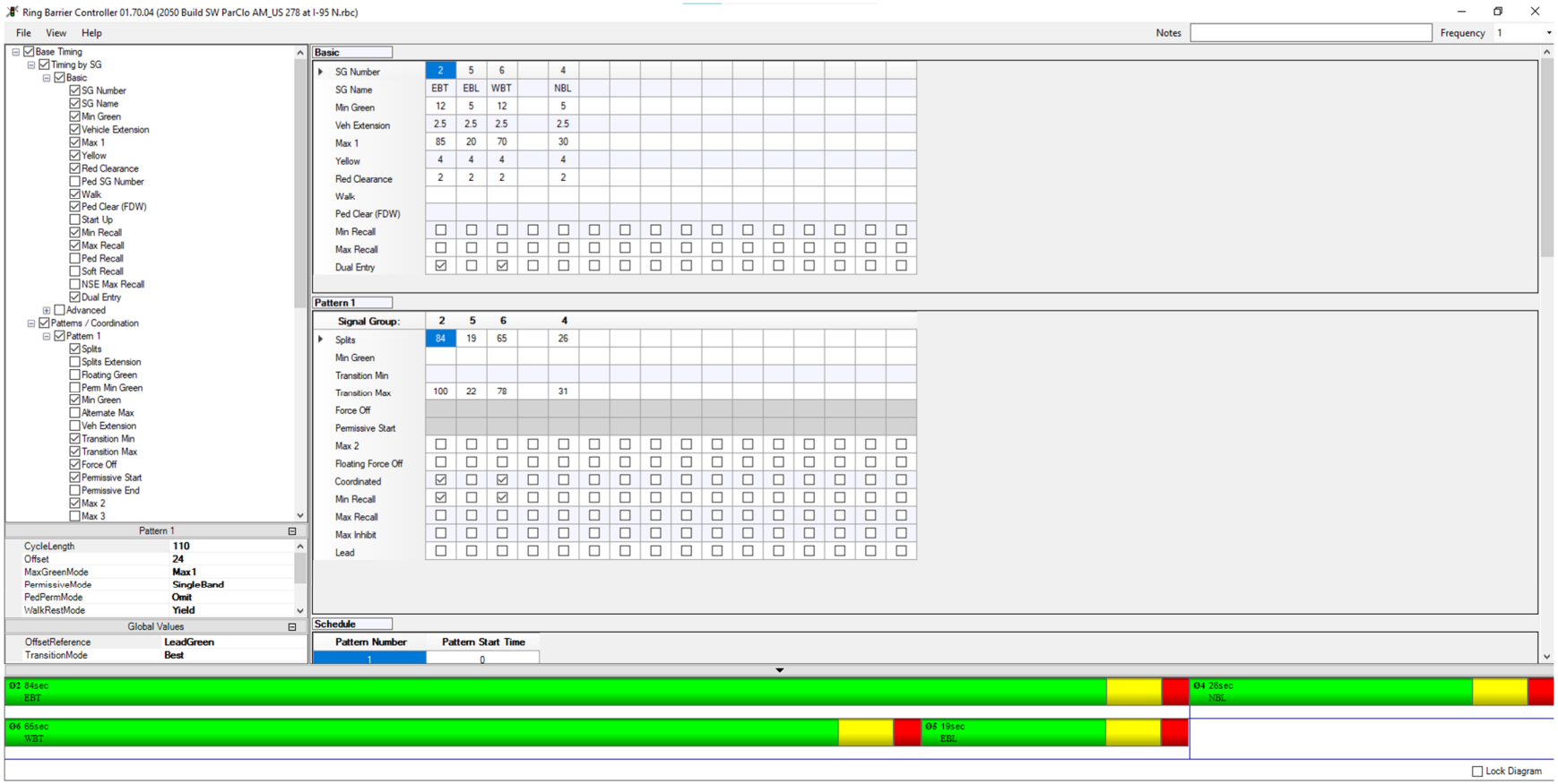


2050 Build South-West Partial Cloverleaf at US 278

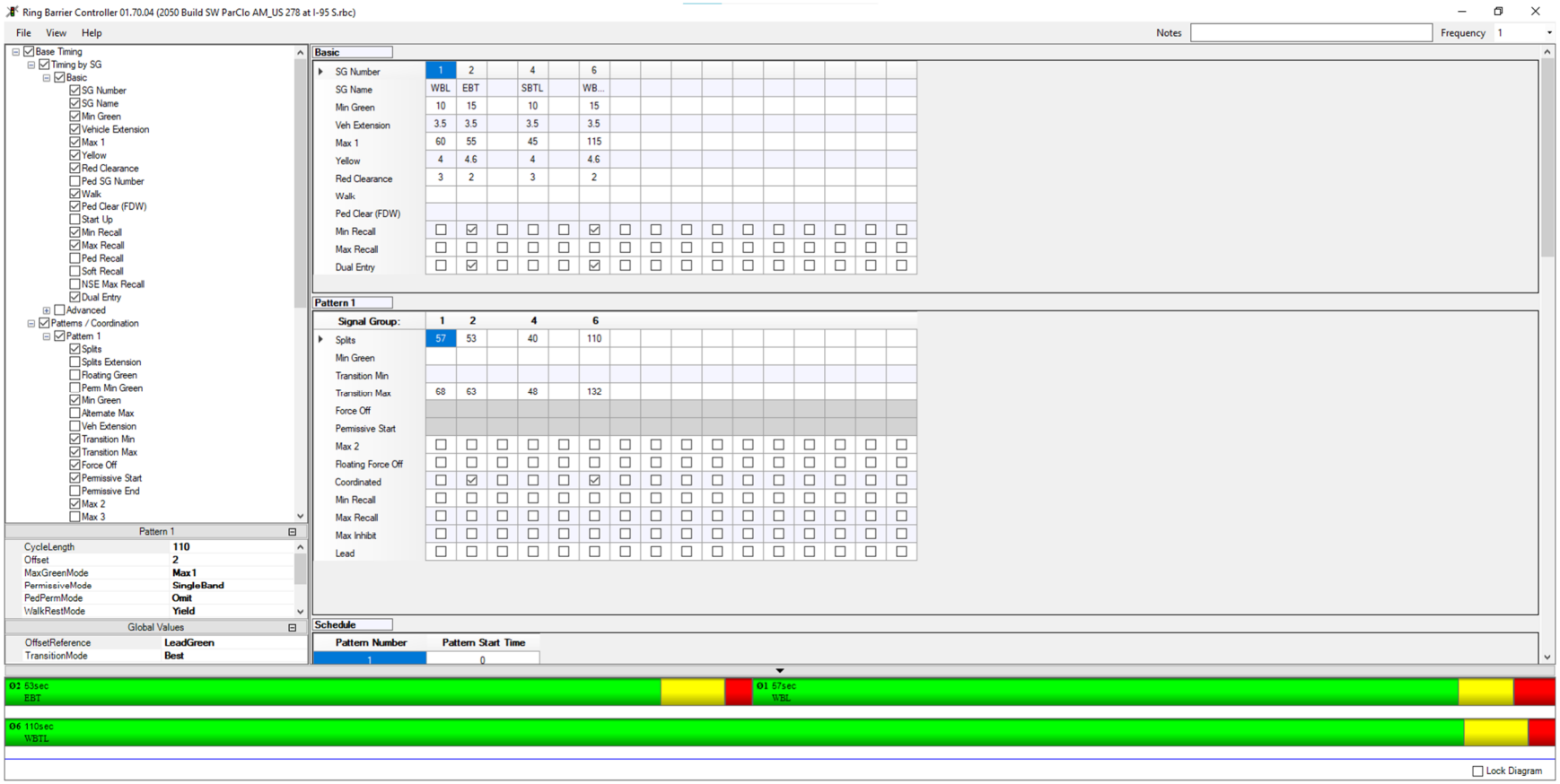
2050 SW ParClo AM US 278 at Henry Moss Boulevard



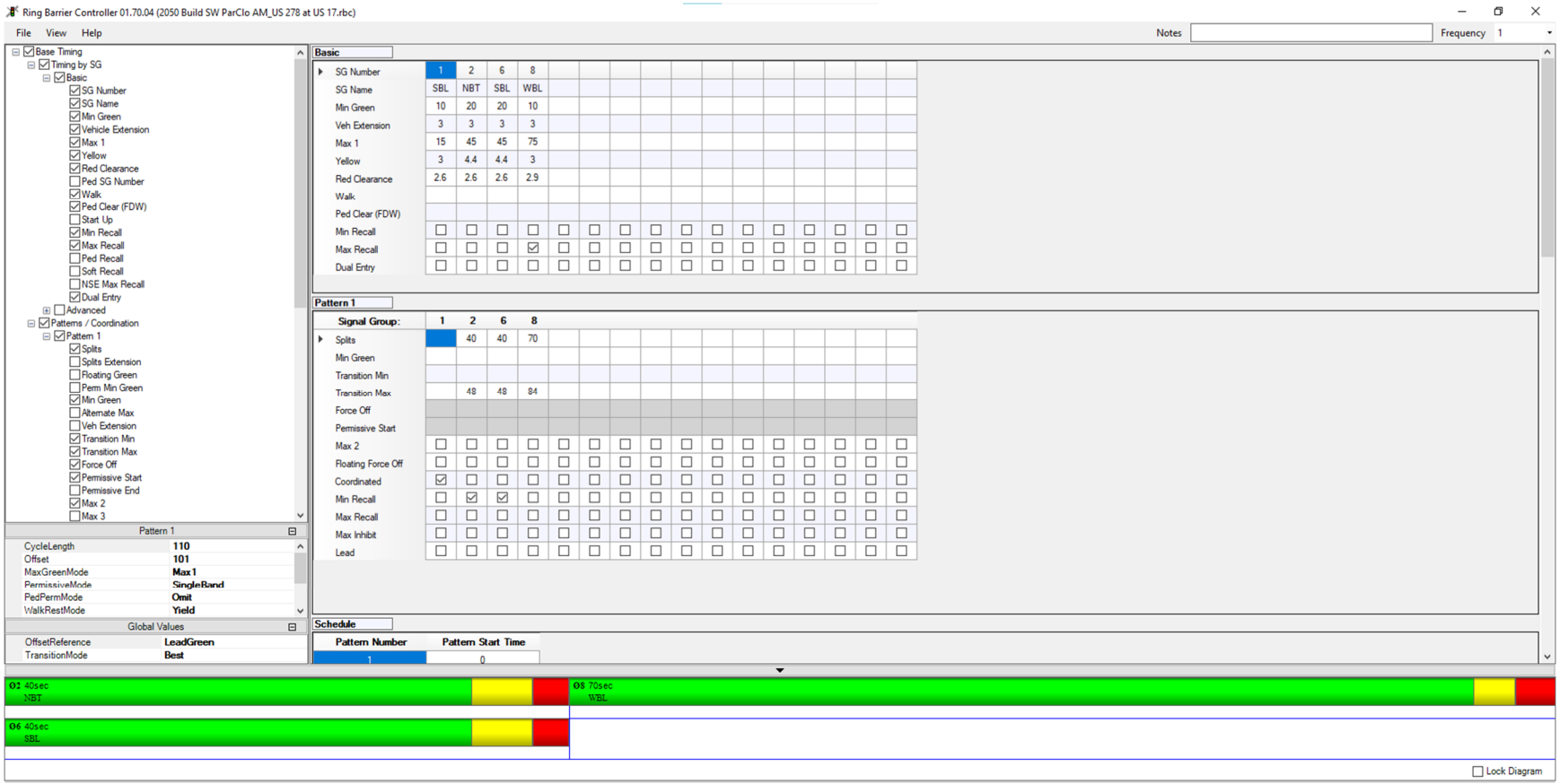
2050 SW ParClo AM US 278 at I-95 NB Ramps



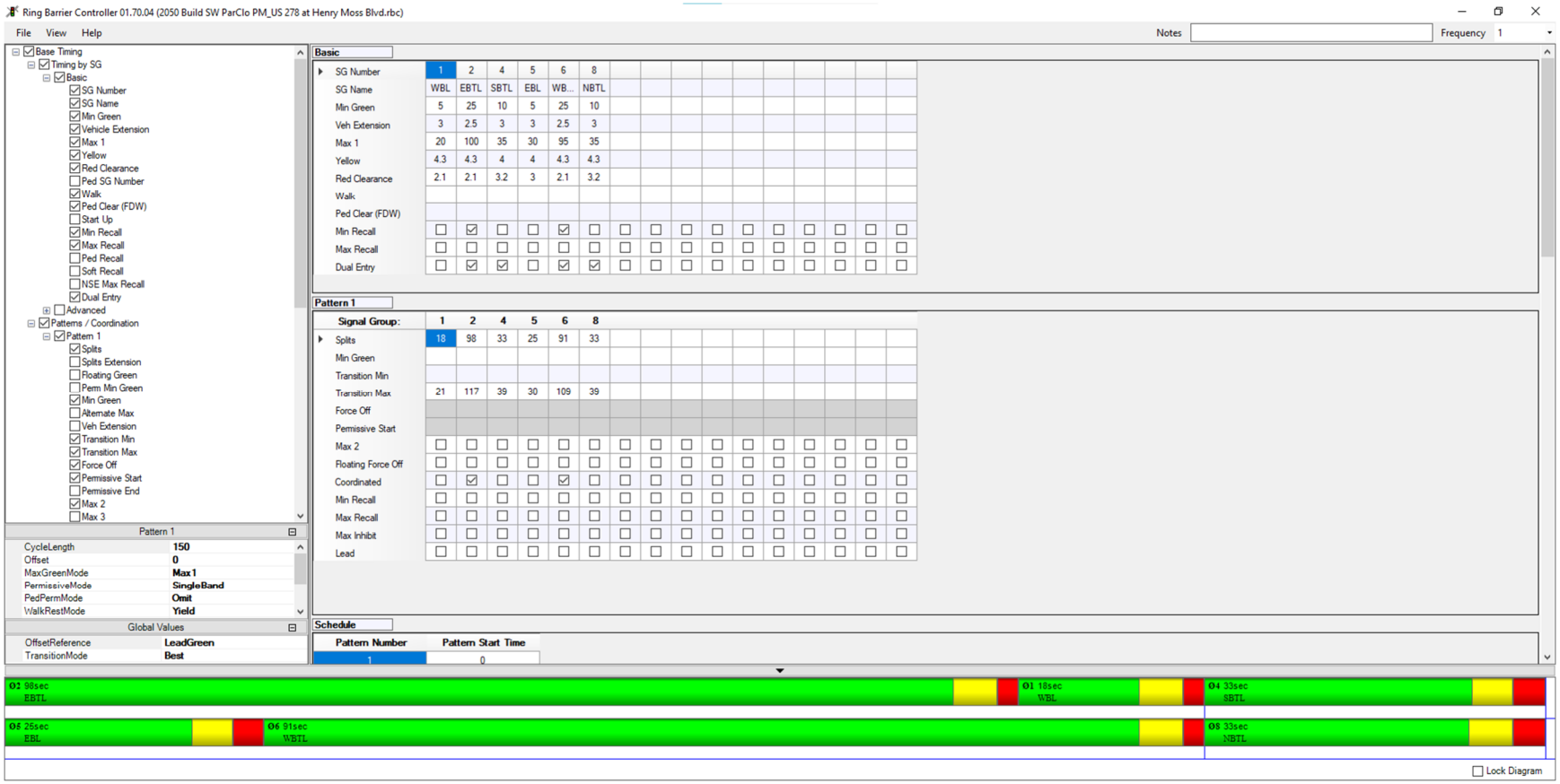
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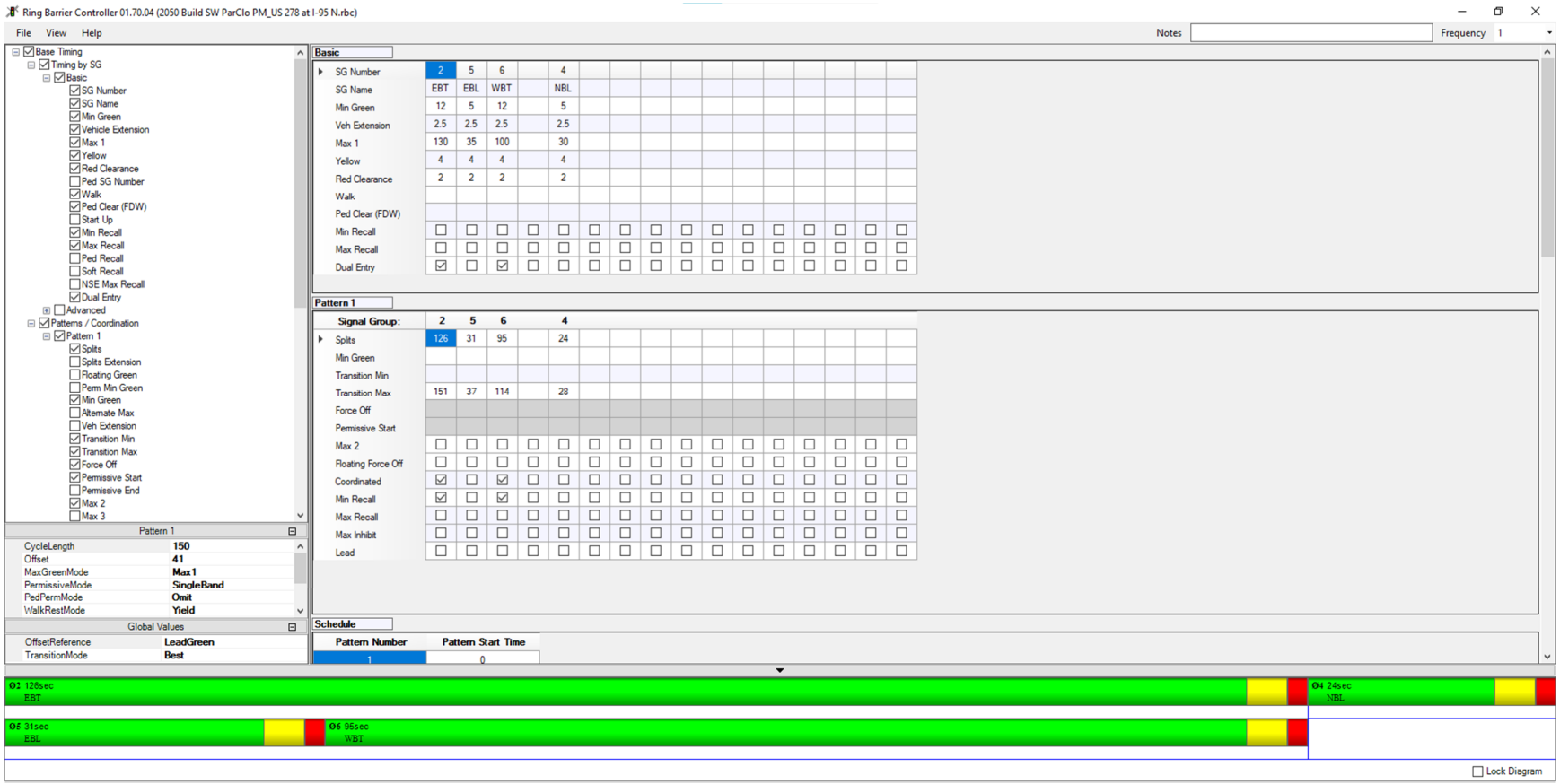
2050 SW ParClo AM US 278 at US 17



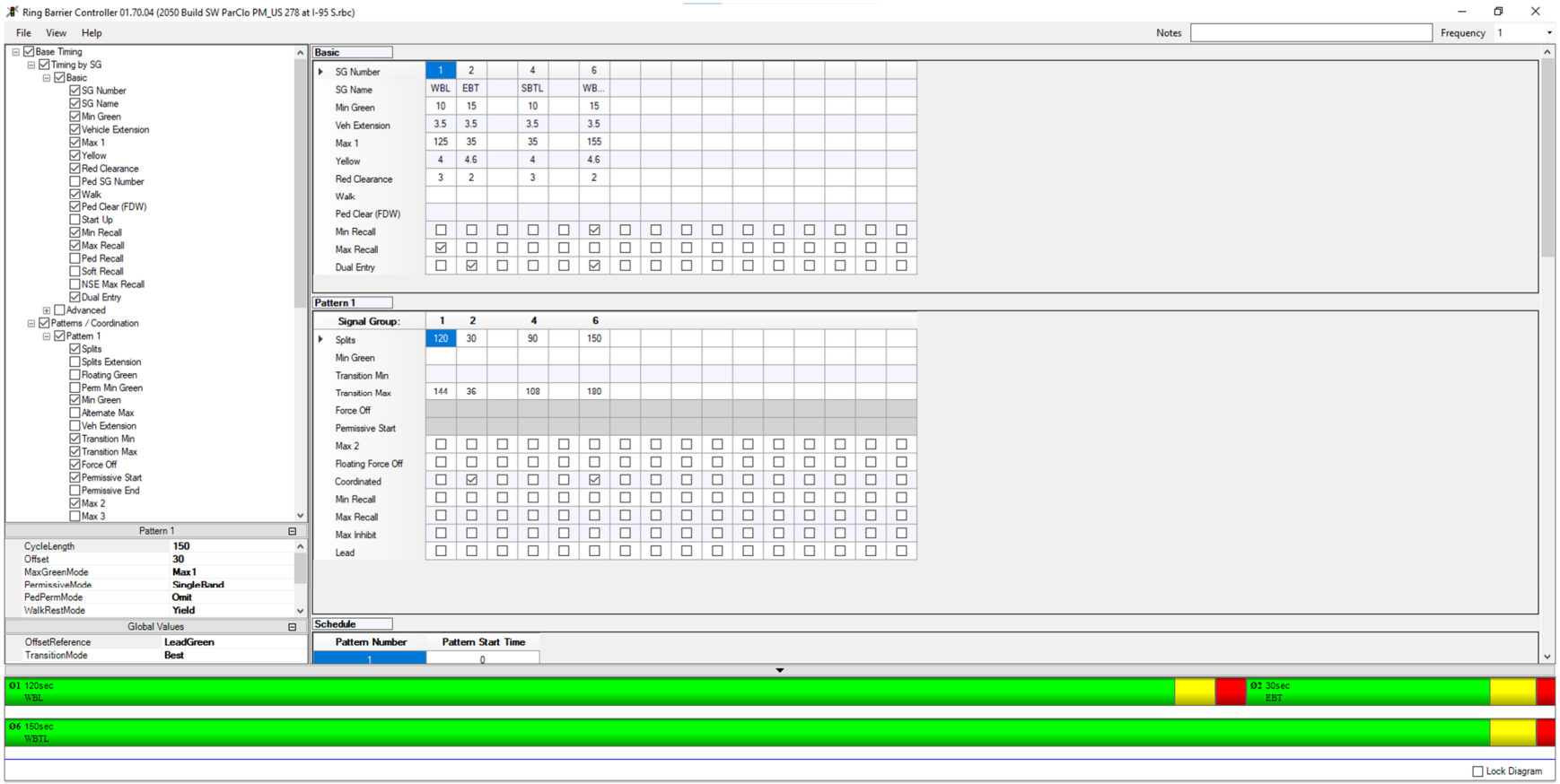
2050 SW ParClo PM US 278 at Henry Moss Boulevard



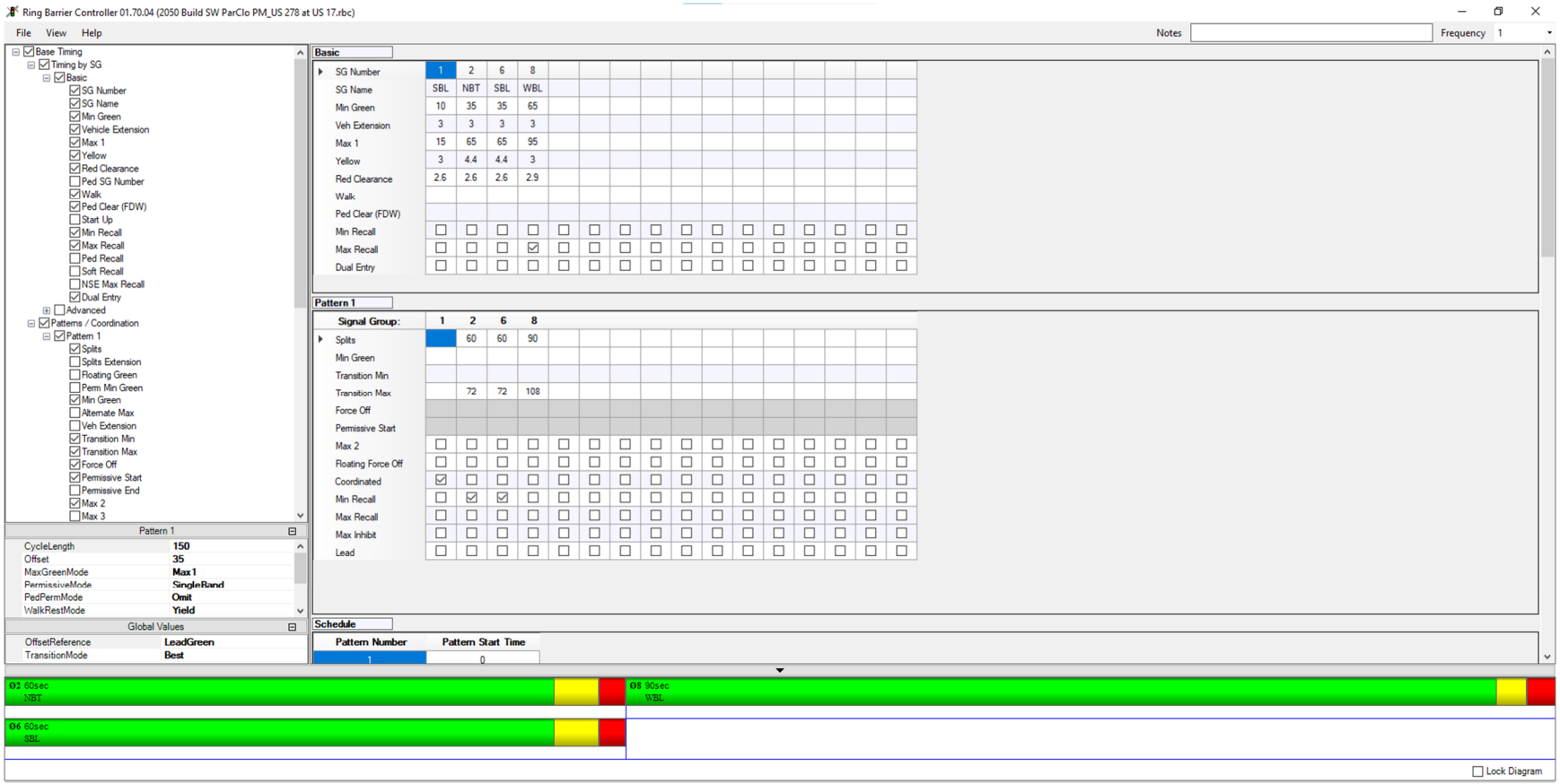
2050 SW ParClo PM US 278 at I-95 NB Ramps



2050 SW ParClo PM US 278 at I-95 SB Ramps



2050 SW ParClo PM US 278 at US 17



APPENDIX I. CONCEPTUAL SIGNING PLAN

FED. RD. DI V. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	JASPER	P040106	I-95	1

N

LOCATED ONE MILE UPSTREAM OF EXIT RAMP

EXIT 8
278 Hardeeville
Hilton Head Is.
1 MILE

5280'

(OVERHEAD AT RAMP DIVERGENCE)

EXIT 8
278 Hardeeville
Hilton Head Is.

ONLY
95 NORTH Florence

(OVERHEAD PRIOR TO CROSSOVER AND RAMP WITH ONLY ARROW CENTERED OVER LEFT LANE)

278 EAST
Beaufort
Hilton Head Is.

95 NORTH Florence

95 SOUTH Savannah ONLY

(OVERHEAD PRIOR TO CROSSOVER)

95 NORTH Florence
RIGHT LANE

95 SOUTH Savannah
LEFT LANE

(OVERHEAD, 1400 FT FROM GORE)

GROUND MOUNTED IN GORE

EXIT 8

(OVERHEAD AT END OF TAPER)

278 WEST
To US 17
Hardeeville

278 EAST
Beaufort
Hilton Head Is.

95 SOUTH

GROUND MOUNTED IN GORE

95 NORTH

GROUND MOUNTED IN GORE

US 17 - WHYTE HARDEE BLVD.

I-95 JASPER HWY.

US 278 - INDEPENDENCE BLVD.

278 WEST
To US 17
Hardeeville

278 EAST
Beaufort
Hilton Head Is.

(OVERHEAD 325 FT PRIOR TO GORE)

ONLY
95 NORTH Florence

95 NORTH Florence
LEFT LANE

95 SOUTH Savannah
RIGHT LANE

OVERHEAD 500 FT PRIOR TO CROSSOVER)

(OVERHEAD PRIOR TO CROSSOVER WITH ONLY ARROW CENTERED OVER LEFT LANE)

95 SOUTH Savannah

278 WEST
Hardeeville

EXIT 8

GROUND MOUNTED IN GORE

95 SOUTH Savannah ONLY

(OVERHEAD PRIOR TO CROSSOVER AND RAMP)

EXIT 8
95 NORTH Florence
278 Beaufort Hilton Head Is.
EXIT ONLY

SET OF TWO - OVERHEAD
FIRST AT BEGINNING OF FOURTH LANE
SECOND AT BEGINNING OF RAMP DIVERGENCE

(OVERHEAD 500FT PRIOR TO SECOND LANE DROP)

LANE ENDS 500 FEET

5280'

3500'

(OVERHEAD 500FT PRIOR TO SECOND LANE DROP)

LANE ENDS 500 FEET

EXIT 8
278
Hardeeville
Hilton Head Is.
1 MILE

LOCATED ONE MILE UPSTREAM OF EXIT RAMP

CDM Smith

0 325 650 975 1300

6 LANE DDI BUILD ALTERNATIVE CONCEPTUAL SIGNING PLAN

NOT FOR CONSTRUCTION

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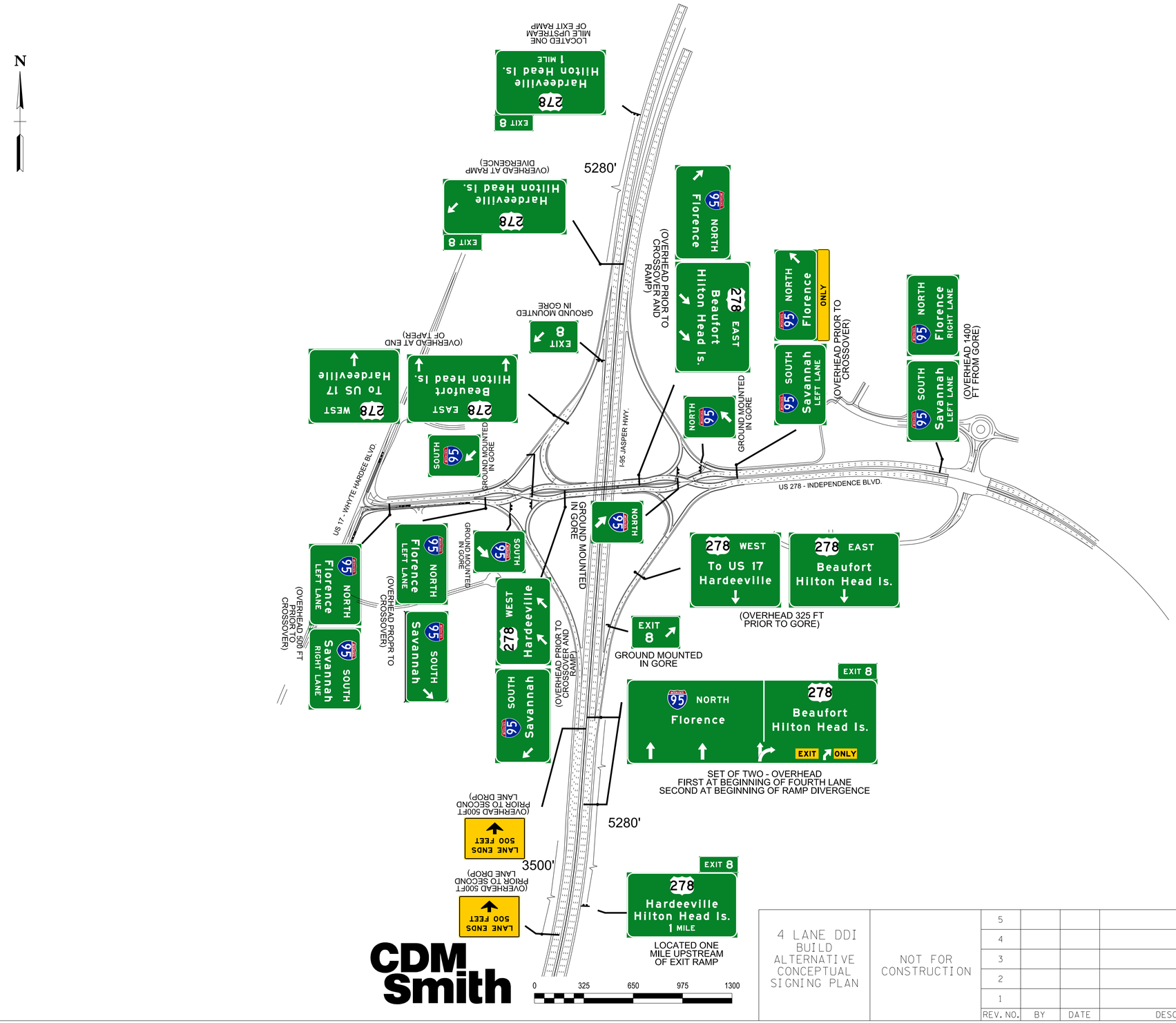
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COLUMBIA, S.C.

PLAN SHEET

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3	S.C.	JASPER	P040106	I-95	2



4 LANE DDI BUILD ALTERNATIVE CONCEPTUAL SIGNING PLAN

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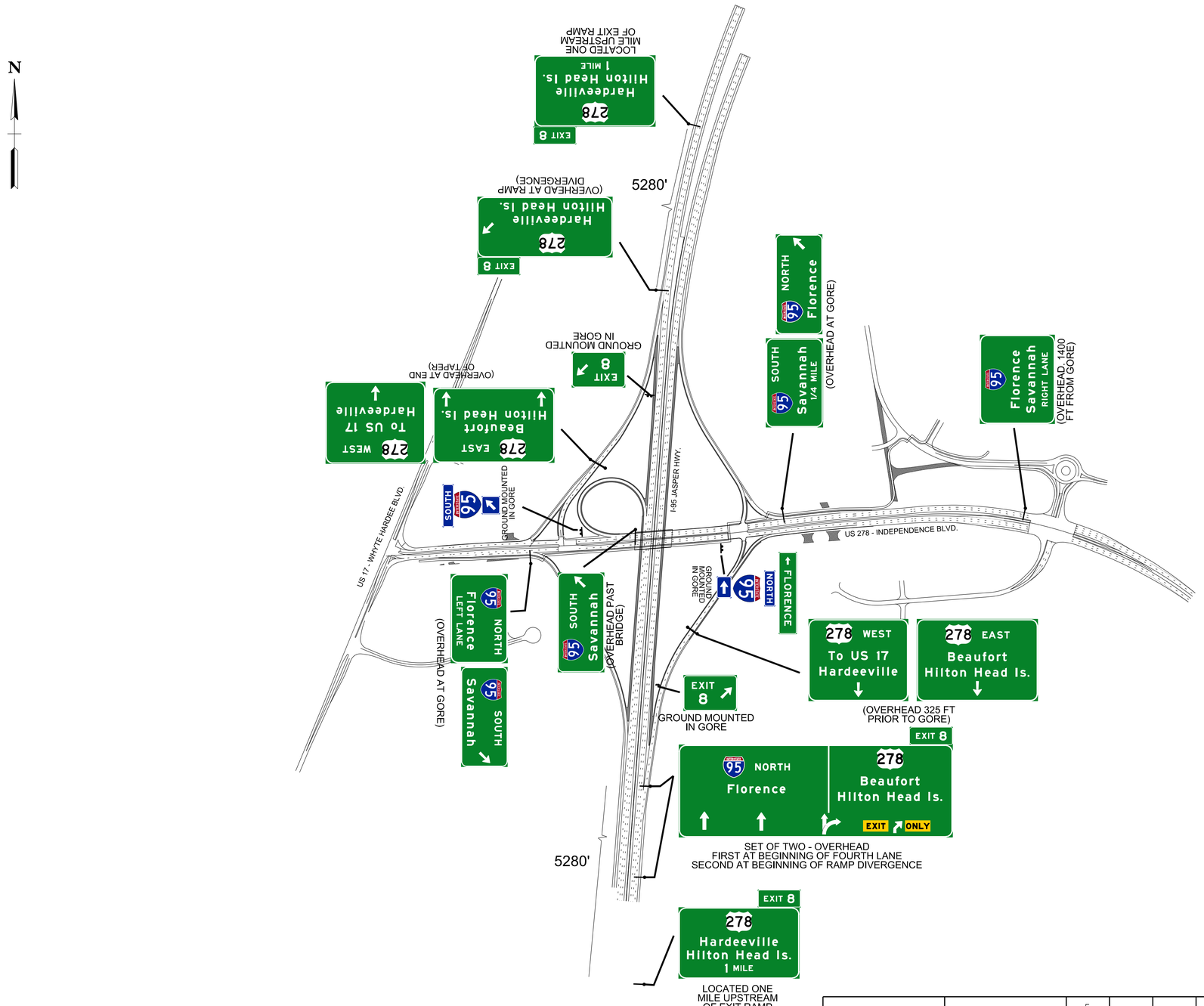
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COLUMBIA, S.C.

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FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	S.C.	JASPER	P040106	I-95	3



CDM Smith

PARCLO BUILD ALTERNATIVE CONCEPTUAL SIGNING PLAN

NOT FOR CONSTRUCTION

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SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
COLUMBIA, S.C.

PLAN SHEET

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BRIDGE HYDRAULIC REPORT
FOR THE REPLACEMENT OF INTERSTATE 95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP
JASPER COUNTY, SOUTH CAROLINA

PROJECT ID P032060

FINAL



MARCH 2022

PREPARED FOR:

SCDOT
South Carolina Department of Transportation

PREPARED BY:

INFRASTRUCTURE CONSULTING & ENGINEERING
West Columbia, South Carolina

SOUTH CAROLINA PROFESSIONAL ENGINEER
No. 17313
LICENSED
MARK WALKER HAMMOND

SOUTH CAROLINA
INFRASTRUCTURE CONSULTING & ENGINEERING, PLLC
No. 4470
CERTIFICATE OF AUTHORIZATION

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INTRODUCTION AND BACKGROUND

The South Carolina Department of Transportation (SCDOT) proposes to replace the existing I-95 southbound bridge over Bagshaw Swamp in Jasper County, South Carolina. The dual-bridge crossing is located approximately 8 miles southwest of the Town of Ridgeland, and the northbound bridge will not be replaced as part of this project. The project location is shown in **Figure 1**.

This report presents the results of a hydraulic design study for the replacement bridge. The intent of the study is to show that no adverse upstream or downstream flooding impacts will occur as a result of construction of the new bridge.

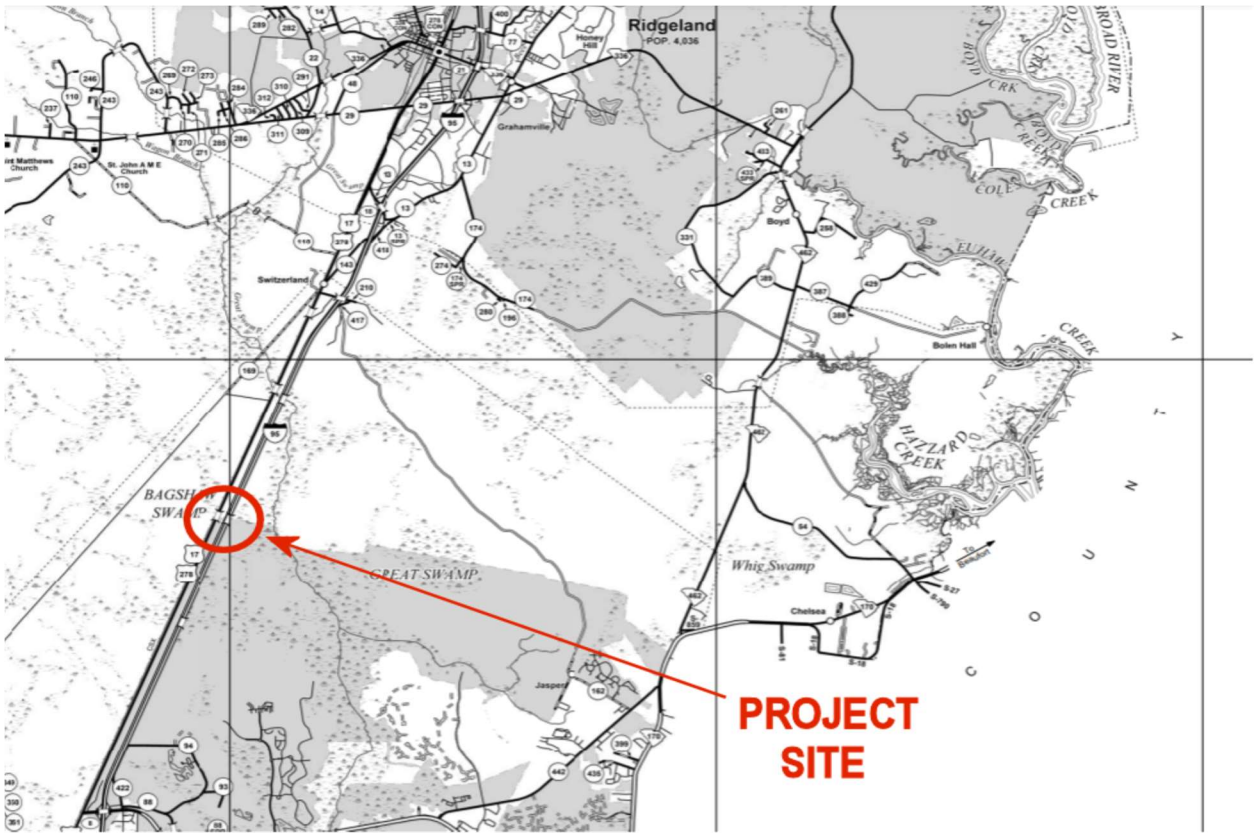


Figure 1. Project location map

PROJECT DESCRIPTION

The I-95 dual-bridge crossing of Bagshaw Swamp has a total drainage area of 18.6 square miles. In the vicinity of the project, the stream exhibits characteristics common to swampy waterways in the lower part of the Coastal Plain region of South Carolina. It is a flat-gradient stream with an undefined channel and a swampy floodplain. The floodplain is mostly covered with mature forest both upstream and downstream of the bridge crossing. Bagshaw Swamp is affected by backwater from Great Swamp. The confluence of the two streams is located approximately 0.5 mile downstream of I-95.

The existing southbound bridge over Bagshaw Swamp is a 120-foot, four-span reinforced tee-beam bridge with an outside width of 39 feet and a minimum low chord elevation of 24.8 feet (NAVD88). The substructure consists of 16-inch square concrete pile bents to support the four spans. The bridge abutments consist of 2:1 sloping abutments that are protected by riprap armoring. The existing bridge is not skewed.

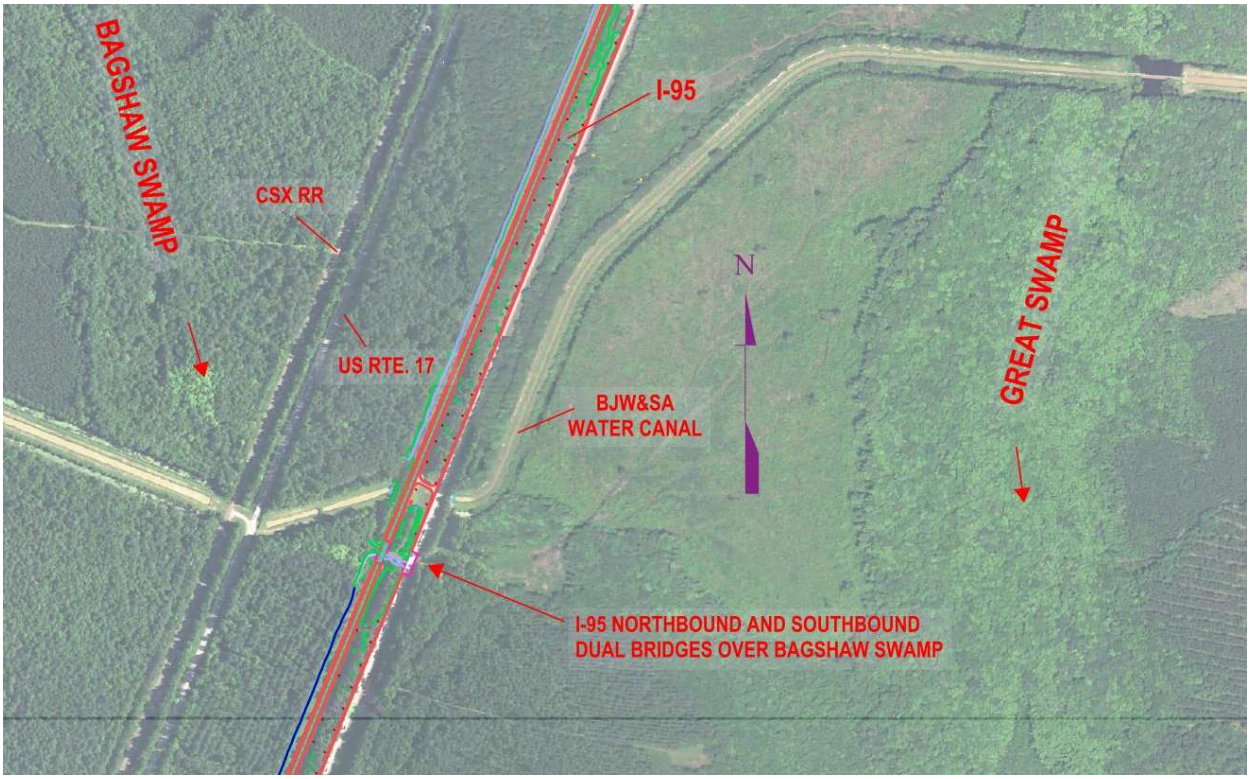


Figure 2. Existing stream crossing – I-95 dual bridges over Bagshaw Swamp

The proposed 130-foot long southbound replacement bridge will consist of four concrete flat slab spans. The bridge will have an outside width of 69.8 feet and a minimum low chord elevation of approximately 25.8 feet (NAVD88). The substructure will consist of 20-inch square concrete driven piles for the interior bents. The proposed bridge will not be skewed. Construction of the proposed new bridge will be done in two stages.

Upstream of the I-95 bridge crossing, a Beaufort-Jasper Water & Sewer Authority (BJW&SA) water canal crosses Bagshaw Swamp and blocks the natural flow of swamp waters between US Route 17 and I-95 (see **Figure 3**). The canal was constructed as a raised earthen embankment, and it rises to an average of approximately 6 feet above the natural floodplain ground elevation.

Conveyance of water beneath the canal is provided by way of two 36-inch RC pipes (each approximately 15 feet in depth below the canal) and connecting catch basins on either side of the canal. The pipes function as "inverted siphons", and flow rates through the pipes are dependent on headwater and tailwater elevations on the upstream and downstream ends of the pipes. The pipes do not provide adequate capacity to carry larger flood discharges, and as a result, floodwaters will back up and store in the swampy areas upstream of the canal.

A hydraulic model of Bagshaw Swamp and the I-95 dual bridge crossing was prepared using the computer program HEC-RAS (version 5.06). The model was used to analyze and compare natural, existing, and proposed conditions, and to confirm that the design of the new bridge meets all criteria established in *The South Carolina Department of Transportation Requirements for Hydraulic Design Studies* (Rev. May 26, 2009).

The I-95 crossing is located within a FEMA Zone A along Bagshaw Swamp, with no 100-year base flood elevations determined. The site is shown on FEMA FIRM map number 45053C0300D (map panel 300 of 375; see **Figure 4**), which has an effective date of October 18, 2019.

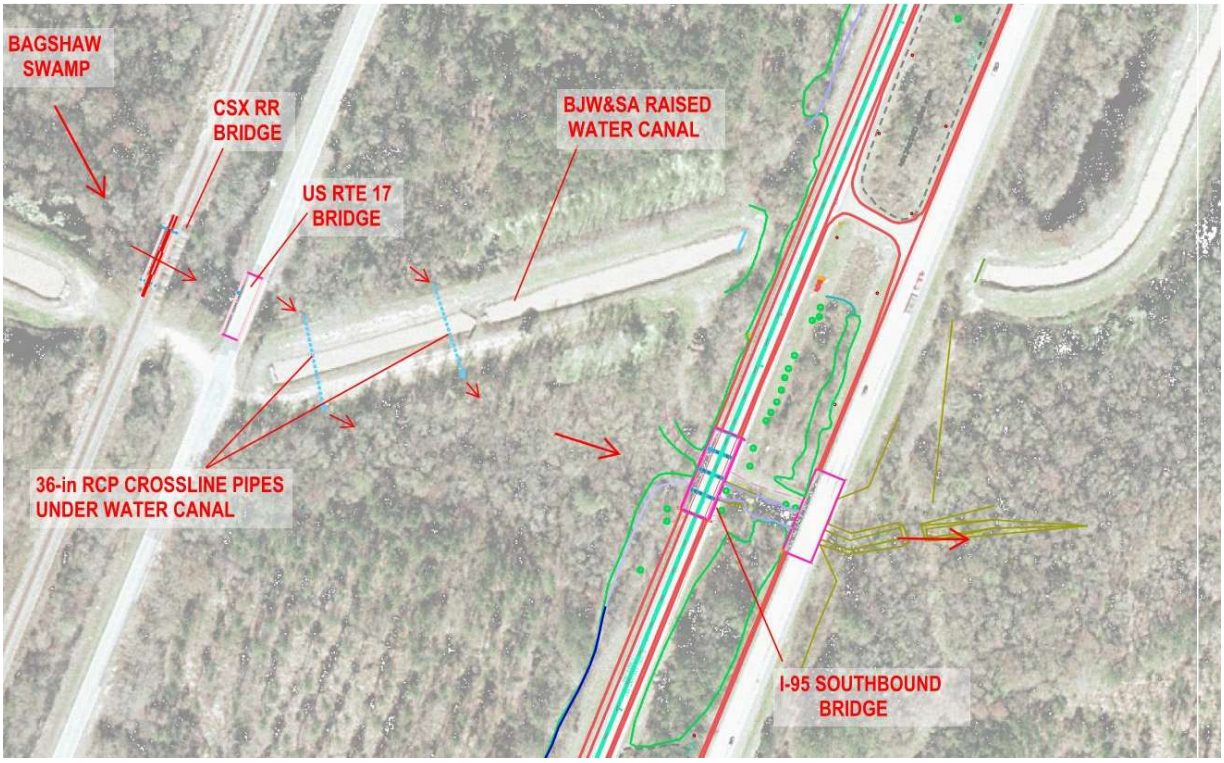


Figure 3. Bagshaw Swamp and BJW&SA raised water canal

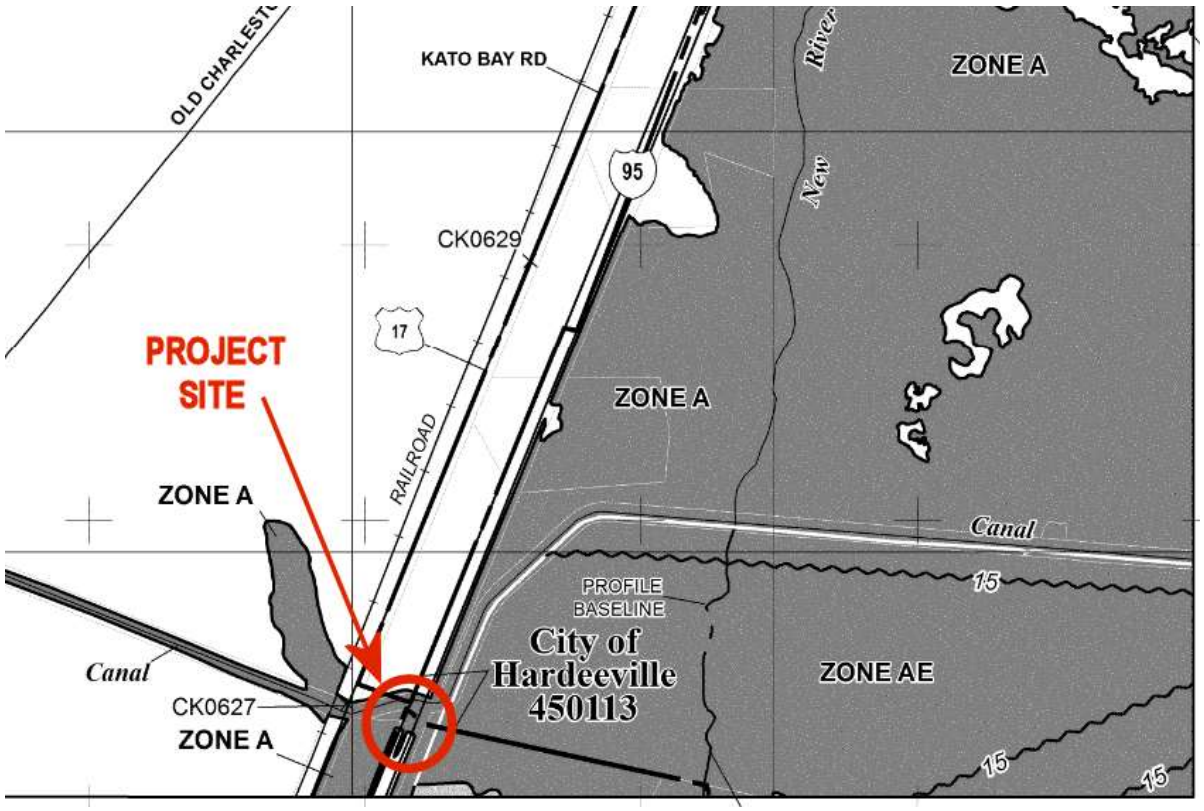


Figure 4. FEMA floodplain boundaries (from Jasper County FEMA FIRM Panel 300 of 375)

HYDRAULIC DESIGN CRITERIA

Per *The South Carolina Department of Transportation Requirements for Hydraulic Design Studies* and other SCDOT bridge hydraulic design policy, the following criteria were established for this project:

- Design flood: Bridge hydraulic analysis and design shall be for the 50-year flood event.
- Freeboard: A minimum of 2.0 feet of freeboard above the design flood event shall be provided for the structure.
- Abutments: 2:1 abutment/bridge end fill slopes will be used. Projection of the new abutment slopes shall not intersect any point on the existing channel bank or channel bottom.
- Abutment setbacks: A minimum of 10 feet of setback shall be provided from the top of the channel banks to toes of abutments.
- Low chord: A minimum low chord elevation of 24.8 feet (NAVD88), equal to the low chord elevation of the existing bridge, shall be provided.
- Backwater: A maximum of 1.0 foot of backwater is allowed for the proposed 100-year profile over the natural profile.

HYDROLOGIC ANALYSIS

The watershed for this project was determined to be approximately 18.6 square miles, all of which lies within the Coastal Plain Hydrologic Region 4.

There are no USGS stream gages known to have been located along Bagshaw Swamp or any other connecting streams in the vicinity of the I-95 crossing.

The Bagshaw Swamp design discharges at I-95 were calculated using Regional regression equations presented in *Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina* (USGS; Scientific Investigations Report 2009-5156; Feaster, Gotvald, and Weaver). These discharges were verified using the USGS website *StreamStats* (*https://streamstats.usgs.gov/ss/*). StreamStats results are presented in **Appendix A**.

USGS flood discharges are presented in **Table 1**.

Table 1. Summary of USGS Peak Flows

Flood Return Period	Discharge (cfs)
2-Year	402
10-Year	1060
25-Year	1440
50-Year	1790
100-Year	2160
500-Year	3020

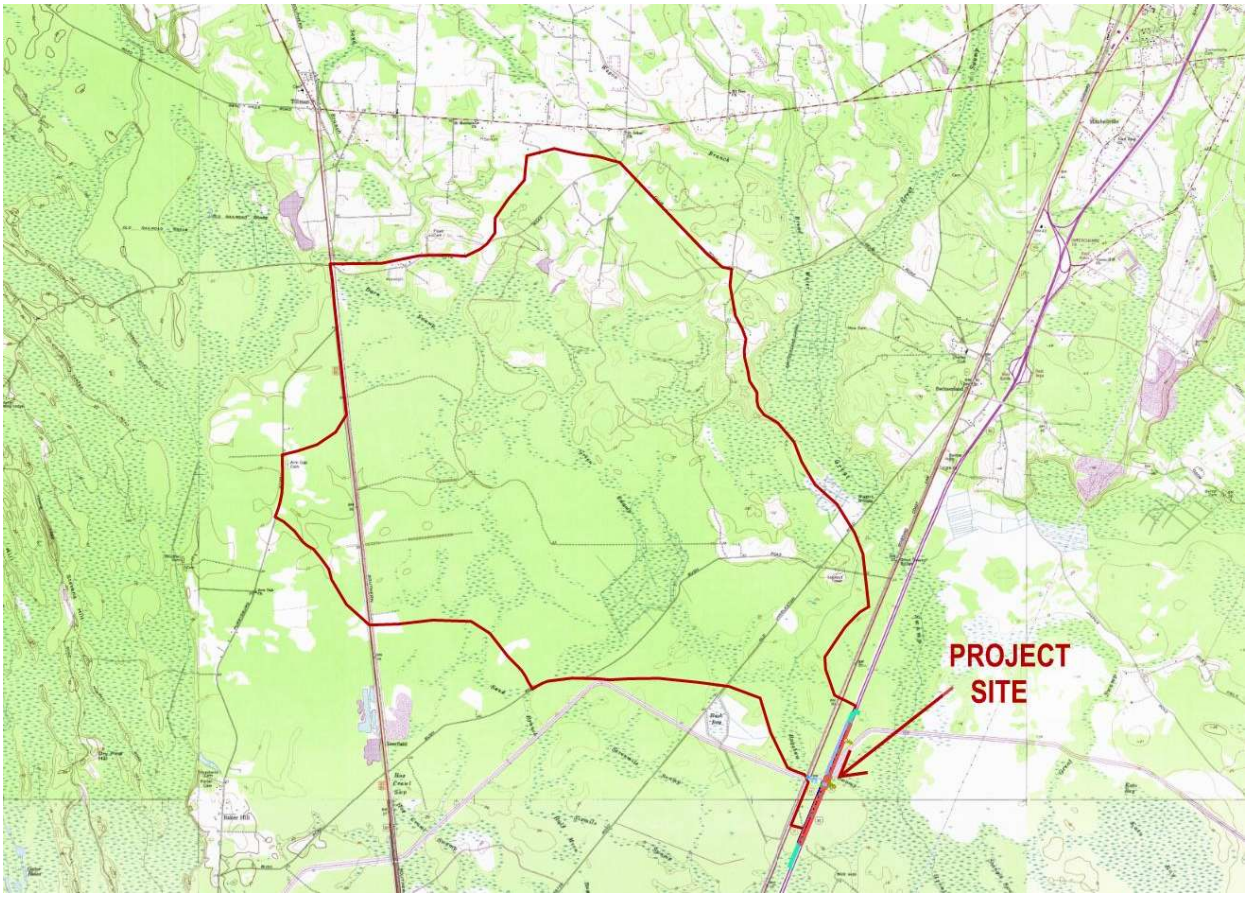


Figure 5. I-95 bridge over Bagshaw Swamp drainage area (18.6 sq. mi.)

Peak flood discharges along Bagshaw Swamp through the I-95 crossing are controlled by four factors:

- Backwater from Great Swamp. The confluence of the two streams is approximately 0.5 mile downstream of I-95.
- The constriction of flow created by the BJW&SA raised earthen canal and the two 36-inch RC pipes which carry flood discharges under it.
- The US Route 17 and CSX Railroad bridges just upstream of the canal. Each of these bridges, and in particular the railroad bridge, provide very constricted cross-sectional areas through which to pass floodwaters.
- The large amount of flood storage volume provided by the swamp itself.

In order to compute the most accurate flood discharges, a flood routing of Bagshaw Swamp was developed using the computer program Hydraflow Hydrographs. The following steps were taken to develop the flood routing study:

- The USGS peak flood discharges (**Table 1**) were used to produce flood hydrographs of Bagshaw Swamp for 2-, 10-, 50-, 100-, and 500-year flood events. These hydrographs were developed using *Determination of Flood Hydrographs for Streams in South Carolina: Volume 1. Simulations of Flood Hydrographs for Rural Watersheds in South Carolina* (USGS; Water-Resources Investigations Report 89-4087; L.R. Bohman)
- To model storage along Bagshaw Swamp, swamp/floodplain elevation-area relationships were developed using LiDAR (provided by SCDNR) for areas upstream of the BJW&SA water canal and the US Route 17/CSX Railroad bridge crossings.

- Headwater/discharge rating curves were computed for both the BJW&SA water canal (using the computer program HY-8) and the US Route 17/CSX Railroad bridge crossings (using HEC-RAS). Because of the close proximity of the US Route 17 and CSX bridges to one another, they were treated as one control structure.
- The Bagshaw Swamp flood hydrographs, ponding/storage volumes, and BJW&SA canal and US 17/CSX Railroad bridge control structures were used to develop the flood routings in Hydraflow Hydrographs.

As a result of the flood routing, it was determined that peak flood discharges through and downstream of the BJW&SA canal are significantly reduced as shown in **Table 2** below.

Table 2. Results of Flood Routing Peak Discharges

Flood Return Period	Discharge (cfs)
2-Year	130
10-Year	255
50-Year	330
100-Year	350
500-Year	455

Based on a HEC-RAS analysis of the stream and by applying the discharges shown in **Table 2** above, it was determined that the water canal will overtop only during a major (500-year) flood event. This finding was corroborated by an on-site discussion with a BJW&SA employee, who provided anecdotal evidence that the canal had never been known to overtop, including major flood events such as the October 2015 and October 2016 (Hurricane Matthew) floods.



Figure 6. Catch basin at downstream end of 36-in RC water canal crossline pipe (canal embankment is on the left side of the photo)

BRIDGE HYDRAULIC ANALYSIS

HEC-RAS version 5.0.6 was used for bridge hydraulic analyses. Four models were prepared to evaluate the bridges:

- Existing Conditions: This model includes the existing I-95 bridge crossing, roadway approaches, and an approximate 4900-foot section of Bagshaw Swamp.
- Proposed Conditions: This model was developed by modifying the existing conditions geometry to proposed conditions to include the I-95 southbound replacement bridge and proposed roadway approach profile.
- Natural Conditions: This model simulated the pre-existing conditions of Bagshaw Swamp, prior to any original bridge construction. All roadway and bridge elements associated with the I-95 crossing (southbound and northbound bridges) were removed from the model.
- Sensitivity Analysis – This model analyzed simulated 100-year water surface profiles of Bagshaw Swamp to verify reasonable convergence of the model at the bridge site using proposed conditions geometry.

MANNING'S ROUGHNESS COEFFICIENTS

Channel and overbank Manning's "n" roughness coefficients were obtained from field observations and aerial photography. A visual inspection of the overbank areas confirmed that floodplains consist of large-growth hardwood and swampy terrain with light undergrowth both upstream and downstream of the bridge. A Manning's "n" value of 0.12 was selected for all floodplain areas of the model. A Manning's "n" value of 0.06 was selected for the main channel upstream and downstream of the bridge, representative of the moderate degree of channel irregularity and sinuosity, bank vegetation, and obstructions. A permanent scour hole (approximately 1.5 feet in depth) exists in the immediate vicinity of the bridge. Due to lack of obstructions in the area of the scour hole, a lower "n" value of 0.05 was used for upstream and downstream cross-sections adjacent to the bridge.

CROSS SECTION GEOMETRY

HEC-RAS cross sections were produced using Jasper County LiDAR provided by SCDNR (for all overbank areas) and field surveys (for stream channels). Channel sections outside the field survey footprint were extrapolated using the nearest surveyed upstream or downstream cross-section. The cross-section locations used in the HEC-RAS model are shown in **Figures 6 and 7**.

HEC-RAS MODEL DEVELOPMENT

The following steps were taken to develop the HEC-RAS bridge hydraulic models:

Existing Run

- The HEC-RAS study area was established, extending along Bagshaw Swamp from a point approximately 1900 feet downstream of I-95 to approximately 3000 feet upstream, a total distance of 4900 linear feet of stream.
- Cross-section locations were established in order to encompass all topographic features affecting stream hydraulics, such as channel bends and areas of different land cover types.
- HEC-RAS cross-section geometry was developed using Jasper County LiDAR and SCDOT field surveys.
- Bridge upstream and downstream cross-sections were set along the toes of existing roadway embankments.
- Stream channel cross-section points within the limits of the SCDOT creek survey were taken from the survey data. For cross-sections outside of the limits of survey, channel geometry was approximated using LiDAR.
- Cross-section reach lengths for the main channel, left overbank, and right overbank were based on distances measured in a Microstation cross-sectional working map of the project area.

- Ineffective flow areas were added to all appropriate cross-sections to model the effects of expansion and contraction and the water-water interfaces with adjacent stream floodplain connected to Bagshaw Swamp.
- Expansion and contraction coefficients were set as 0.3 and 0.5 throughout most of the model due to the effects of the various structures (four bridges and BJW&SA canal) providing obstructions to flow. All other cross-sections along the furthest downstream and upstream sections of the model were set as 0.1 and 0.3.
- Existing roadway embankment and bridge geometry were added in the bridge data editor for the existing bridge. This information was based on elevations provided by ground topo surveys and other field measurements.
- Existing bridge pier locations and widths were applied to the model based on survey data.
- The bridge modeling approach was set as the energy equation for low flow methods and pressure/weir calculations for high-flow methods.
- Design discharges from the Hydraflow Hydrograph analysis were applied to the model's steady flow data editor for the development of five flood profiles: 2-year, 10-year, 50-year, 100-year, and 500-year.
- Downstream reach boundary conditions were set based on a separate HEC-RAS model of Great Swamp (see output included in **Appendix G**.

PROPOSED CONDITIONS HEC-RAS MODEL

The Existing Conditions model was copied and modified to create a Proposed Conditions model using the following steps:

- The existing bridge geometry was modified to reflect the proposed new southbound bridge geometry. The proposed bridge span lengths, roadway profile, roadway/deck width, and pier locations/widths were input into the bridge data editor.
- The internal bridge sections along with the existing bridge abutments were modified to reflect new abutments for construction of the proposed bridge.
- Ineffective flow locations and elevations were updated to match the wider bridge opening.
- Contraction and expansion coefficients remained the same as the Existing Conditions model.
- The bridge modeling approach remained the same as the Existing Conditions model.
- Design discharges and downstream boundary conditions remained the same as the Existing Conditions model.

NATURAL CONDITIONS HEC-RAS MODEL

The Existing Conditions model was copied, and the following steps were taken to create the Natural Conditions model:

- All I-95 southbound and northbound bridge and roadway geometric elements were deleted from the model.
- Ineffective flow areas were removed from all cross-sections influenced by the I-95 bridges.
- Contraction and expansion coefficients were set to 0.1 and 0.3, respectively, where appropriate for all cross-sections due to the removal of the bridge crossings.
- Design discharges and downstream boundary conditions remained the same as the Existing Conditions model.

SENSITIVITY ANALYSIS MODEL

The Sensitivity Analysis model was developed using the Proposed Conditions geometry and applying a new flow file with three flood profiles: 1) 100-year profile with normal starting water surface elevation, 2) 100-year profile with a starting water surface elevation of normal water plus 3 feet, and 3) 100-year profile with a starting water surface elevation of normal water minus 3 feet.

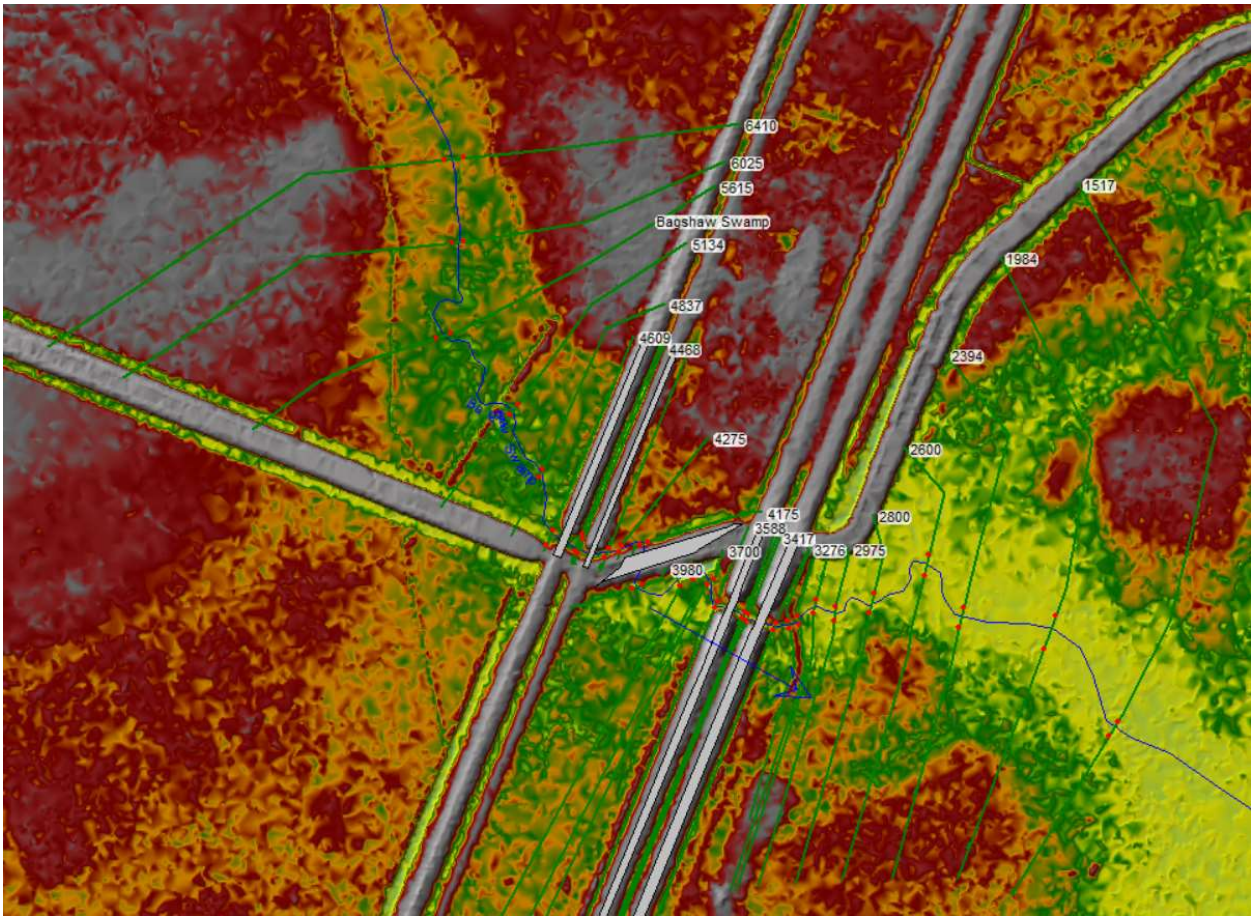


Figure 7. HEC-RAS geometric layout (overall)

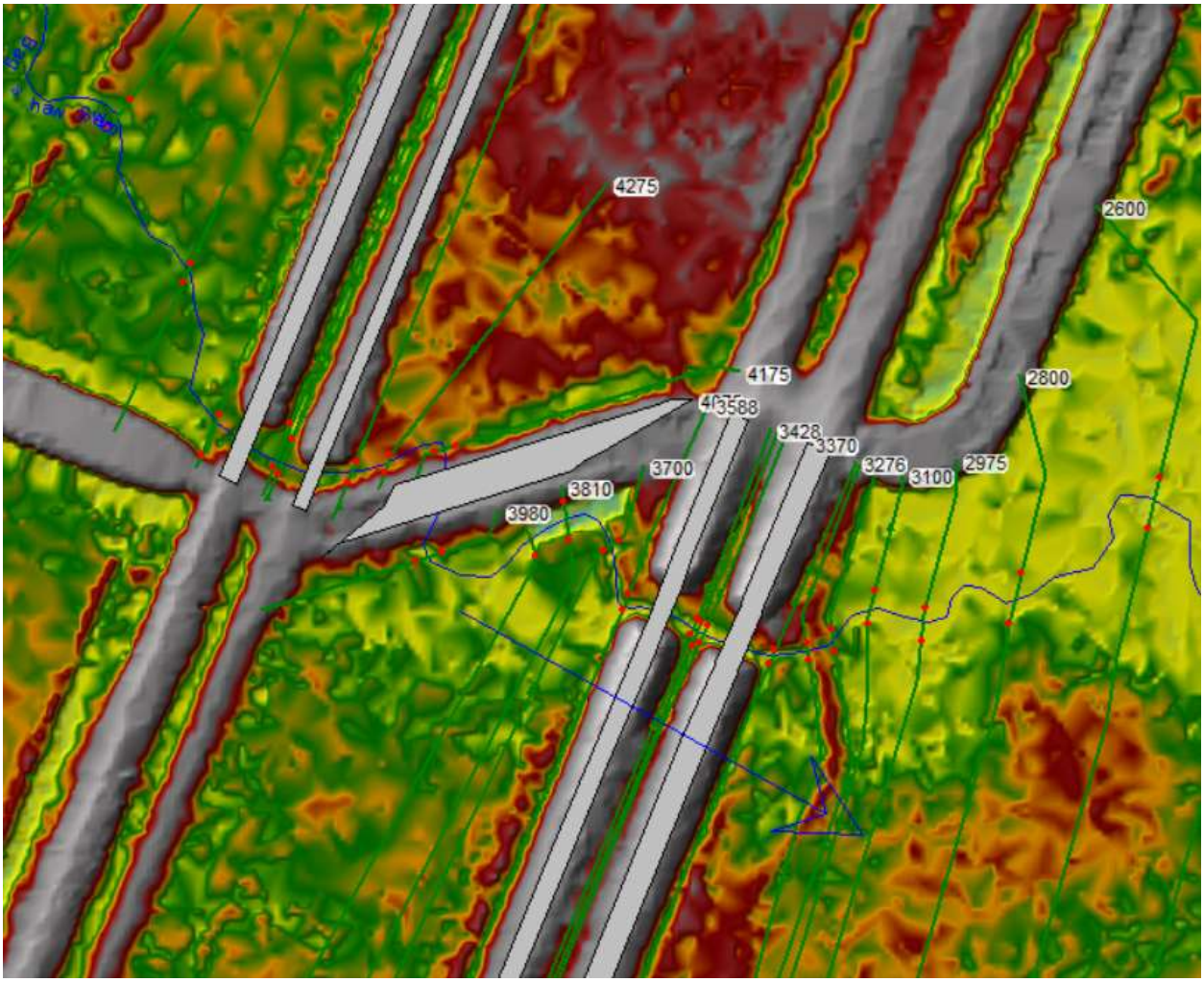


Figure 8. HEC-RAS geometric layout (bridge vicinity)

HEC-RAS RESULTS

Table 3 presents a comparison of water surface elevations and backwater within the limits of the HEC-RAS model. Comparisons are shown for 50- and 100-year profiles for natural, existing, and proposed conditions analyses.

Table 4 presents the results of the sensitivity analysis. Considering the flat gradient of Bagshaw Swamp and close proximity of Great Swamp downstream, it is unreasonable to perform a sensitivity analysis and achieve satisfactory convergence. Considering the additional freeboard available for this bridge crossing (over 8 feet), the lack of convergence in the sensitivity analysis should not be a cause for concern.

Table 5 presents the available freeboard at the upstream face of the proposed bridge for the 50- and 100-year floods.

Detailed HEC-RAS results are presented in **Appendices H through K**.

Table 3. HEC-RAS Water Surface Profile Results

River Station	50-year Water Surface Elevations (feet-NAVD88)			50-year Backwater (feet)*	100-year Water Surface Elevations (feet-NAVD88)			100-year Backwater (feet)*
	Natural	Existing	Proposed		Natural	Existing	Proposed	
1517	16.50	16.50	16.50	---	16.90	16.90	16.90	---
1984	16.50	16.50	16.50	---	16.90	16.90	16.90	---
2394	16.51	16.51	16.51	---	16.90	16.90	16.90	---
2600	16.51	16.51	16.51	---	16.91	16.91	16.91	---
2800	16.51	16.52	16.52	---	16.91	16.91	16.91	---
2975	16.52	16.52	16.52	---	16.91	16.92	16.92	---
3100	16.53	16.53	16.53	---	16.92	16.92	16.92	---
3166	16.53	16.54	16.54	---	16.92	16.93	16.93	---
3214	16.53	16.54	16.54	---	16.92	16.93	16.93	---
3276	16.54	16.55	16.55	---	16.93	16.93	16.93	---
3370	**I-95 Northbound Bridge**							
3406	16.54	16.75	16.74	0.20	16.93	17.10	17.10	0.17
3417	16.55	16.76	16.75	0.20	16.93	17.11	17.11	0.18
3428	16.55	16.75	16.75	0.20	16.93	17.11	17.11	0.18
3370	**I-95 Southbound Bridge**							
3588	16.57	17.14	17.17	0.60	16.94	17.42	17.44	0.50
3700	16.58	17.18	17.20	0.62	16.94	17.45	17.47	0.53
3810	16.58	17.18	17.20	0.62	16.95	17.45	17.47	0.52
3880	16.58	17.19	17.21	0.63	16.95	17.46	17.47	0.52
3980	16.63	17.21	17.23	0.60	16.98	17.47	17.49	0.51
4075	**BJW&SA Water Canal**							
4175	20.24	20.37	20.38	0.14	20.52	20.62	20.63	0.11
4275	20.24	20.37	20.38	0.14	20.52	20.62	20.63	0.11
4339	20.24	20.37	20.38	0.14	20.52	20.62	20.63	0.11
4408	**US Route 17 Bridge**							
4468	20.32	20.44	20.45	0.12	20.60	20.70	20.70	0.10
4481	20.32	20.44	20.45	0.12	20.60	20.70	20.70	0.10
4540	**CSX Railroad Bridge**							
4609	20.37	20.49	20.50	0.13	20.66	20.76	20.76	0.10
4837	20.42	20.54	20.55	0.13	20.72	20.82	20.82	0.10
5134	20.47	20.59	20.60	0.13	20.78	20.87	20.88	0.10
5615	20.51	20.62	20.63	0.12	20.82	20.91	20.92	0.10
6025	20.52	20.64	20.65	0.13	20.84	20.93	20.94	0.10
6410	20.54	20.65	20.66	0.12	20.86	20.95	20.95	0.09

*Backwater values represent the WSE difference between *Proposed* and *Natural* profiles at cross-sections upstream of the bridge.

Table 4. HEC-RAS Sensitivity Analysis Results

	100-year Water Surface Elevations (feet-NAVD88)			
River Station	-3' Profile	Normal Water Surface Profile	+3' Profile	Difference
1517	13.90	16.90	19.90	6.00
1984	14.60	16.90	19.90	5.30
2394	14.79	16.90	19.90	5.11
2600	14.88	16.91	19.90	5.02
2800	15.03	16.91	19.90	4.87
2975	15.17	16.92	19.90	4.83
3100	15.25	16.92	19.90	4.75
3166	15.30	16.93	19.90	4.60
3214	15.36	16.93	19.90	4.54
3276	15.48	16.93	19.90	4.42
3370	**I-95 Northbound Bridge**			
3406	15.96	17.10	19.93	3.97
3417	15.98	17.11	19.93	3.95
3428	15.98	17.11	19.93	3.95
3508	**I-95 Southbound Bridge**			
3588	16.96	17.44	19.98	3.02
3700	16.97	17.47	19.99	3.02
3810	16.98	17.47	19.99	3.01
3880	17.01	17.47	19.99	2.98
3980	16.92	17.49	19.99	3.07
4075	**BJW&SA Water Canal**			
4175	20.53	20.63	21.17	0.64
4275	20.53	20.63	21.17	0.64
4339	20.53	20.63	21.17	0.64
4408	**US Route 17 Bridge**			
4468	20.61	20.70	21.24	0.63
4481	20.61	20.70	21.24	0.63
4540	**CSX Railroad Bridge**			
4609	20.67	20.76	21.30	0.53
4837	20.73	20.82	21.34	0.61
5134	20.79	20.88	21.39	0.60
5615	20.83	20.92	21.42	0.59
6025	20.85	20.94	21.43	0.58
6410	20.87	20.95	21.44	0.57

Table 5. Proposed Bridge Design Freeboard for 50- and 100-year Floods

Bridge	Low Chord Elevation (feet-NAVD88)	50-year Water Surface Elevation (feet-NAVD88)	Freeboard (feet)	100-year Water Surface Elevation (feet-NAVD88)	Freeboard (feet)
I-95 Southbound over Bagshaw Swamp	25.8	17.2	8.6	17.4	8.4

SCOUR STUDY

A scour analysis was prepared based on SCDOT Hydraulic Design Bulletin 2019-3 and other criteria as presented in *The South Carolina Department of Transportation Requirements for Hydraulic Design Studies*. Both USGS Envelope Curves (based on *The South Carolina Bridge-Scour Envelope Curves* (USGS; Scientific Investigations Report 2016-5121; Benedict, Feaster, and Caldwell)) and HEC-18 scour methodologies (based on the FHWA Hydraulic Toolbox Version 5.0) were used to analyze the scour potential of the proposed new bridge. Results of the scour analysis are presented in **Appendix O.**

The existing bridge demonstrates signs of clearwater contraction scour, and an approximate 1.5-foot deep scour hole has formed under and through the bridge opening. Existing clearwater scour is typical for swampy bridge crossings in the Coastal Plain of South Carolina, and the fact that this small amount of scour that has occurred over the 53-year life of the existing bridges indicates that the scour potential for this bridge is low. Furthermore, the longer proposed bridge with more opening area and less obstructions from foundation elements will help to decrease bridge scour potential somewhat.

Based on guidance provided by USGS, since the proposed bridge is less than 240 feet in length and is over a swampy stream, a single scour hole will form under the bridge opening based on abutment scour depths, as shown in **Figure 9** below. Computed abutment scour depths are 6.5 feet (100-year) and 7.8 feet (500-year).

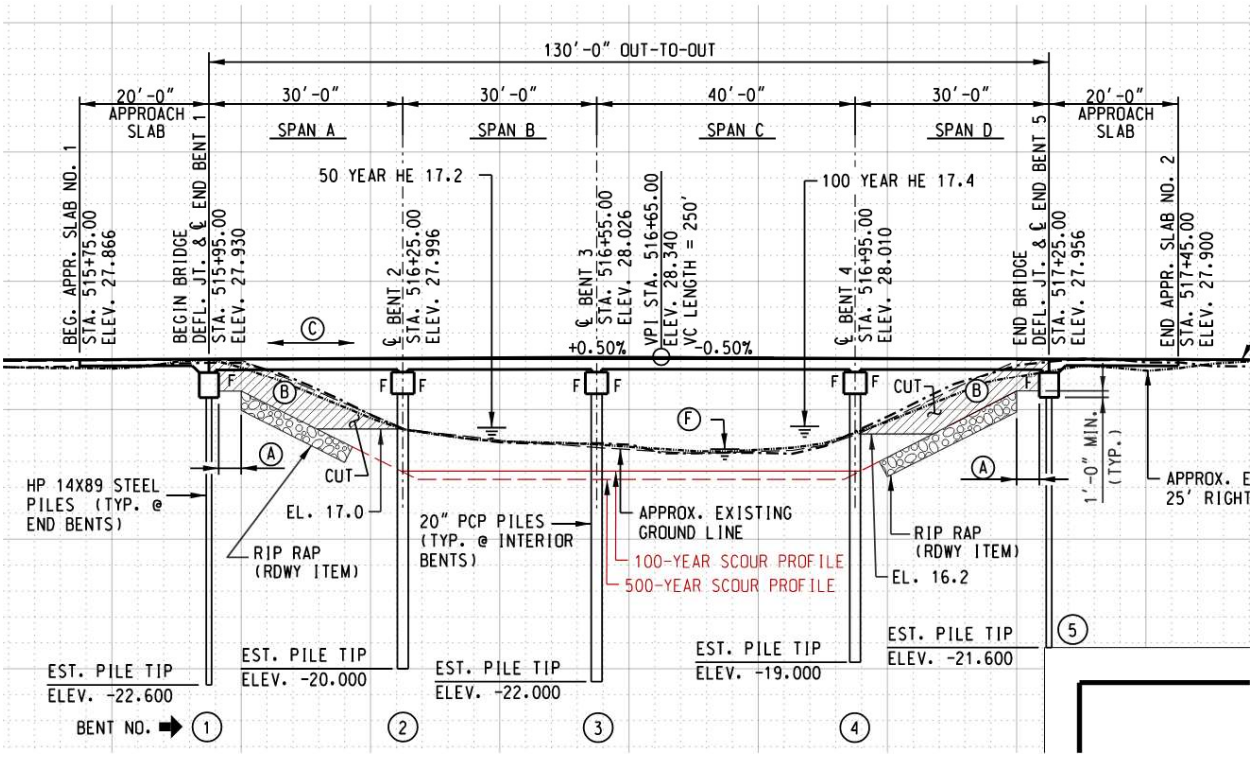


Figure 9. Scour Profile

CONCLUSION

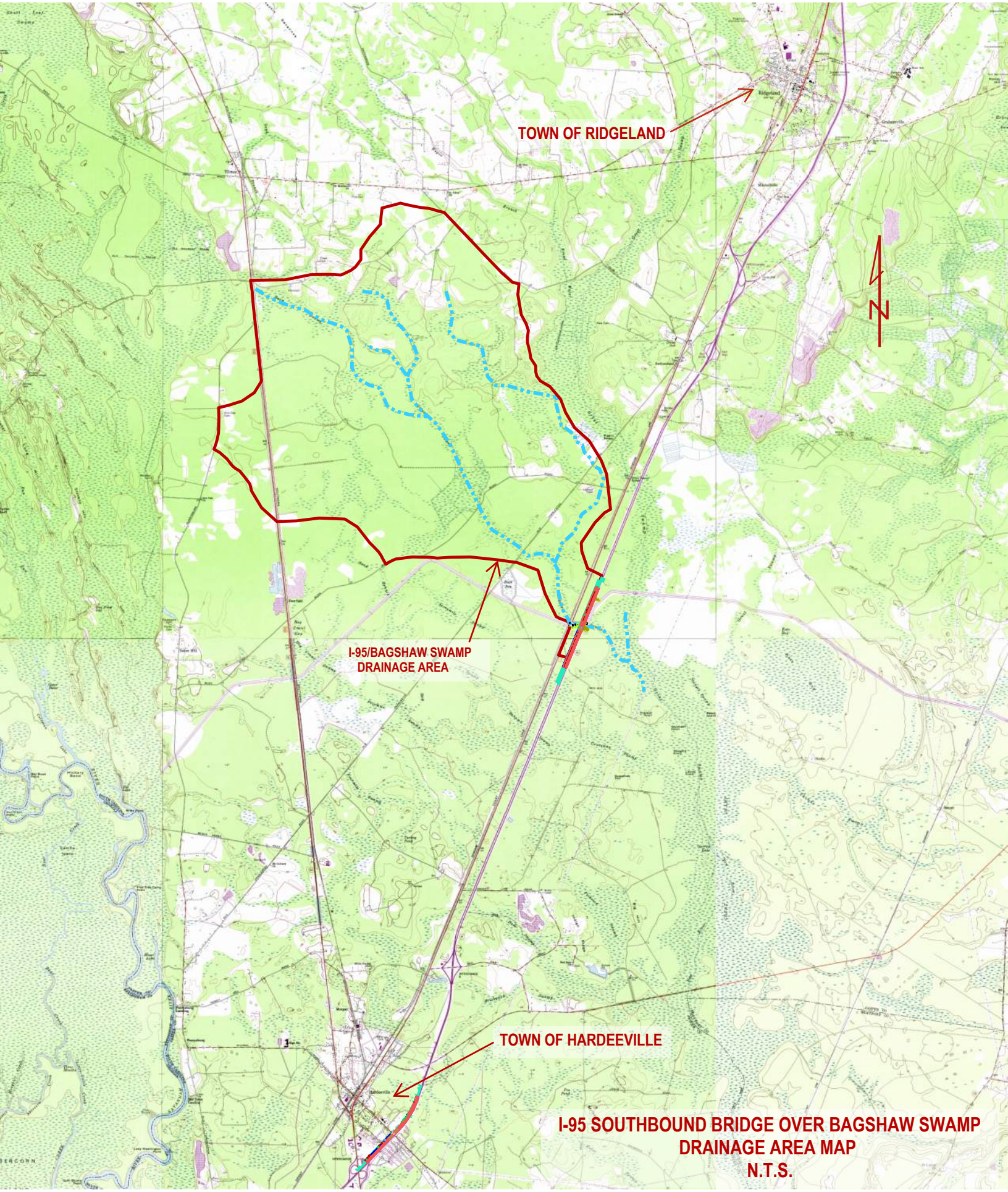
Hydraulic design of the I-95 Bridge over Bagshaw Swamp is in conformance with criteria established by *The South Carolina Department of Transportation Requirements for Hydraulic Design Studies*. The proposed new bridge will be longer and will include a larger opening area, which will create a more efficient hydraulic design.

No adverse flooding impacts upstream or downstream of the proposed bridge will occur as a result of construction of the proposed new bridge.

Backwater created by the proposed new bridge will not exceed 0.53 feet for the 100-year flood, and a minimum of 8.6 feet of freeboard will be supplied for the bridge for the 50-year design flood.

APPENDIX A

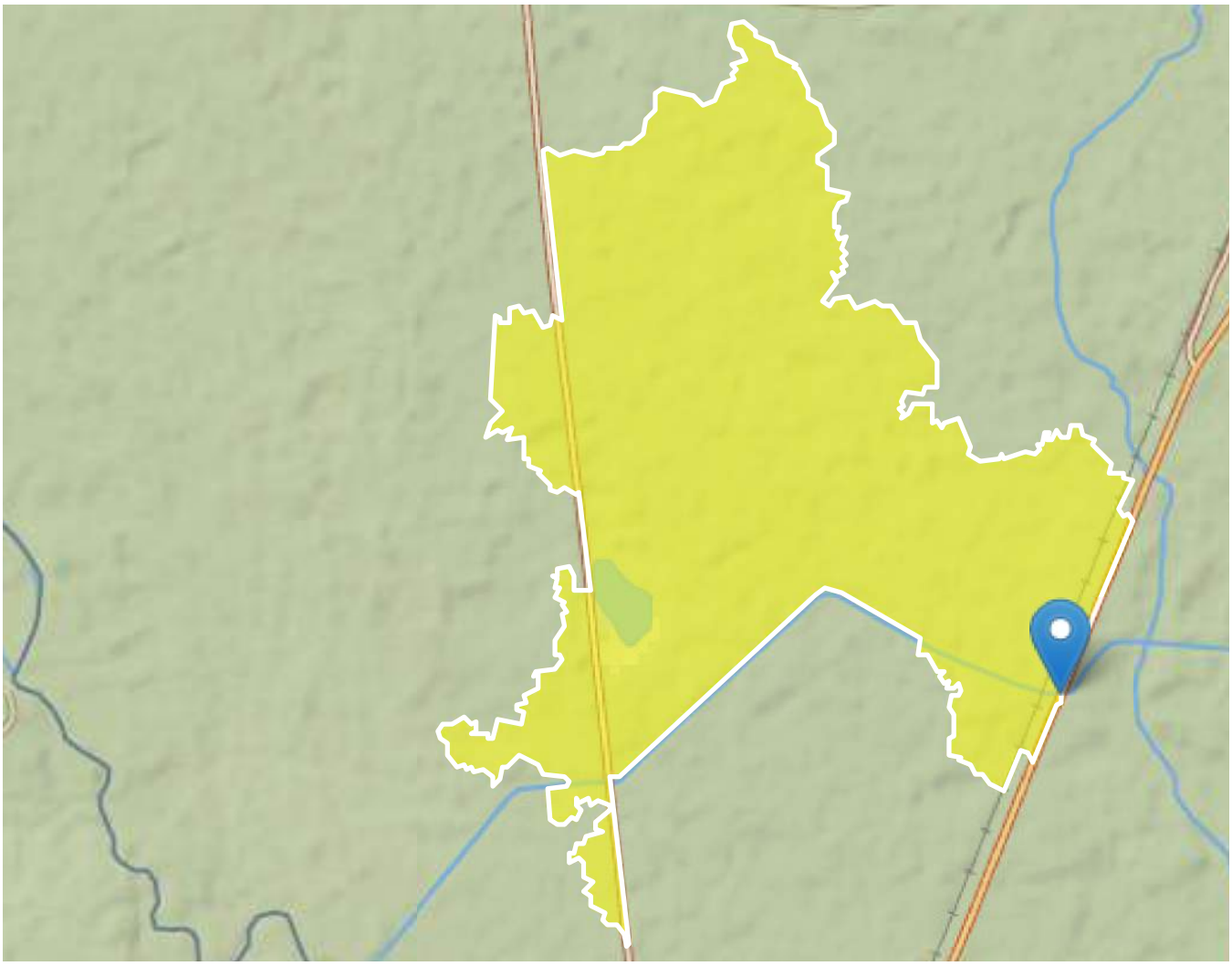
HYDROLOGIC CALCULATIONS



I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP
DRAINAGE AREA MAP
N.T.S.

I-95 Southbound Bridge over Bagshaw Swamp

Region ID: SC
Workspace ID: SC20181107121913947000
Clicked Point (Latitude, Longitude): 32.37726, -81.03050
Time: 2018-11-07 07:19:28 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	18.6	square miles
PCTREG1	Percentage of drainage area located in Region 1	0	percent
PCTREG2	Percentage of drainage area located in Region 2	0	percent
PCTREG3	Percentage of drainage area located in Region 3	0	percent
PCTREG4	Percentage of drainage area located in Region 4	100	percent
PCTREG5	Percentage of drainage area located in Region 5	0	percent
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	0.41	percent
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	8.74	inches

Peak-Flow Statistics Parameters [Peak Southeast US over 1 sqmi 2009 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	18.6	square miles	1	9000
PCTREG1	Percent Area in Region 1	0	percent	0	100

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PCTREG2	Percent Area in Region 2	0	percent	0	100
PCTREG3	Percent Area in Region 3	0	percent	0	100
PCTREG4	Percent Area in Region 4	100	percent	0	100
PCTREG5	Percent Area in Region 5	0	percent	0	100

Peak-Flow Statistics Parameters [Region 4 rural under 1 sqmi 2014 5030]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	18.6	square miles	0.1	1
LC06IMP	Percent Impervious NLCD2006	0.41	percent	0.2	34.8
I24H50Y	24 Hour 50 Year Precipitation	8.74	inches	6.51	10.9

Peak-Flow Statistics Flow Report [Peak Southeast US over 1 sqmi 2009 5156]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SEp
2 Year Peak Flood	402	ft^3/s	231	697	34.5
5 Year Peak Flood	769	ft^3/s	446	1330	34
10 Year Peak Flood	1060	ft^3/s	602	1850	35.1

Statistic	Value	Unit	PIl	PIu	SEp
25 Year Peak Flood	1440	ft^3/s	795	2620	37.5
50 Year Peak Flood	1790	ft^3/s	953	3350	39.6
100 Year Peak Flood	2160	ft^3/s	1110	4180	41.9
200 Year Peak Flood	2500	ft^3/s	1240	5020	44.3
500 Year Peak Flood	3020	ft^3/s	1430	6370	47.7

Peak-Flow Statistics Disclaimers [Region 4 rural under 1 sqmi 2014 5030]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Region 4 rural under 1 sqmi 2014 5030]

Statistic	Value	Unit
2 Year Peak Flood	424	ft^3/s
5 Year Peak Flood	821	ft^3/s
10 Year Peak Flood	1160	ft^3/s
25 Year Peak Flood	1660	ft^3/s
50 Year Peak Flood	2080	ft^3/s
100 Year Peak Flood	2540	ft^3/s
200 Year Peak Flood	3070	ft^3/s
500 Year Peak Flood	3810	ft^3/s

Peak-Flow Statistics Citations

Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2009, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006:

Volume 3, South Carolina: U.S. Geological Survey Scientific Investigations Report 2009-5156, 226 p. (http://pubs.usgs.gov/sir/2009/5156/)

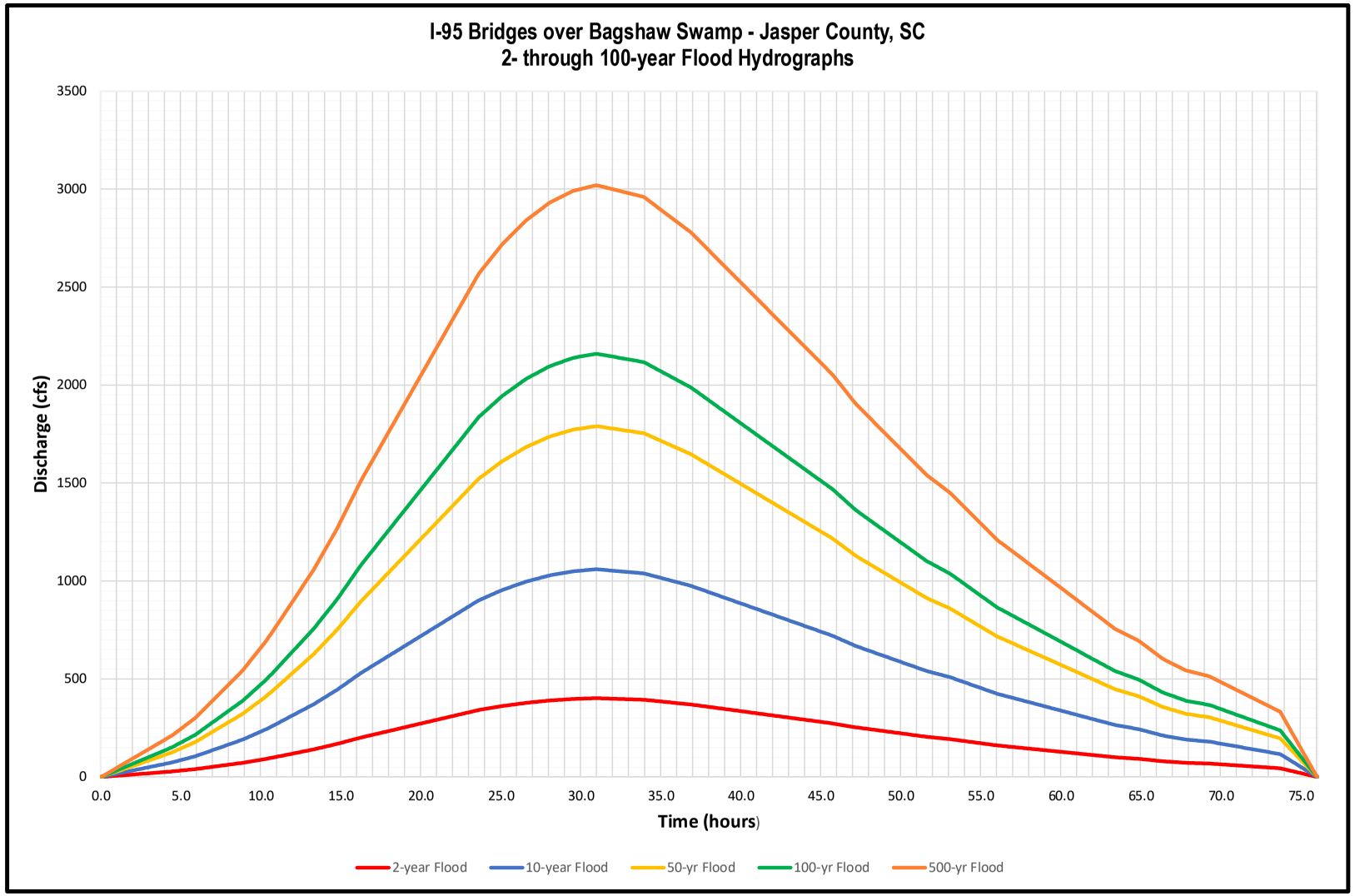
Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2014, Methods for estimating the magnitude and frequency of floods for urban and small, rural streams in Georgia, South Carolina, and North Carolina, 2011 (ver. 1.1, March 2014): U.S. Geological Survey Scientific Investigations Report 2014–5030, 104 p. (http://pubs.usgs.gov/sir/2014/5030/)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

USGS Software Disclaimer: This software has been approved for release by the U.S. Geological Survey (USGS). Although the software has been subjected to rigorous review, the USGS reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

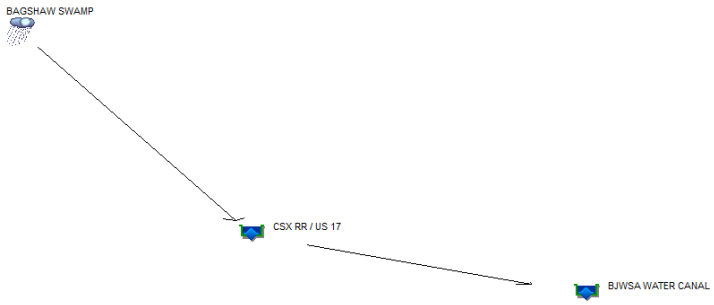
Application Version: 4.2.1


I-95 Bridges over Bagshaw Swamp - Jasper County, SC
2- through 100-year Flood Hydrographs
Discharge (cfs)
3500
3000
2500
2000
1500
1000
500
0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
Time (hours)
2-year Flood
10-year Flood
50-yr Flood
100-yr Flood
500-yr Flood

APPENDIX B

HYDRAFLOW HYDROGRAPH RESULTS

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Manual	BAGSHAW SWAMP
2	Reservoir	CSX RR / US 17
3	Reservoir	BJWSA WATER CANAL

Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.01

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	Manual	-------	-------	401.90	-------	3019.10	1059.70	-------	1789.40	2159.30	BAGSHAW SWAMP
2	Reservoir	1	-------	140.11	-------	456.08	256.49	-------	327.94	349.59	CSX RR / US 17
3	Reservoir	2	-------	133.22	-------	455.39	255.70	-------	327.81	349.45	BJWSA WATER CANAL

NOTE: SINCE THE PROGRAM DOES NOT COMPUTE 500-YEAR ANALYSES, "5-YR" WAS USED INSTEAD TO REPRESENT THE 500-YEAR FLOOD IN THIS STUDY.

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.01

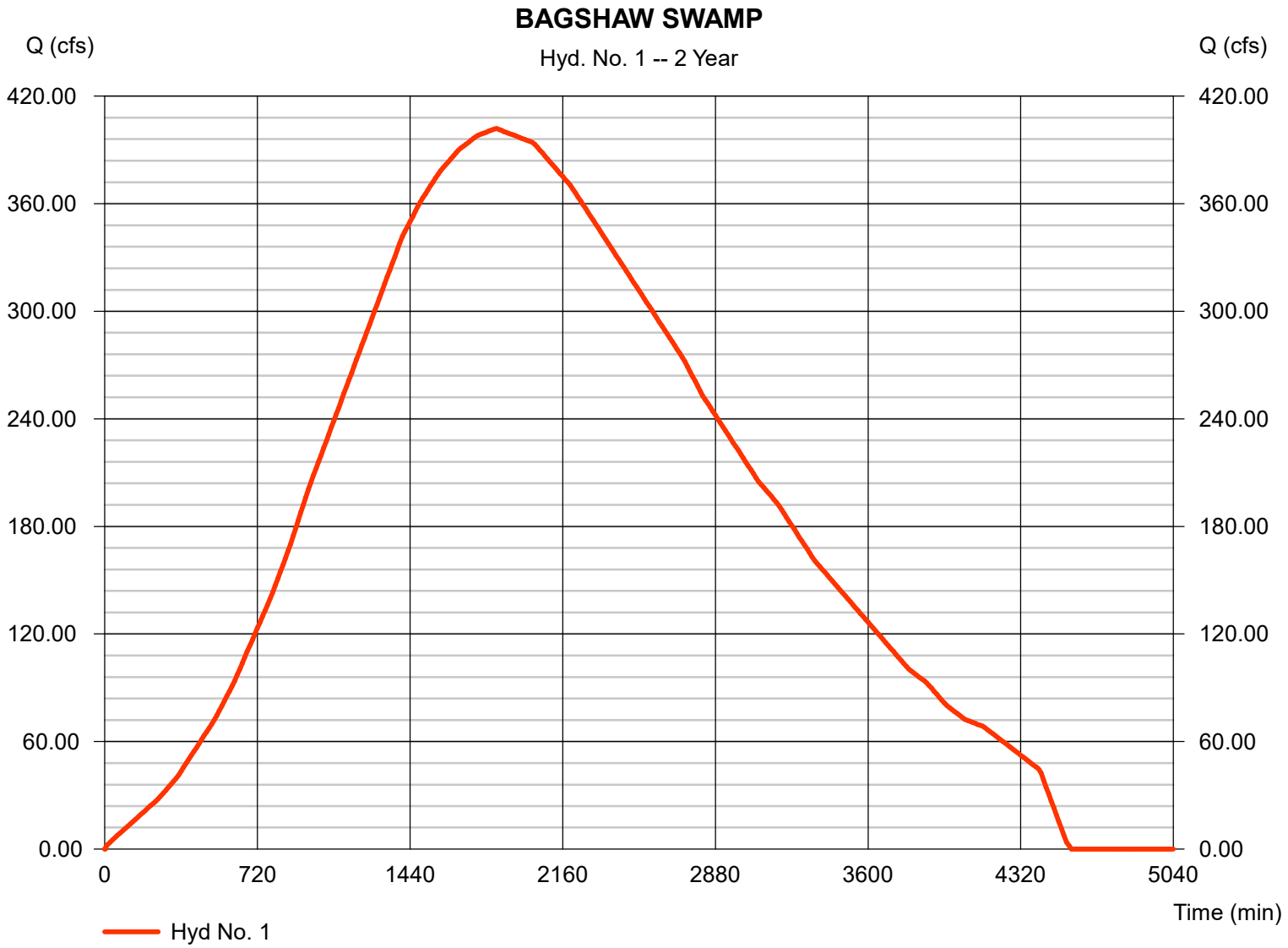
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Manual	401.90	12	2156	63,639,740	----	------	------	BAGSHAW SWAMP
2	Reservoir	140.11	12	3504	53,550,680	1	16.59	32,890,640	CSX RR / US 17
3	Reservoir	133.22	12	4416	53,547,470	2	19.18	3,636,658	BJWSA WATER CANAL

Hydrograph Report

Hyd. No. 1

BAGSHAW SWAMP

Hydrograph type	= Manual	Peak discharge	= 401.90 cfs
Storm frequency	= 2 yrs	Time to peak	= 2156 min
Time interval	= 12 min	Hyd. volume	= 63,639,740 cuft



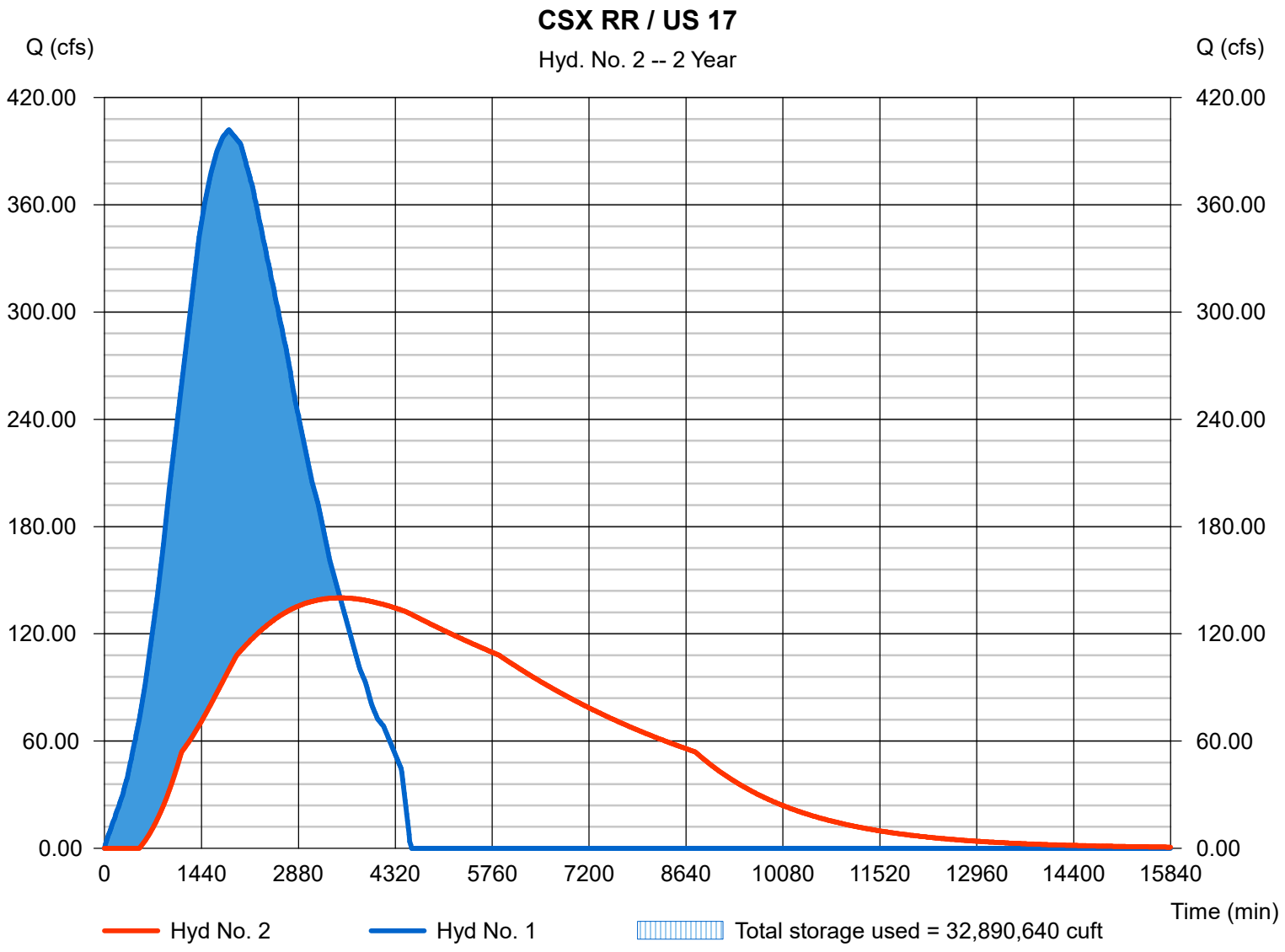
Hydrograph Report

Hyd. No. 2

CSX RR / US 17

Hydrograph type	=	Reservoir	Peak discharge	=	140.11 cfs
Storm frequency	=	2 yrs	Time to peak	=	3504 min
Time interval	=	12 min	Hyd. volume	=	53,550,680 cuft
Inflow hyd. No.	=	1 - BAGSHAW SWAMP	Max. Elevation	=	16.59 ft
Reservoir name	=	BAGSHAW_SWAMP/CSX_RR	Max. Storage	=	32,890,640 cuft

Storage Indication method used.



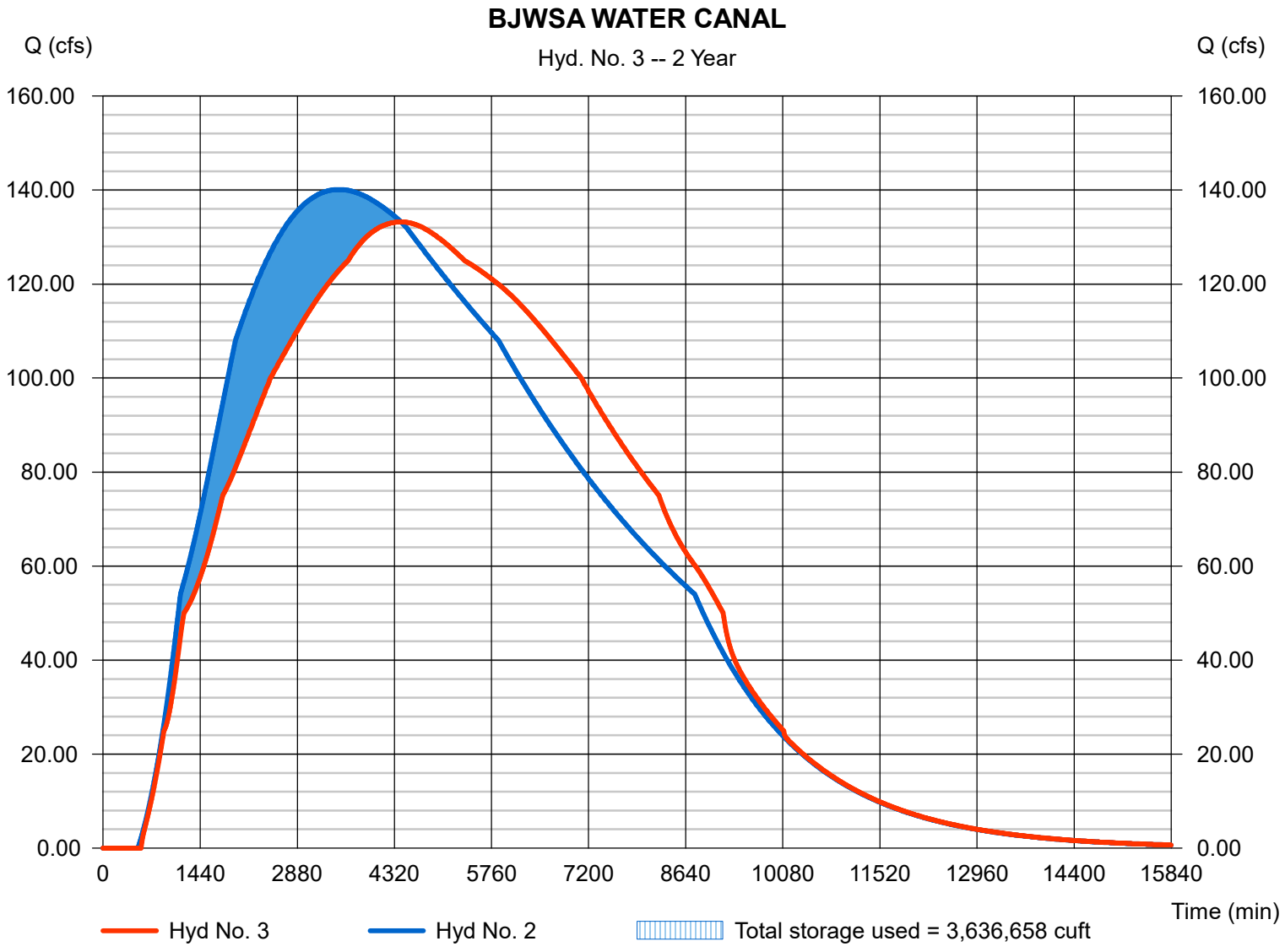
Hydrograph Report

Hyd. No. 3

BJWSA WATER CANAL

Hydrograph type	=	Reservoir	Peak discharge	=	133.22 cfs
Storm frequency	=	2 yrs	Time to peak	=	4416 min
Time interval	=	12 min	Hyd. volume	=	53,547,470 cuft
Inflow hyd. No.	=	2 - CSX RR / US 17	Max. Elevation	=	19.18 ft
Reservoir name	=	BAGSHAW_SWAMP/BJWSA CANAL	Max. Storage	=	3,636,658 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.01

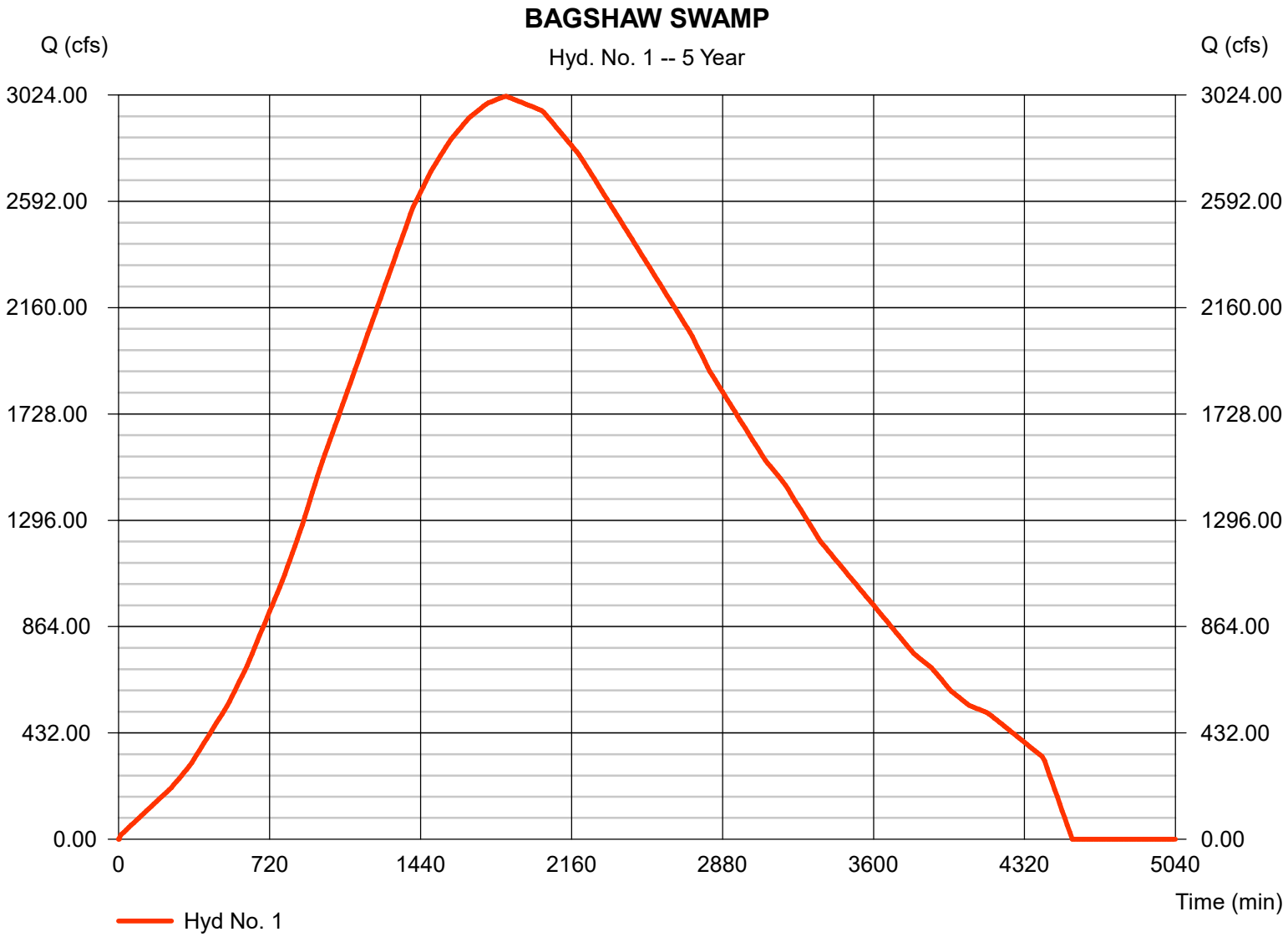
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Manual	3019.10	12	1848	409,774,200	----	------	------	BAGSHAW SWAMP
2	Reservoir	456.08	12	4224	408,748,000	1	21.28	332,959,300	CSX RR / US 17
3	Reservoir	455.39	12	4368	408,744,900	2	21.83	8,722,259	BJWSA WATER CANAL

Hydrograph Report

Hyd. No. 1

BAGSHAW SWAMP

Hydrograph type	= Manual	Peak discharge	= 3019.10 cfs
Storm frequency	= 5 yrs	Time to peak	= 1848 min
Time interval	= 12 min	Hyd. volume	= 409,774,200 cuft



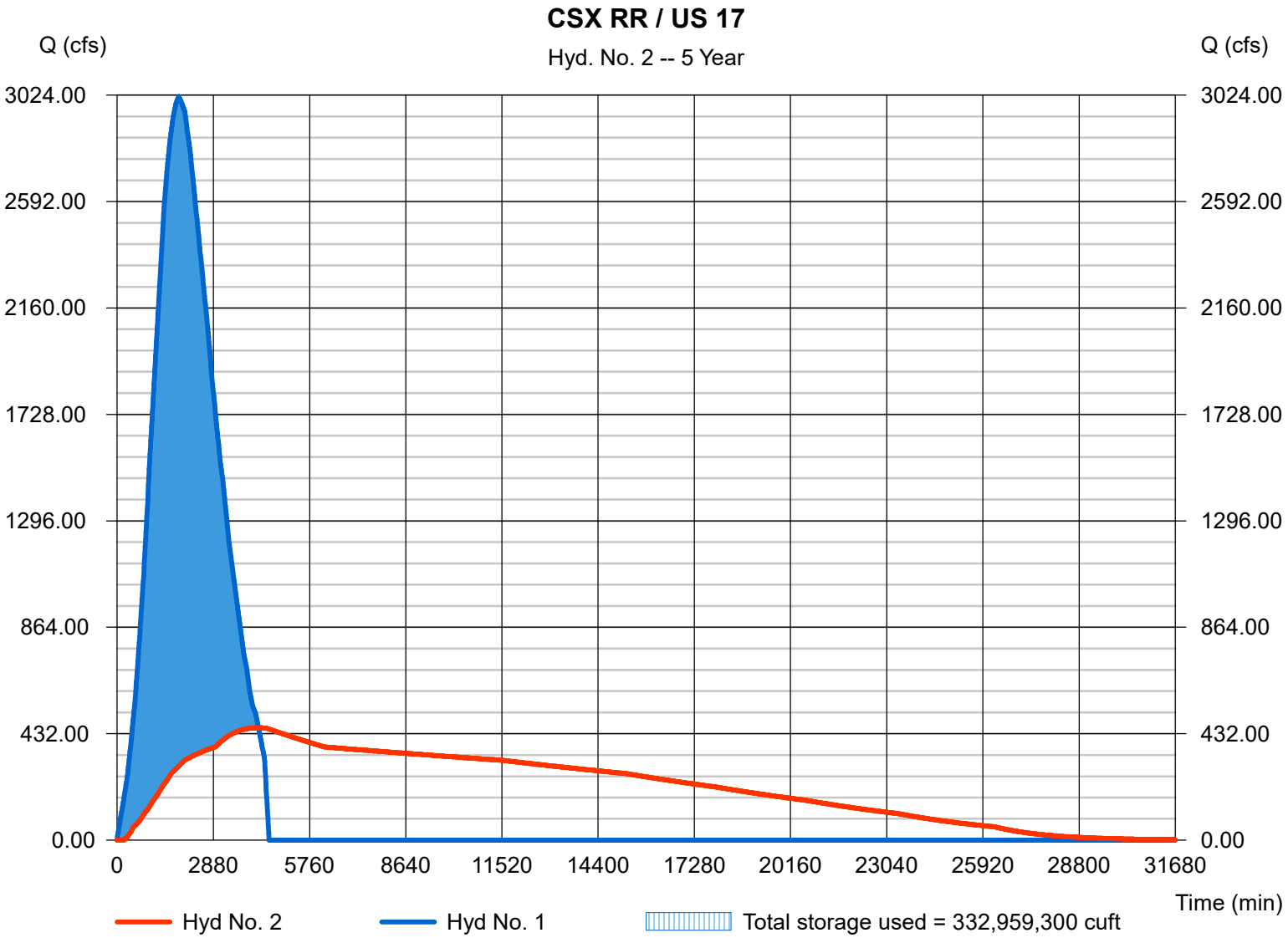
Hydrograph Report

Hyd. No. 2

CSX RR / US 17

Hydrograph type	=	Reservoir	Peak discharge	=	456.08 cfs
Storm frequency	=	5 yrs	Time to peak	=	4224 min
Time interval	=	12 min	Hyd. volume	=	408,748,000 cuft
Inflow hyd. No.	=	1 - BAGSHAW SWAMP	Max. Elevation	=	21.28 ft
Reservoir name	=	BAGSHAW_SWAMP/CSX_RR	Max. Storage	=	332,959,300 cuft

Storage Indication method used.



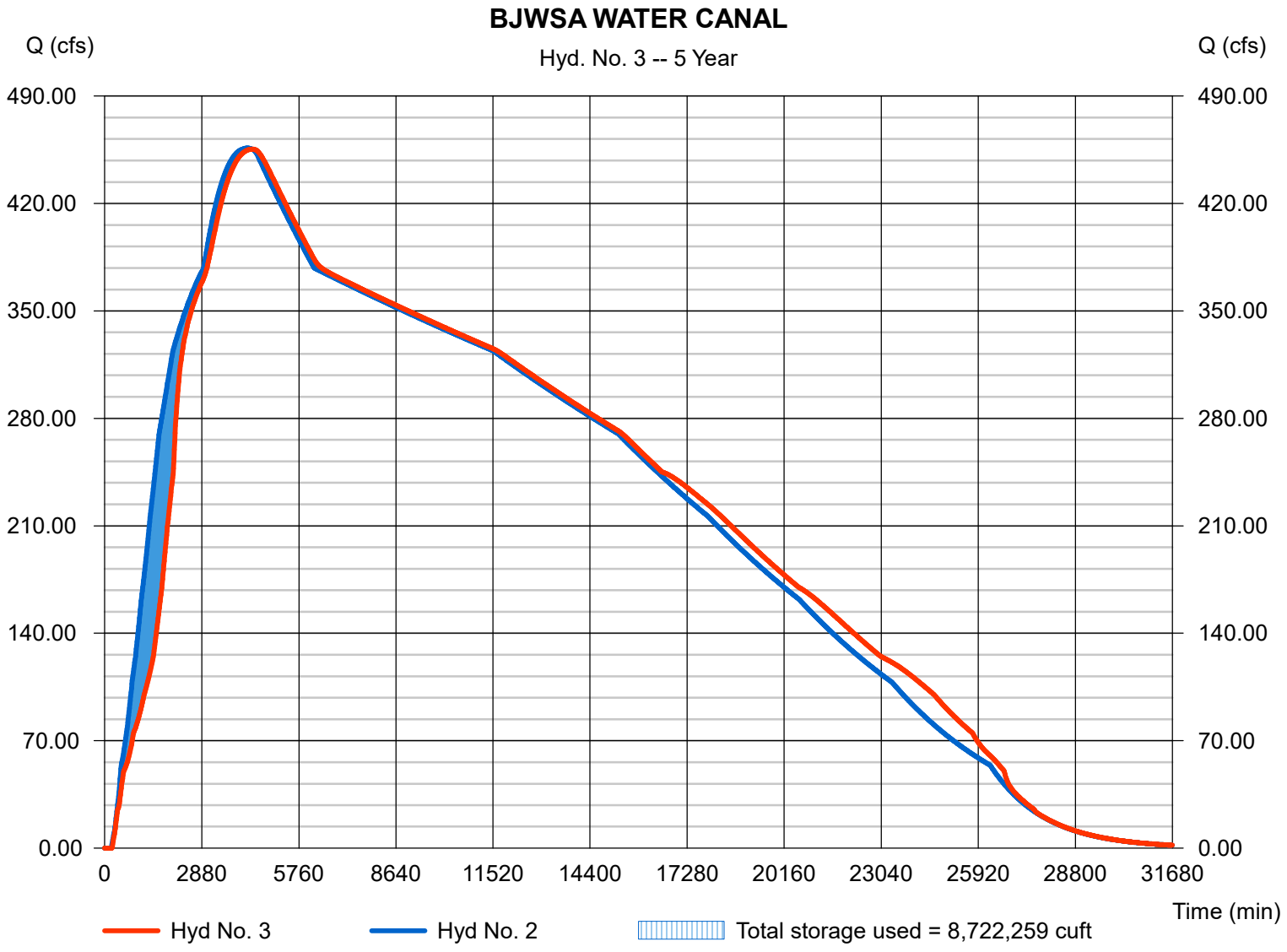
Hydrograph Report

Hyd. No. 3

BJWSA WATER CANAL

Hydrograph type	=	Reservoir	Peak discharge	=	455.39 cfs
Storm frequency	=	5 yrs	Time to peak	=	4368 min
Time interval	=	12 min	Hyd. volume	=	408,744,900 cuft
Inflow hyd. No.	=	2 - CSX RR / US 17	Max. Elevation	=	21.83 ft
Reservoir name	=	BAGSHAW_SWAMP/BJWSA CANAL	Max. Storage	=	8,722,259 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.01

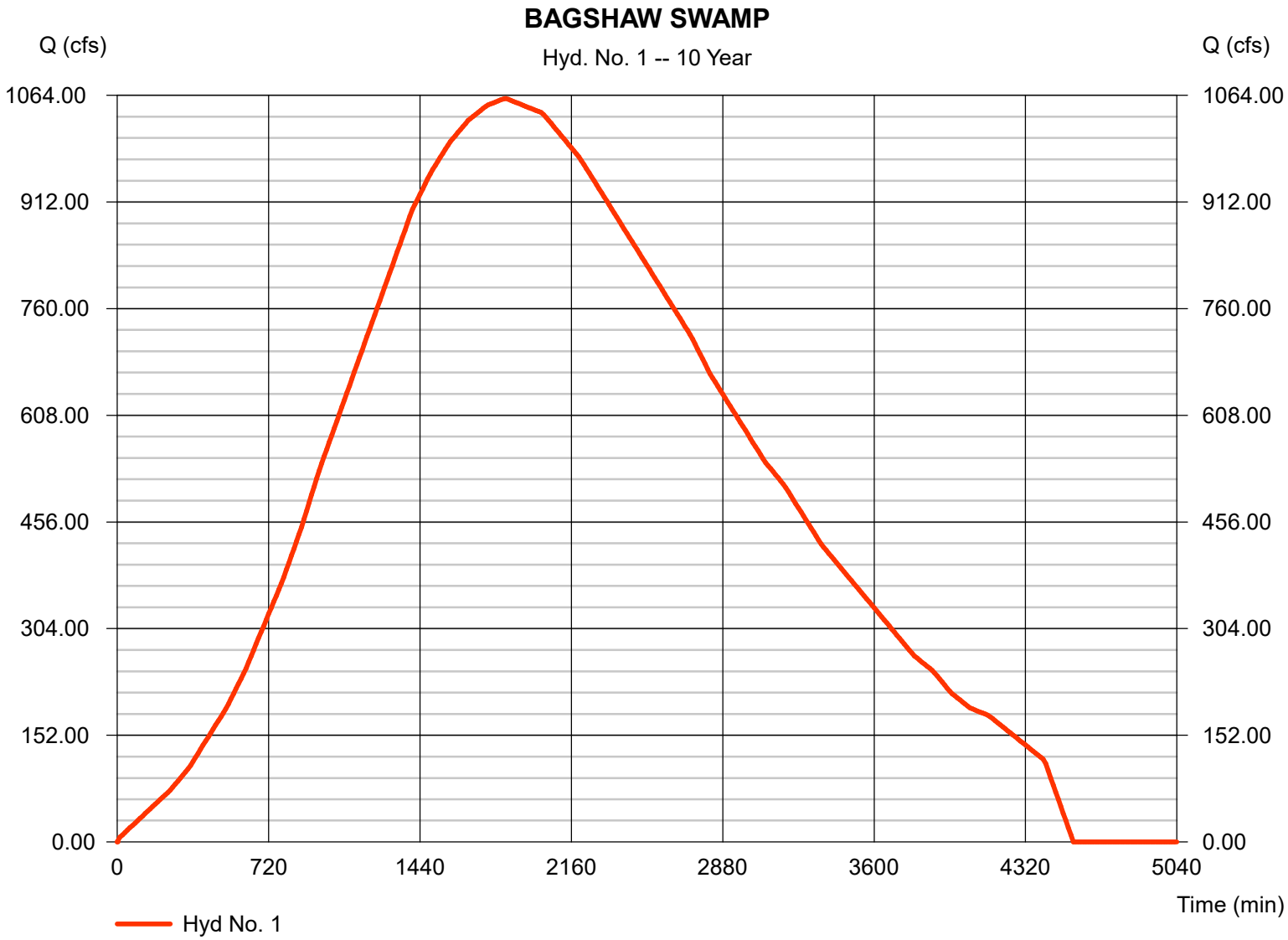
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Manual	1059.70	12	1848	143,830,800	----	------	------	BAGSHAW SWAMP
2	Reservoir	256.49	12	3828	142,831,300	1	18.75	101,330,600	CSX RR / US 17
3	Reservoir	255.70	12	4080	142,827,800	2	21.04	7,028,803	BJWSA WATER CANAL

Hydrograph Report

Hyd. No. 1

BAGSHAW SWAMP

Hydrograph type	= Manual	Peak discharge	= 1059.70 cfs
Storm frequency	= 10 yrs	Time to peak	= 1848 min
Time interval	= 12 min	Hyd. volume	= 143,830,800 cuft



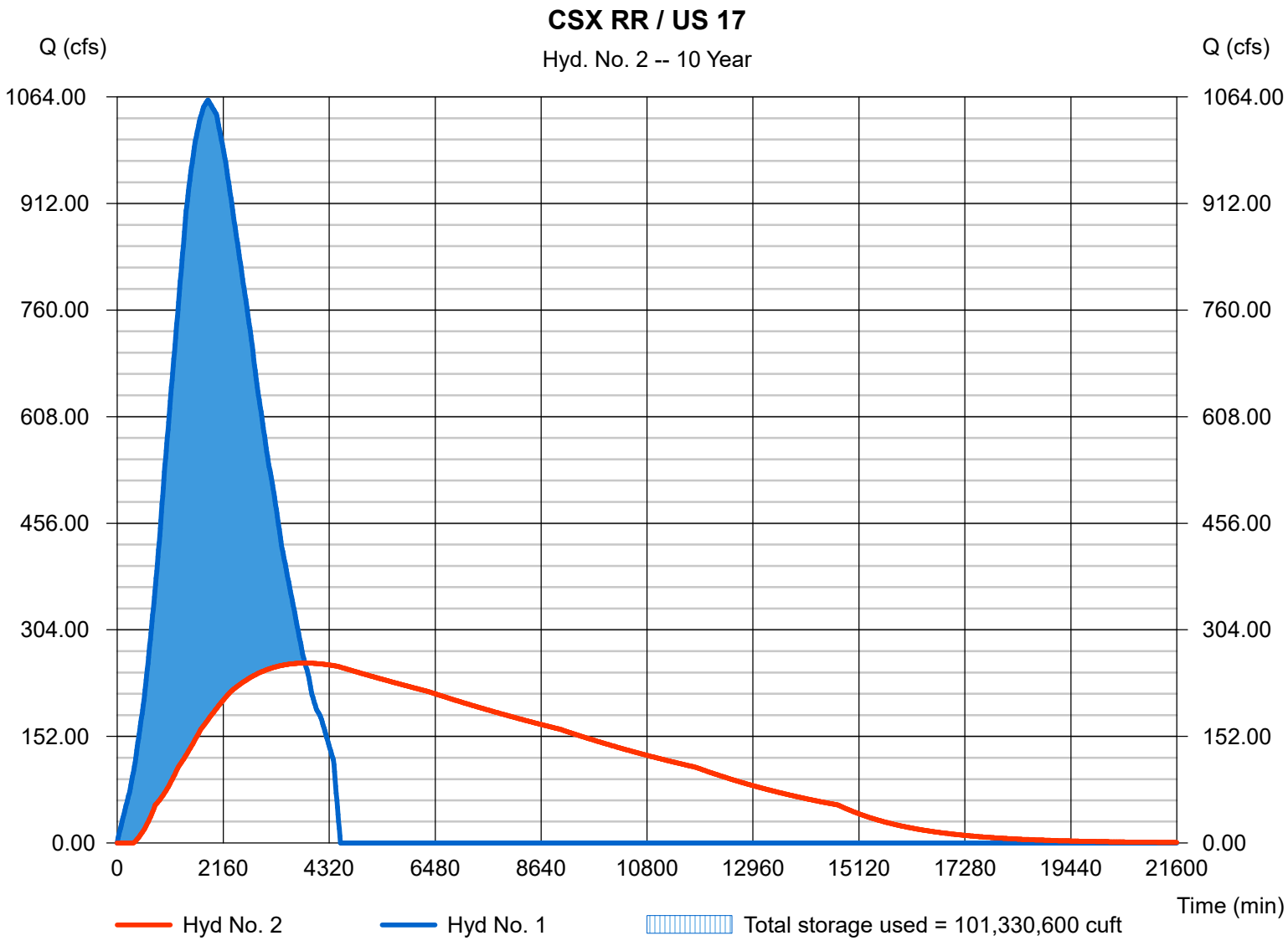
Hydrograph Report

Hyd. No. 2

CSX RR / US 17

Hydrograph type	=	Reservoir	Peak discharge	=	256.49 cfs
Storm frequency	=	10 yrs	Time to peak	=	3828 min
Time interval	=	12 min	Hyd. volume	=	142,831,300 cuft
Inflow hyd. No.	=	1 - BAGSHAW SWAMP	Max. Elevation	=	18.75 ft
Reservoir name	=	BAGSHAW_SWAMP/CSX_RR	Max. Storage	=	101,330,600 cuft

Storage Indication method used.



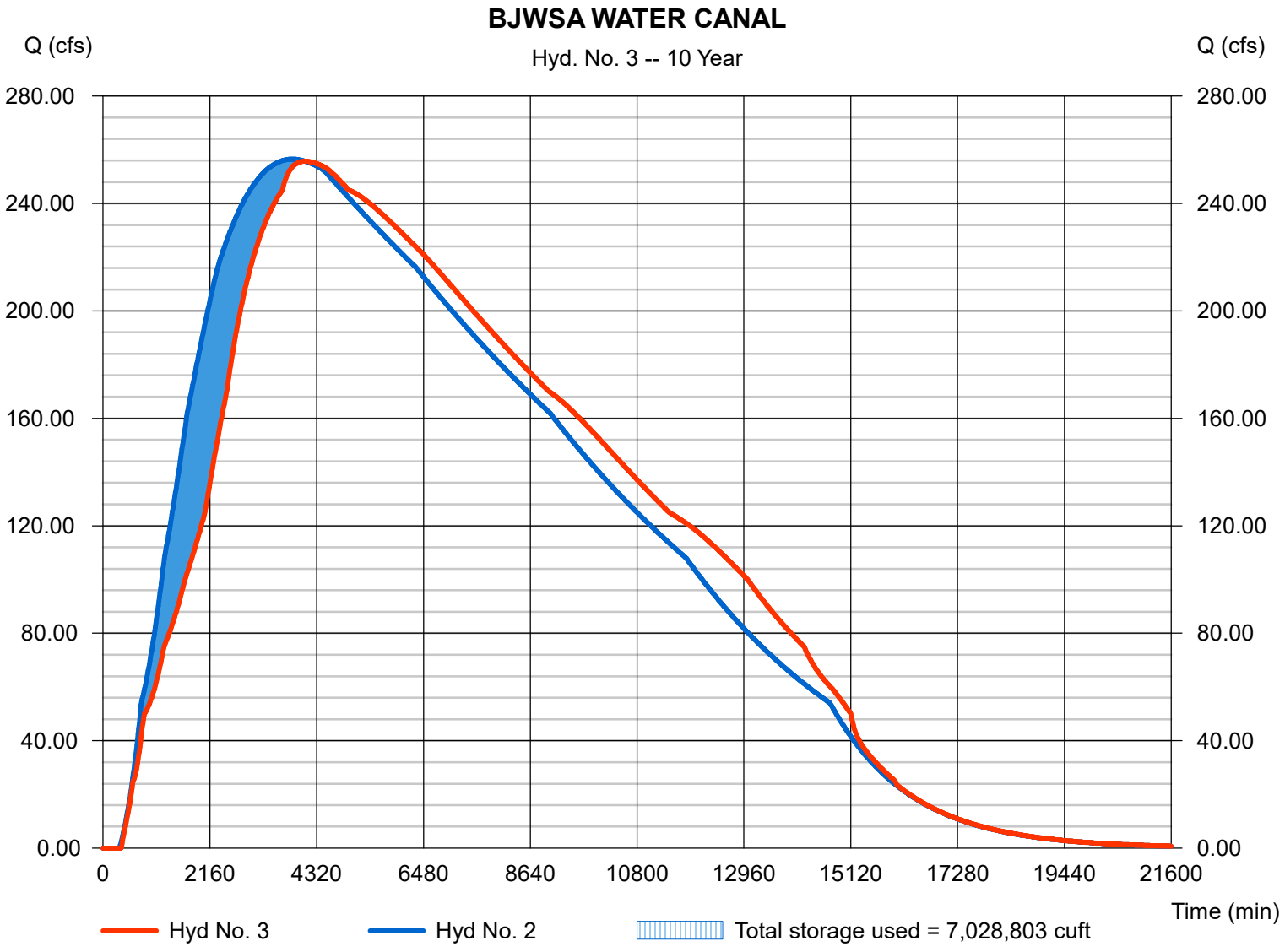
Hydrograph Report

Hyd. No. 3

BJWSA WATER CANAL

Hydrograph type	=	Reservoir	Peak discharge	=	255.70 cfs
Storm frequency	=	10 yrs	Time to peak	=	4080 min
Time interval	=	12 min	Hyd. volume	=	142,827,800 cuft
Inflow hyd. No.	=	2 - CSX RR / US 17	Max. Elevation	=	21.04 ft
Reservoir name	=	BAGSHAW_SWAMP/BJWSA CANAL	Max. Storage	=	7,028,803 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.01

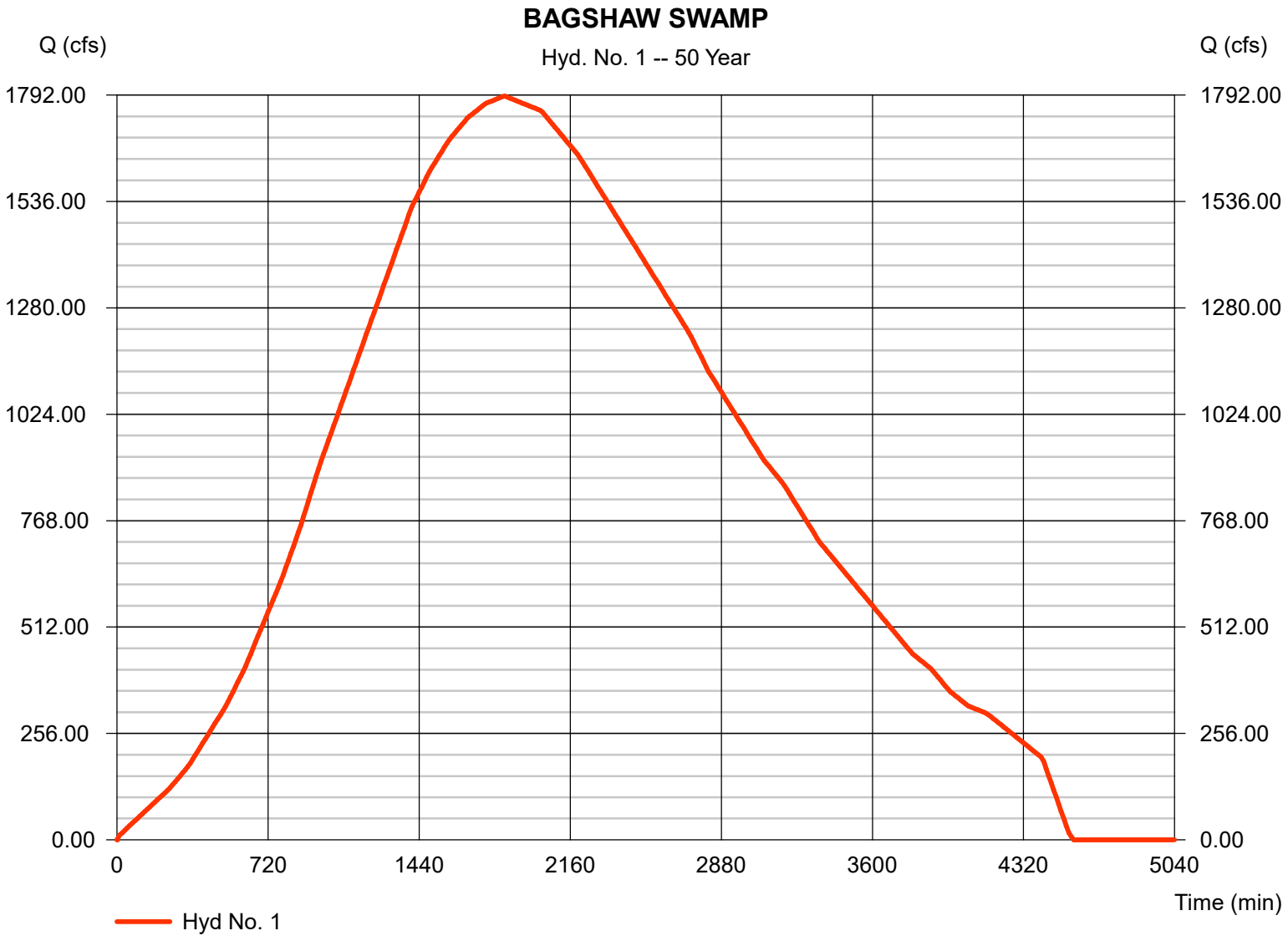
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Manual	1789.40	12	1848	242,889,400	----	------	------	BAGSHAW SWAMP
2	Reservoir	327.94	12	4044	241,887,800	1	20.07	185,091,200	CSX RR / US 17
3	Reservoir	327.81	12	4224	241,884,700	2	21.32	7,640,362	BJWSA WATER CANAL

Hydrograph Report

Hyd. No. 1

BAGSHAW SWAMP

Hydrograph type	= Manual	Peak discharge	= 1789.40 cfs
Storm frequency	= 50 yrs	Time to peak	= 1848 min
Time interval	= 12 min	Hyd. volume	= 242,889,400 cuft



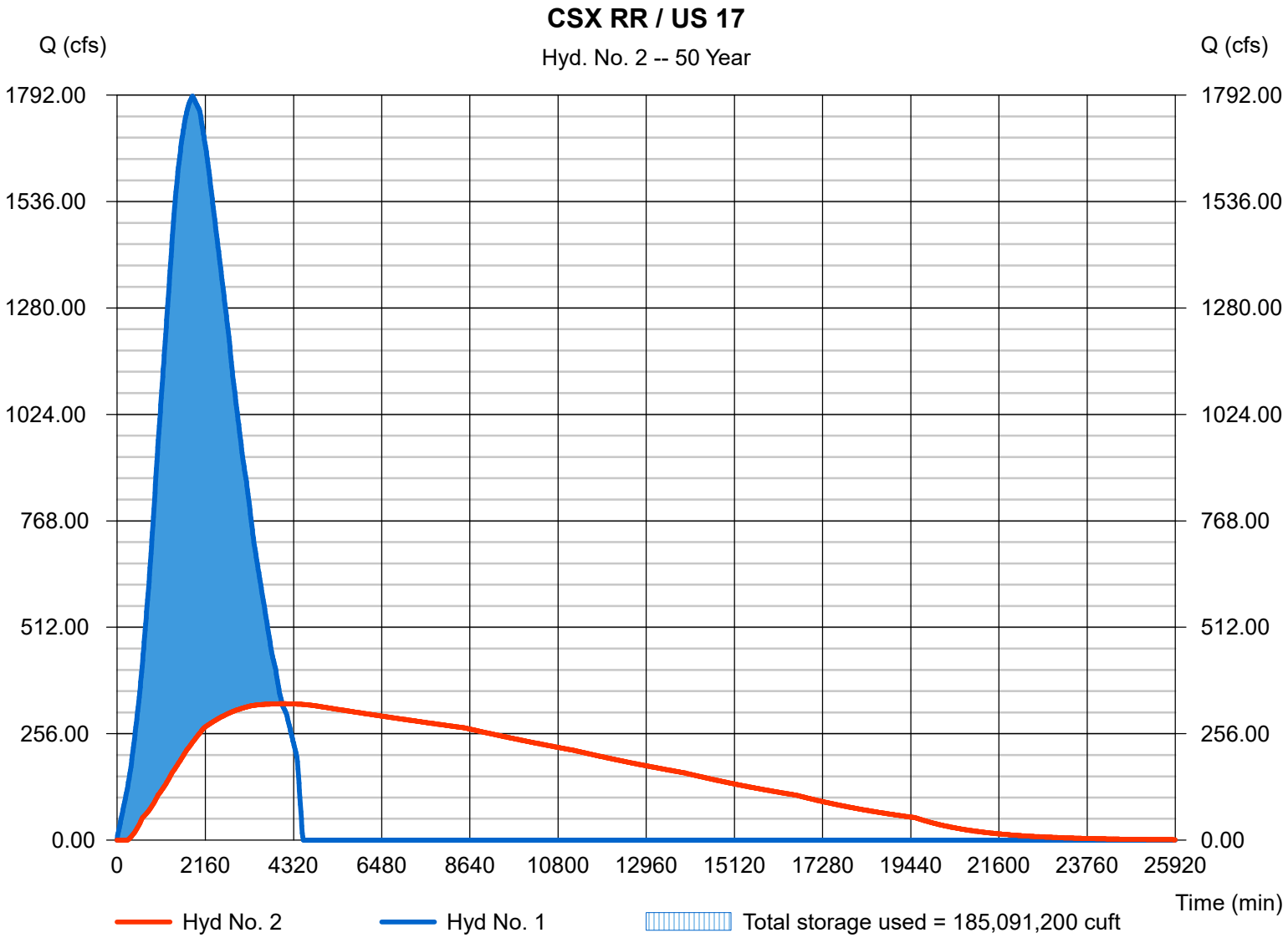
Hydrograph Report

Hyd. No. 2

CSX RR / US 17

Hydrograph type	=	Reservoir	Peak discharge	=	327.94 cfs
Storm frequency	=	50 yrs	Time to peak	=	4044 min
Time interval	=	12 min	Hyd. volume	=	241,887,800 cuft
Inflow hyd. No.	=	1 - BAGSHAW SWAMP	Max. Elevation	=	20.07 ft
Reservoir name	=	BAGSHAW_SWAMP/CSX_RR	Max. Storage	=	185,091,200 cuft

Storage Indication method used.



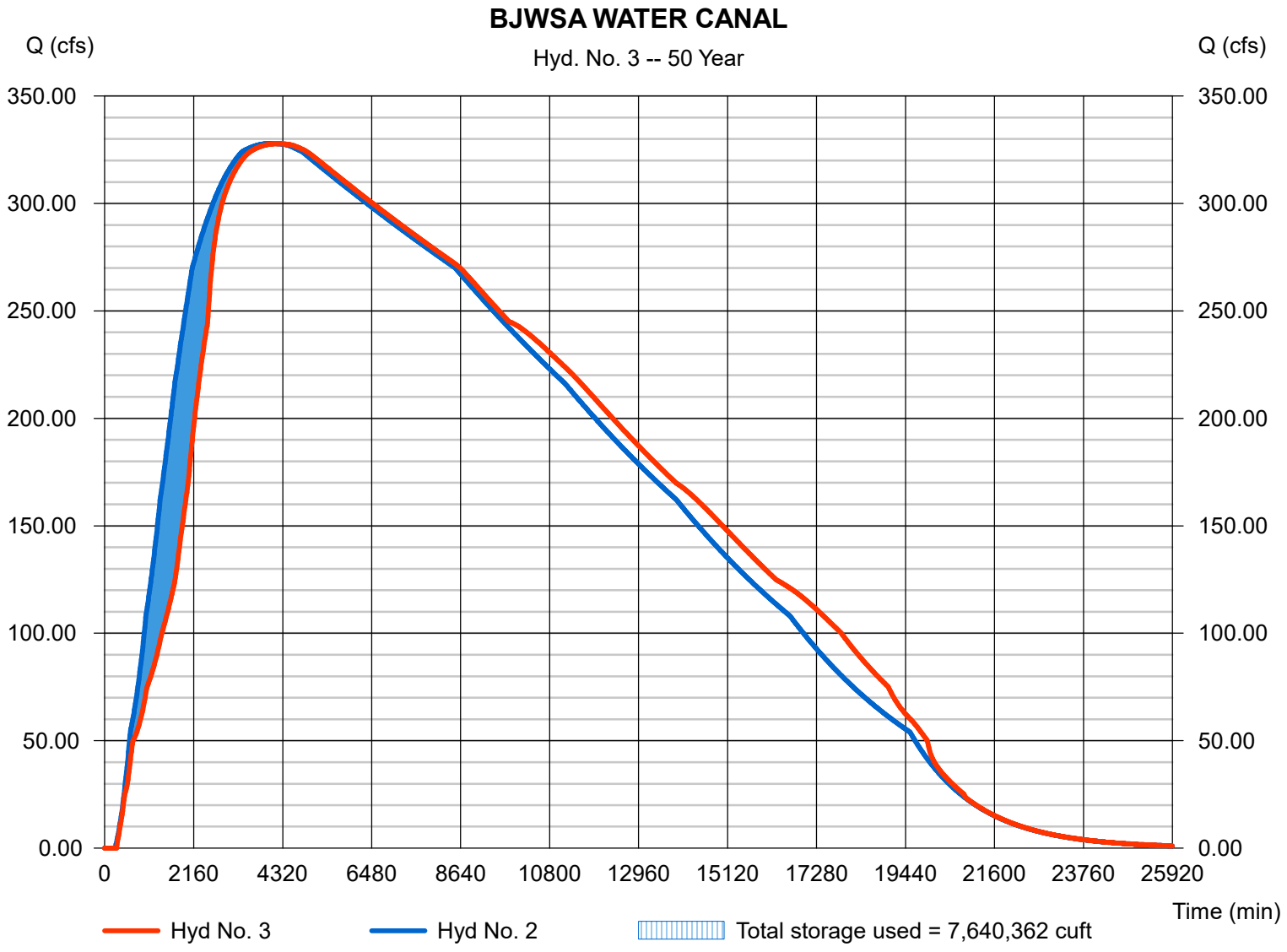
Hydrograph Report

Hyd. No. 3

BJWSA WATER CANAL

Hydrograph type	=	Reservoir	Peak discharge	=	327.81 cfs
Storm frequency	=	50 yrs	Time to peak	=	4224 min
Time interval	=	12 min	Hyd. volume	=	241,884,700 cuft
Inflow hyd. No.	=	2 - CSX RR / US 17	Max. Elevation	=	21.32 ft
Reservoir name	=	BAGSHAW_SWAMP/BJWSA CANAL	Max. Storage	=	7,640,362 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.01

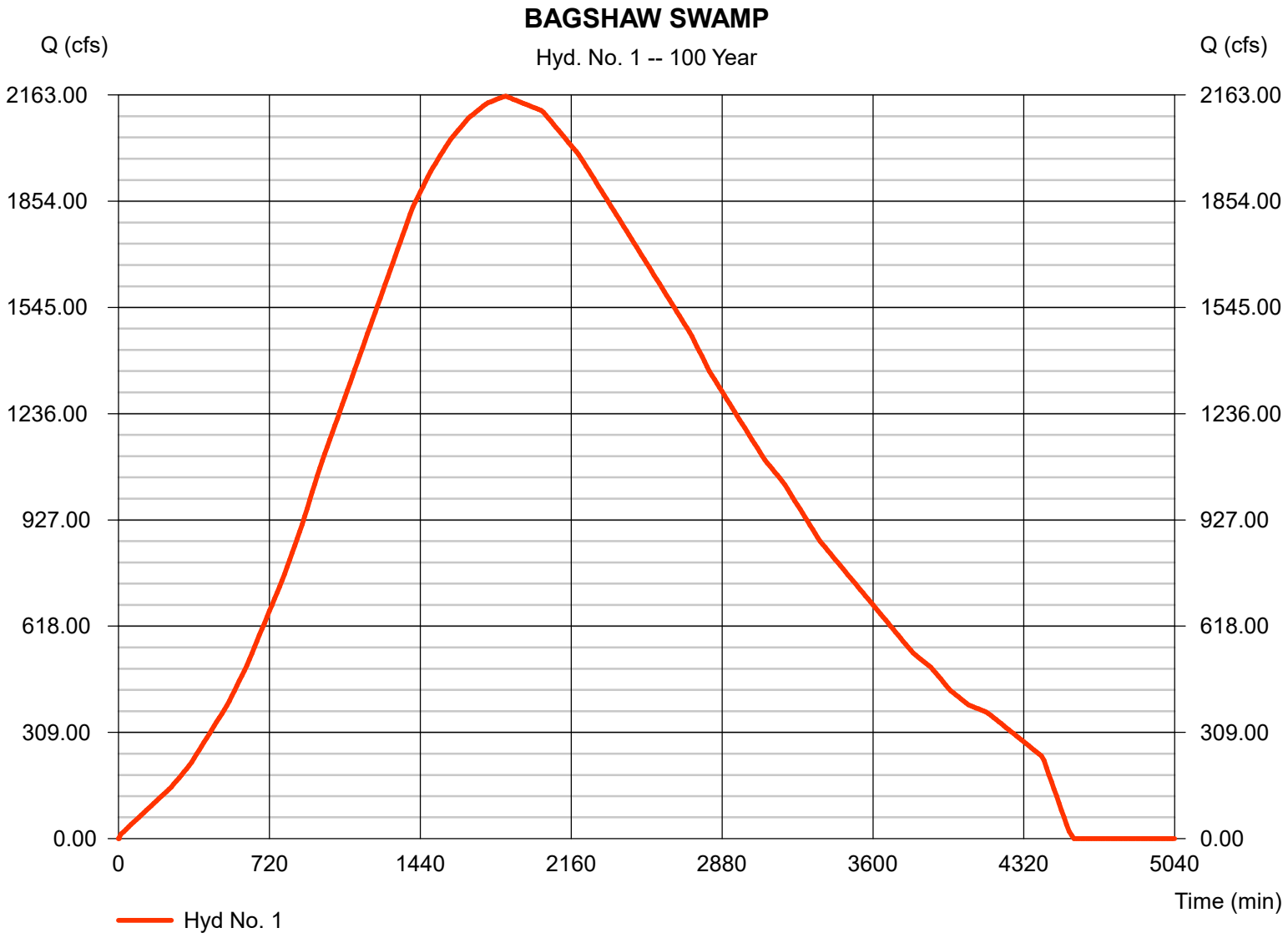
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Manual	2159.30	12	1848	293,091,100	----	------	------	BAGSHAW SWAMP
2	Reservoir	349.59	12	4176	292,092,400	1	20.47	229,851,100	CSX RR / US 17
3	Reservoir	349.45	12	4320	292,089,900	2	21.41	7,823,879	BJWSA WATER CANAL

Hydrograph Report

Hyd. No. 1

BAGSHAW SWAMP

Hydrograph type	= Manual	Peak discharge	= 2159.30 cfs
Storm frequency	= 100 yrs	Time to peak	= 1848 min
Time interval	= 12 min	Hyd. volume	= 293,091,100 cuft



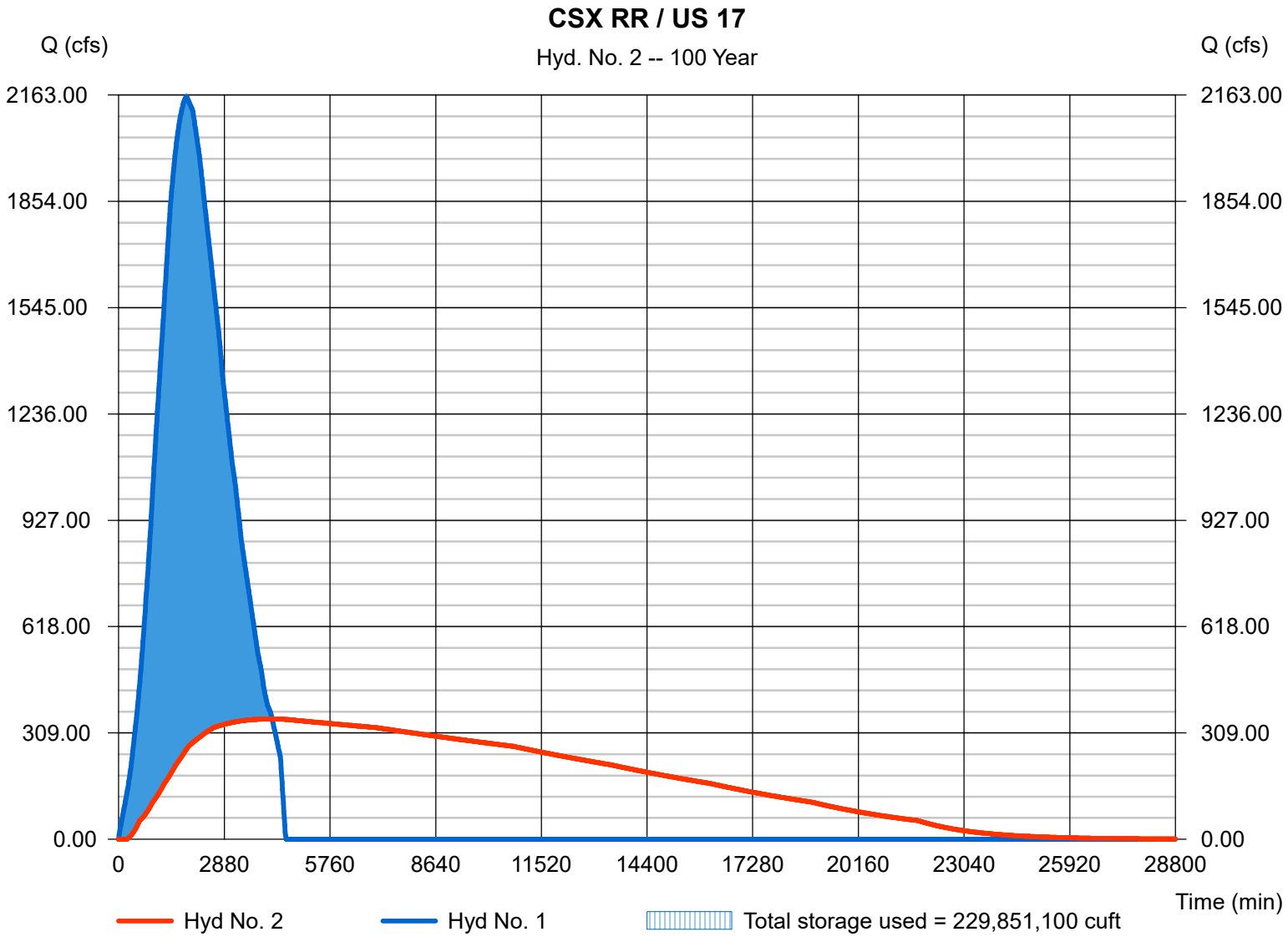
Hydrograph Report

Hyd. No. 2

CSX RR / US 17

Hydrograph type	=	Reservoir	Peak discharge	=	349.59 cfs
Storm frequency	=	100 yrs	Time to peak	=	4176 min
Time interval	=	12 min	Hyd. volume	=	292,092,400 cuft
Inflow hyd. No.	=	1 - BAGSHAW SWAMP	Max. Elevation	=	20.47 ft
Reservoir name	=	BAGSHAW_SWAMP/CSX_RR	Max. Storage	=	229,851,100 cuft

Storage Indication method used.



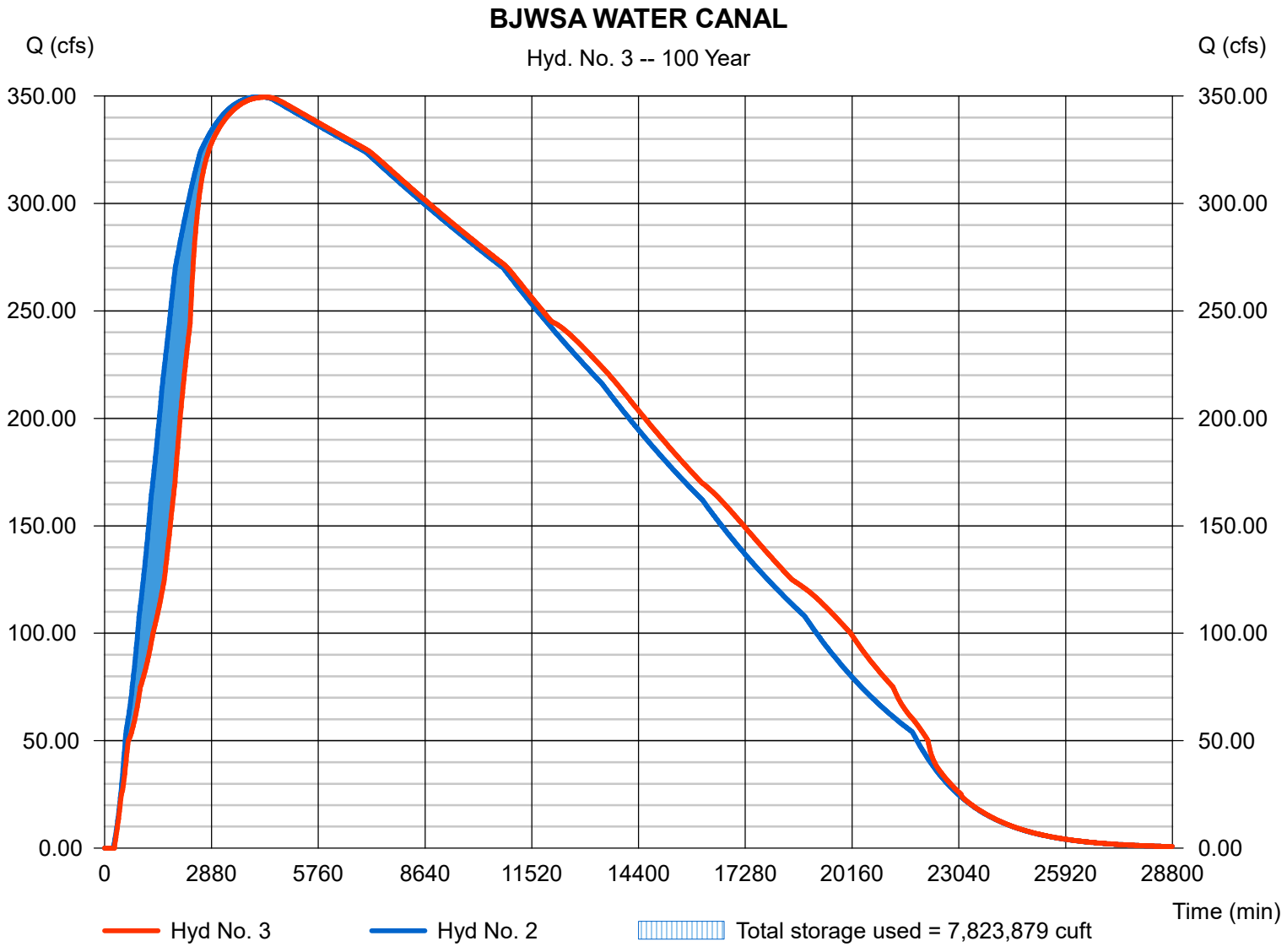
Hydrograph Report

Hyd. No. 3

BJWSA WATER CANAL

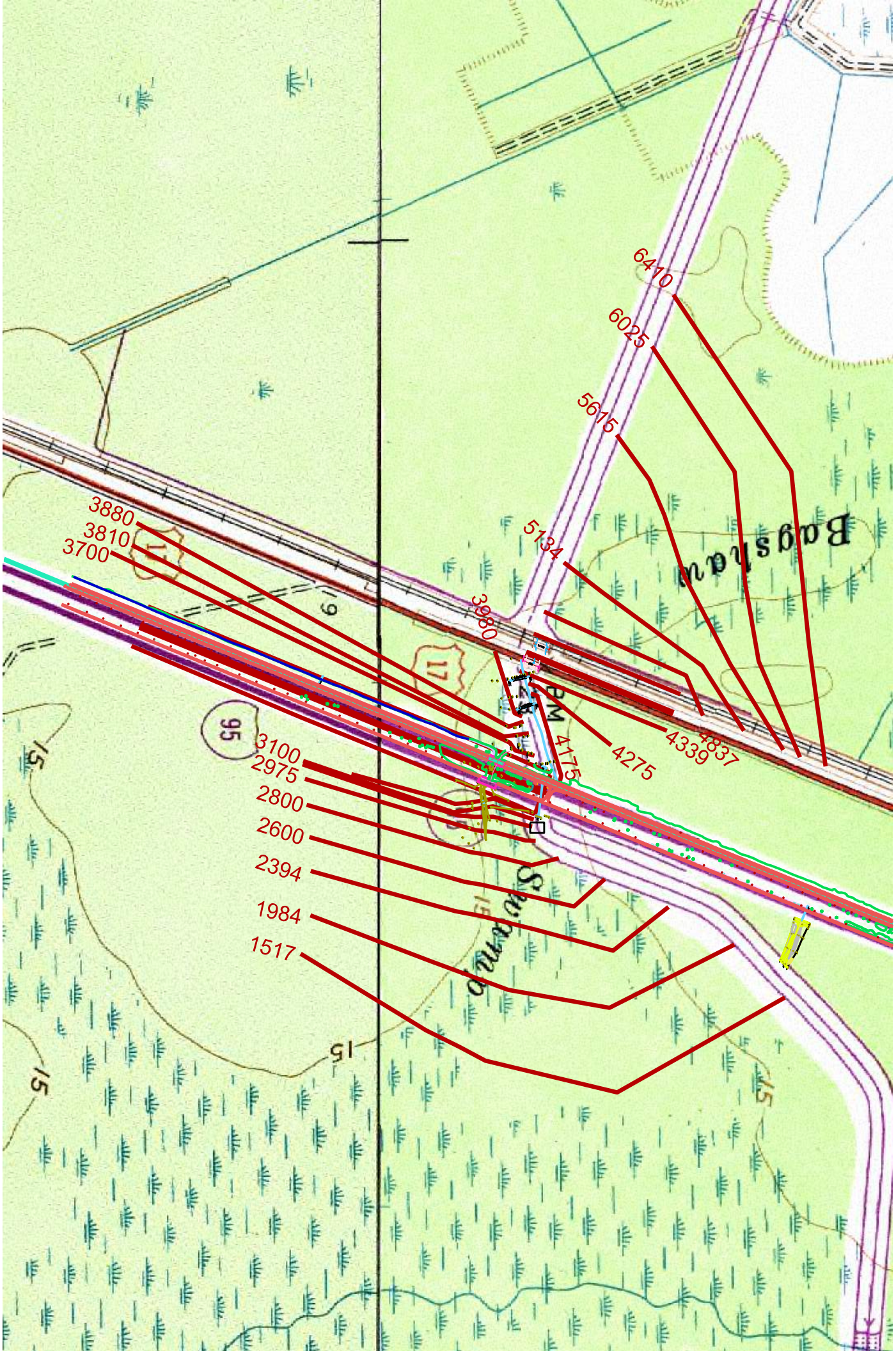
Hydrograph type	=	Reservoir	Peak discharge	=	349.45 cfs
Storm frequency	=	100 yrs	Time to peak	=	4320 min
Time interval	=	12 min	Hyd. volume	=	292,089,900 cuft
Inflow hyd. No.	=	2 - CSX RR / US 17	Max. Elevation	=	21.41 ft
Reservoir name	=	BAGSHAW_SWAMP/BJWSA CANAL	Max. Storage	=	7,823,879 cuft

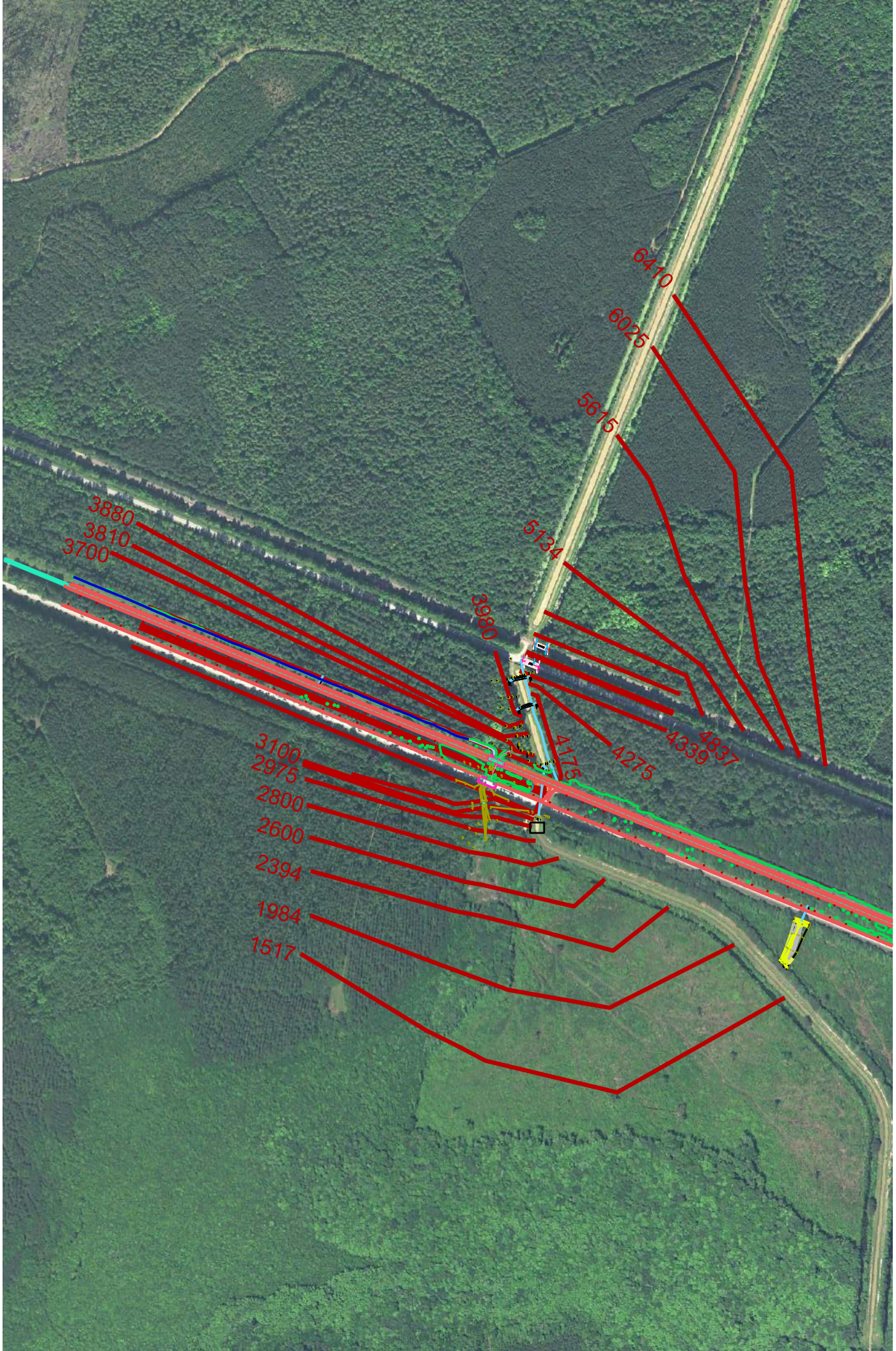
Storage Indication method used.

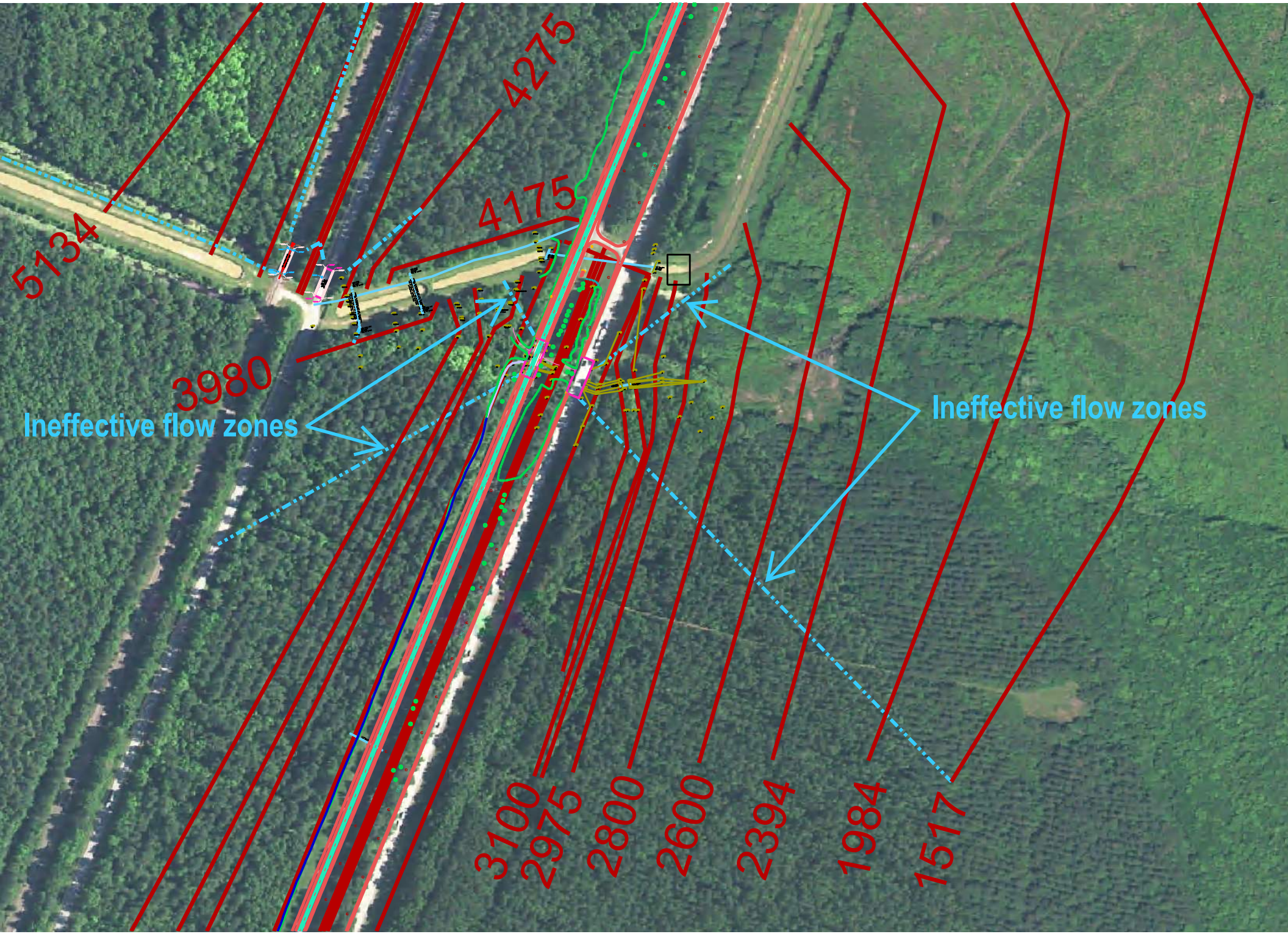


APPENDIX C

HEC-RAS GEOMETRY LAYOUT


6410
6025
5615
5134
3980
4837
4339
4275
4175
3880
3810
3700
3100
2975
2800
2600
2394
1984
1517


6410
6025
5615
5134
3980
4837
4339
4275
4175
3880
3810
3700
3100
2975
2800
2600
2394
1984
1517


4275
4175
5134
3980
Ineffective flow zones
Ineffective flow zones
3100
2975
2800
2600
2394
1984
1517

APPENDIX D

HYDROLOGY DATA SHEET

Date: **11/18/2020**

Hydrology Data for Bridge over **Bagshaw Swamp**

County: **Jasper** Rd./Rte.: **I-95 SB**

Structure No.: **2710009530800**

Bridge Length: 130 ft. Bridge Roadway Width: 66.5 ft.

Begin Station: 515+95 End Station: 517+25

Skew Angle: 0 ° Bridge Span Configuration: 30'-30'-40'-30'

Bridge Span Type(s): Concrete Flat Slab

Minimum F.G. Elevation: 27.9 ft. Min. Low Chord Elevation: 25.8 ft.

End Fill Slope: 2:1 Riprap Req'd? √ Yes to Elev: 20.0 ft.

___ No

Comments:

Historical High Water Elevation: _____ Location: _____

50-Year High Water Elevation = **17.2**

100-Year High Water Elevation = **17.5**

HYDROLOGY DATA:

D.A. = **18.6** sq. mi. = **11,900** ac.

Q 50 = **330** cfs

Vel. 50 = **1.4** ft./sec.

50 Year Headwater Elevation= **17.2** ft.

including **0.63** ft. backwater

Q 100 = **350** cfs

Vel. 100 = **1.3** ft./sec.

100 Year Headwater Elevation = **17.4** ft.

including **0.52** ft. backwater

Overtopping Flood: Q = **---** cfs

Probability = **< 0.2 %**

APPENDIX E

HYDRAULIC DESIGN & RISK ASSESSMENT DATA FORMS

1.6.1 Title Sheet

HYDRAULIC DESIGN AND RISK ASSESSMENT FOR

BRIDGE / BRIDGE REPLACEMENT OVER
BAGSHAW SWAMP

ROUTE / ROAD NUMBER:	I-95 SOUTHBOUND
FILE NO.:	P032060
PROJECT NO.:	
PIN:	
COUNTY NAME:	JASPER
DATE:	9 / 18 / 2018

PREPARED BY:	MWH
CHECKED BY:	LMW

Hydraulic Design Reference for this study is the :
May 26th
2009

Edition of SCDOT's "Requirements for Hydraulic Design Studies."

(Place stamp and signature in this space)

Signed and Sealed

1.6.2 Comparative Data Sheet

COMPARATIVE DATA

PROJECT DESCRIPTION

County:	JASPER	Rt. / Rd. No.:	I-95 SOUTHBOUND
Stream:	BAGSHAW SWAMP	File No:	
Project No:	P032060	PIN:	
Charge Code:		Road Squad:	
Project Engineer:			

By:	MWH	Date:	9 / 18 / 2018
Checked By:	LMW	Date:	

	ROUTE/ROAD NO.'s				
DISTANCE FROM NEW BR. (mi.)					
DRAINAGE AREA (sq. mi.)					
ZONE					
Q_{10} (cfs)					
Q_{25} (cfs)					
Q_{50} (cfs)					
Q_{100} (cfs)					
Q_{500} (cfs)					
BRIDGE LENGTH (ft.)					
AVG. FINISHED GRADE (ft.)					
OPENING FURNISHED (sq.ft.)					
VELOCITY (ft./sec)					
HIGHWATER ELEV. (ft.)					
HIGHWATER DATE					
HIGHWATER DEPTH (ft.)					
OBSERVED WATER ELEV. (ft.)					
OBSERVED WATER DATE					
OBSERVED WATER DEPTH (ft.)					
FILE/DOCKET/PROJECT NO.					
DATUM/DATUM TIE					

1.6.3 Site Inspection Form

SITE INSPECTION FORM

PROJECT DESCRIPTION

County: JASPER
Rt. / Rd. No.: I-95 SOUTHBOUND
Stream: BAGSHAW SWAMP
File No: P032060
Project No: P032060
PIN:
By: Infrastructure Consulting & Engineering
Date: / /

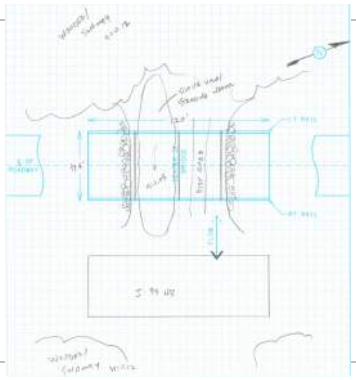
Note: All references to left and right are looking in the direction of flow.

EXISTING BRIDGE

Length: 120 ft. Width: 39.4 ft. Max. Span Length: 30 ft.
Alignment: Tangent ☑ Curved ☐
Bridge skewed? Yes ☐ No ☑ Angle:
End Abutment Type: SPILL THROUGH
Riprap on Fills? Yes ☑ No ☐ Condition: GOOD
Superstructure Type: CONCRETE TEE BEAM
Substructure Type: CONCRETE PILES
Utilities Present? Yes ☐ No ☑ Describe:

Debris Accumulations on Bridge: Percent Blocked (Horizontal): 0 %
Percent Blocked (Vertical): 0 %
Hydraulic Problems? Yes ☐ No ☑ Describe:

Draw Sketch of Bridge and Stream Below: (Show north arrow and direction of flow)



1.6.3.1 Site Characteristics Form

SITE CHARACTERISTICS FORM

General Topography _____

Stream Type (circle one)

Straight Braided Anabranched (Meandering)

Are channel banks stable? Yes ☑ No ☐

If No, describe: _____

Soil Type SANDY

Exposed Rock? Yes ☐ No ☑

If Yes, give description and location: _____

Describe potential for debris: LOW DUE TO LOW VELOCITIES

Give description and location of any structures or other property that could be damaged by backwater: NONE

Describe any other features that might affect or be affected by the hydraulic performance of the proposed bridge: RAW WATER CANAL UPSTREAM SIGNIFICANTLY REDUCES DISCHARGES THROUGH BRIDGE. WATER FLOWS UNDER CANAL THROUGH TWO 36" INVERTED SIPHONS.

1.6.3.2 Manning's "n" Values – for Channels

MANNING'S "n" VALUES – FOR CHANNELS

$n = [(n_b+n_1+ n_2 +n_3+n_4)\ m]$

Channel	n_b -- *Base n for soil*
Earth	.020
Rock Cut	.025
Fine Gravel	.024
Course Gravel	.028

Channel	n_1 -- *Degree of Irregularity*
Smooth	.000
Minor	.001-.005
Moderate	.006-.010
Severe	.011-.020

	n_2 -- *Variations of Channel Cross Sections*
Gradual	.000
Alternating Occasionally	.001-.005
Frequently	.010-.015

	n_3 -- *Relative Effect of Obstructions*
Negligible	.000-.004
Minor	.010-.015
Appreciable	.020-.030
Severe	.040-.060

	n_4 -- *Vegetation*
Low	.002-.010
Medium	.010-.025
High	.025-.050
Very High	.050-.100

	m -- *Degree of Meandering*
Minor	1.00
Appreciable	1.15
Severe	1.30

SITE OBSERVATIONS FOR CHANNELS

Channel Depth	n_b	n_1	n_2	n_3	n_4	m	*Computed n*
	0.02	0.01	0.01	0.01	0.01	1.0	0.06

1.6.4 Risk Assessment

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION FLOODPLAIN AND RISK ASSESSMENT

Regulation 23 CFR 650 shall apply to all encroachment and to all actions which affect base floodplains, except for repairs made with emergency funds. (See HEC-17) Note: These studies shall be summarized in the environmental review document prepared pursuant to 23 CFR 771.

Project Description: REPLACE AGING AND SUBSTANDARD BRIDGE OVER BAGSHAW SWAMP.

A. Narrative Describing Purpose and Need for Project:

a. Relevant Project History:

b. Project Location (attach Location and Project Map):
I-95 SOUTHBOUND, 8 MILES SOUTHWEST OF TOWN OF RIDGELAND.

c. Major Issues and Concerns: NONE.

B. Are there any floodplain(s) regulated by FEMA located in the project area?

Yes ☐ **No** ☑

C. Will fill be placed within a 100-year floodplain?

Yes ☐ **No** ☑

Page 1 of 5

D. Will the existing profile grade be raised within the floodplain?

Yes ☑ **No** ☐

E. If applicable, please discuss the practicability of alternatives to any longitudinal encroachments.

F. Please include a discussion of the following: commensurate with the significance of the risk or environmental impact for all alternatives containing encroachments and those actions which would support base floodplain development:

i. What are the flood-related risks associated with implementation of the action?

BRIDGE REPLACEMENT WILL BE SIMILAR IN SIZE (LENGTH AND SPAN ARRANGEMENT) COMPARED TO EXISTING BRIDGE. SIMILAR PERFORMANCE AND HYDRAULIC CHARACTERISTICS ANTICIPATED.

ii. What are the impacts on the natural and beneficial floodplain values?

MINOR IMPACTS ON THE NATURAL FLOODPLAIN.

iii. Will the bridge entice people to build in floodplains?

NO.

iv. What measures were used to minimize floodplain impacts associated with the action?

NONE.

v. Were any measures used to restore and preserve the natural and beneficial floodplain values impacted by the action?

NO.

G. Please discuss the practicability of alternatives to any significant encroachments or to support of incompatible floodplain development.

N/A

H. List local, state, and federal water resources and floodplain management agencies consulted to determine if the proposed highway action is consistent with existing watershed and floodplain management programs. Describe any information obtained on development and proposed actions in the affected area. Please include agency documentation.

N/A

I. BACKWATER DAMAGE FORM

Major flood damage applies to shopping centers, hospitals, industrial facilities, residential areas, schools, farming operations, etc.

1. *Does the maximum flood cause major damage to upstream property?*

Yes - (Go to 2.) No - (Go to 3.)

2. *Would this damage occur if the road were not there?*

Yes - (Go to 3.)

No - (Perform a limited Least Total Expected Cost (LTEC) (HEC-17) analysis to see if the bridge opening should be increased and/or grades raised to minimize the damage potential. Go to II.)

3. *Was this a bridge replacement? If so, was the bridge opening increased enough to increase the discharge passed through the bridge?*

Yes - (Go to 4.) No - (Go to II.)

4. *Does the increased flow cause major damage downstream?*

Yes - (Perform a limited LTEC analysis to determine if the bridge opening should be reduced, the floodway redefined, and flood easements purchased upstream or if flood easements should be purchased downstream. Go to II.)

No - (Go to II)

II. TRAFFIC RELATED LOSSES

1. *Is the overtopping flood greater than the 100-year flood?*

Yes - (Go to III.) No - (Go to 2.)

2. *Does the ADT exceed 50 vehicles per day?*

Yes - (Go to 3.) No - (Go to III.)

3. *Does the duration of road closure in days, multiplied by the difference in length, in miles between the normal route and the detour, exceed 20?*

Yes - (Go to 4.) No - (Go to III.)

4. *Does the annual risk cost for traffic related costs exceed 10% of the estimated annual capital costs?*

Yes - (Perform a limited LTEC analysis to compare the cost to raise the grades and if necessary increase the bridge length with the traffic related costs. Go to III.)

No - (Go to III.)

III. ROADWAY AND/OR STRUCTURE REPAIR COST

1. *Is the overtopping flood less than the 100-year flood?*

Yes - (Go to 2) No - (Go to 3)

2. *Is the overtopping flood less than 0.5 foot over the low point on the roadway and duration no more than 1.0 hour?*

Yes - (Go to 3)

No - (perform a limited LTEC analysis to determine if the grades should be raised and/or the bridge opening increased or that the repair cost for embankment erosion are less significant. Traffic cost should be included in this evaluation.)

3. *Is the proposed bridge or culvert structure subject to potential damage due to debris?*

Yes - (Go to 4) No - (Go to 5)

4. *Perform a limited LTEC analysis to determine if the structure should be modified. (Go to 5.)*

5. *The risk assessment has determined the most economical design for the crossing within the design constraint*s.

Revised 3/16/09

BRIDGE REPLACEMENT SCOPING TRIP RISK ASSESSMENT FORM

COUNTY: Jasper DATE: 11/20/2020

ROAD #: I-95 SB STREAM CROSSING: Bagshaw Swamp

Purpose & Need for the Project:

The South Carolina Department of Transportation (SCDOT) proposes to replace the I-95 southbound bridge over Bagshaw Swamp due structural deficiencies in the existing bridge structure.

I. FEMA Acknowledgement

Is this project located in a regulated FEMA Floodway? ☐ Yes ☒ No

Panel Number: 4501120125B Effective Date: 09/29/1986 (See Attached)

II. FEMA Floodmap Investigation

FEMA Flood Profile Sheet Number N/A illustrates the existing 100 year flood:

☐ Passes under the existing low chord elevation.
☐ Is in contact with the existing low chord elevation.
☐ Overtops the existing bridge finished grade elevation.

III. No Rise/CLOMR Preliminary Determination

☑ Preliminary assessment indicates this project may be constructed to meet the "No-Rise" requirements. A detailed hydraulic analysis will be performed to verify this assessment.

Justification:

☐ Preliminary assessmnet indicates this project may require a CLOMR/LOMR. Impacts will be determined by a detailed hydraulic analysis.

Justification:

BRIDGE REPLACEMENT SCOPING TRIP RISK ASSESSMENT FORM

IV. Preliminary Bridge Assessment

A. Locate Existing Plans

a. Bridge Plans ☑ Yes ☐ No File No. 27.314.4 Sheet No. _____ (See Attached)

b. Road Plans ☐ Yes ☐ No File No. _____ Sheet No. _____ (See Attached)

B. Historical Highwater Data

a. USGS Gage ☐ Yes ☑ No Gage No. _____ Results: _____

b. SCDOT/USGS Documented Highwater Elevations ☐ Yes ☑ No Results: _____

c. Existing Plans ☐ Yes ☑ No See Above

V. Field Review

A. Existing Bridge

Length: 120 ft. Width: 39.4 ft. Max. span Length: 30 ft.

Alignment: ☑ Tangent ☐ Curved

Bridge Skewed: ☐ Yes ☑ No Angle: _____

End Abutment Type: Spill Through Abutments

Riprap on End Fills: ☑ Yes ☐ No Condition: Good

Superstructure Type: Concrete tee beams
Substructure Type: Concrete piles

Utilities Present: ☐ Yes ☑ No
Describe:

Debris Accumulation on Bridge: Percent Blocked Horizontally: 0 %
Percent Blocked Vertically: 0 %

Hydraulic Problems: ☐ Yes ☐ No
Describe:

BRIDGE REPLACEMENT SCOPING TRIP RISK ASSESSMENT FORM

V. Field Review (cont.)

B. Hydraulic Features

a. Scour Present: ☑ Yes ☐ No Location: Shallow scour hole in channel

b. Distance from F.G. to Normal Water Elevation: 13.8 ft.
c. Distance from Low Steel to Normal Water Elev.: 11.0 ft.
d. Distance from F.G. to High Water Elevation: 10.6 ft.
e. Distance from Low Steel to High Water Elev.: 7.8 ft.

f. Channel Banks Stable: ☑ Yes ☐ No
Describe: Mostly undefined, swampy channel.

g. Soil Type: Sandy

h. Exposed Rock: ☐ Yes ☑ No Location:

i. Give Description and Location of any structures or other property that could be damaged due to additional backwater.

None.

C. Existing Roadway Geometry

a. Can the existing roadway be closed for an On-Alignment Bridge Replacement
☐ Yes ☑ No
Describe:

If "yes", does the existing vertical and horizontal curves meet the proposed design speed criteria?

If "No", will the proposed bridge be:
☑ Staged Constructed
☐ Replaced on New Alignment

VI. Field Review (cont.)

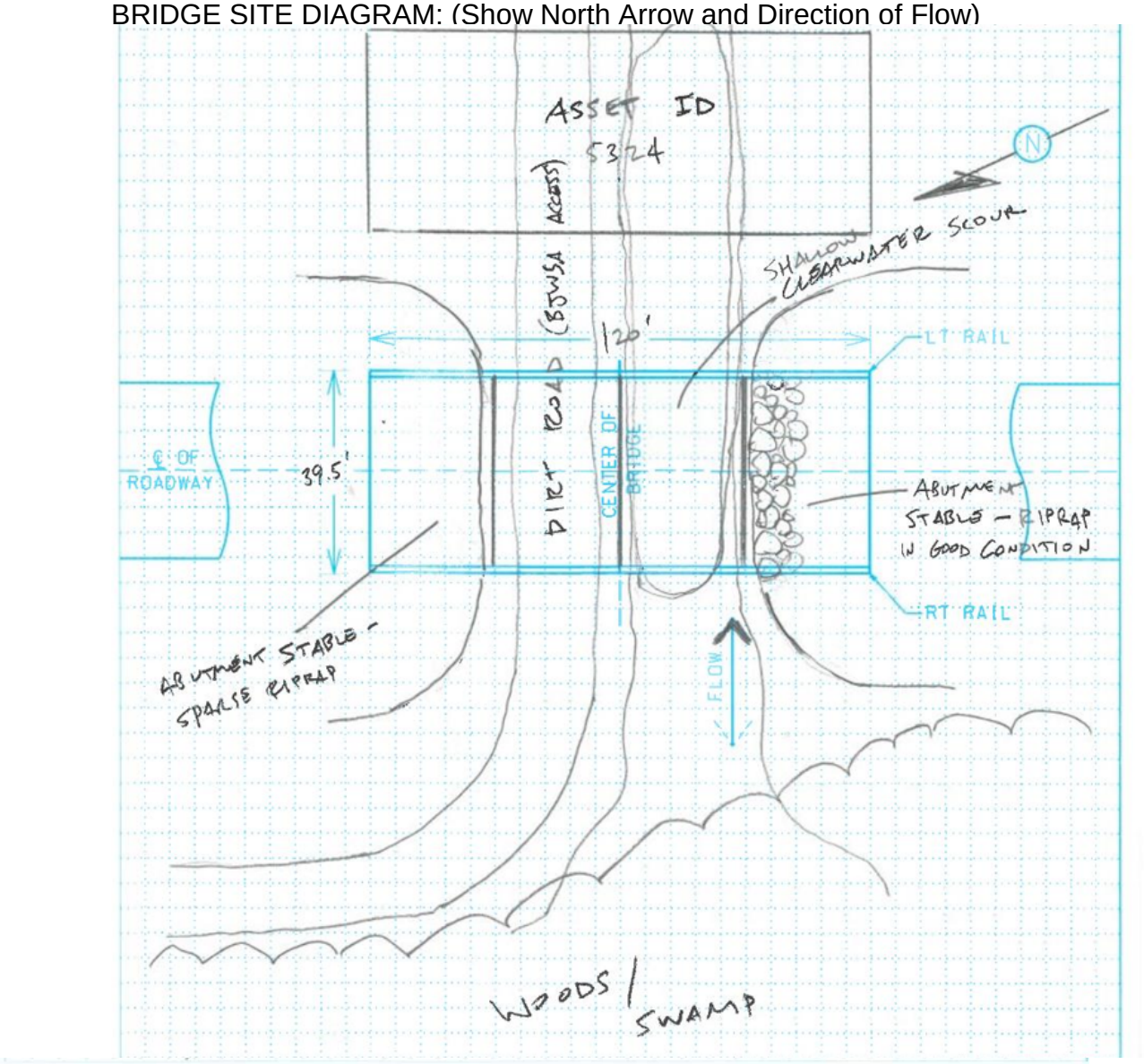
A. Proposed Bridge Recommendation:

Length: 130 ft. Width: 69.8 ft. Elevation: 27.9 ft.

Span Arangement: 30'-30'-40'-30' flat slab

Notes: _____

BRIDGE SITE DIAGRAM: (Show North Arrow and Direction of Flow)



Performed By: Mark W. Hammond

Title: Hydraulic Engineer



P

N

APPROXIMATE SCALE

2000 0 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

JASPER COUNTY, SOUTH CAROLINA
(UNINCORPORATED AREAS)

PANEL 125 OF 260
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
450112 0125 B

EFFECTIVE DATE:
SEPTEMBER 29, 1986

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDIX F

LEVEL 1 AND LEVEL 2 ANALYSIS

Project:	**I-95 SB over Bagshaw Swamp**			Prepared by:	**MWH**	Date:	**11/18/2020**
Project No.:	**P032060**	County:	**Jasper**	Checked by:	**LMW**	Date:	**11/19/2020**

LEVEL 1 – Qualitative & Geomorphic Analysis

STEP 1 – Define Stream Characteristics

1. STREAM SIZE	**SMALL (LESS THAN 100 FT.)**
2. FLOW HABIT	**PERENNIAL**
3. BED MATERIAL	**SAND**
4. VALLEY SETTING	**LOW RELIEF VALLEY**
5. FLOODPLAINS	**WIDE (>10 X CHANNEL WIDTH)**
6. NATURAL LEVEES	**LITTLE OR NONE**
7. APPARENT INCISION	**NOT INCISED**
8. CHANNEL BOUNDARIES	**ALLUVIAL**
9. TREE COVER ON BANKS	**>90% OF BANKLINE**
10. SINUOSITY	**SINUOUS/MEANDERING**
11. BRAIDED STREAMS	**NOT BRAIDED**
12. ANABRANCHED STREAMS	**LOCALLY ANABRANCHED**
13. VARIABILITY OF WIDTH AND DEVELOPMENT OF BARS	**WIDER AT BENDS**

LEVEL 2 – Evaluate Land Use Changes

The I-95 Bagshaw Swamp watershed mostly consists of wooded, rural lands. There are no anticipated significant changes in future land usage due to development, and as a result, no shifts in sediment supply to Bagshaw Swamp.

STEP 3 – Assess Overall Stream Stability

Bagshaw Swamp has undefined channels both upstream and downstream of the bridge crossing. The stream gradient in the vicinity of I-95 is flat, with a slope of 0.0009 ft/ft. Sediment size, sediment load, flow velocity and stream power are all small or low. Based on HEC-20 (Rev. April 2012) Figure 4.2 (see below), the stream can be classified as stable.

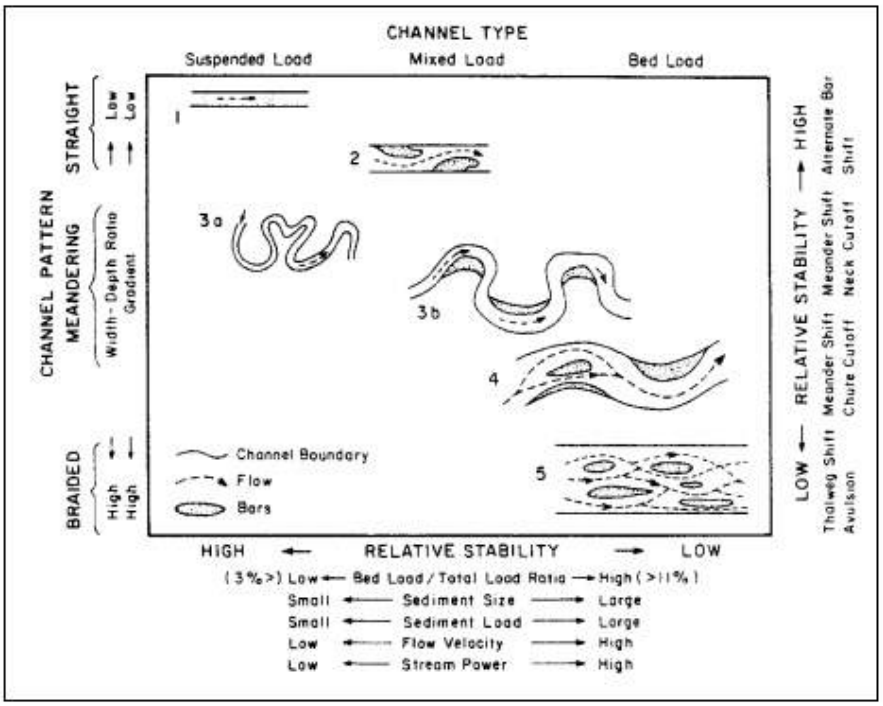


Figure 4.2. Channel classification and relative stability as hydraulic factors are varied (after FHWA 1981).

STEP 4 – Evaluate Lateral Stability

Based on a site evaluation, Bagshaw Swamp is stable laterally.

STEP 5 – Evaluate Vertical Stability

Bagshaw Swamp has experienced clearwater contraction scour in the vicinity of the bridge crossing. This is typical of swampy bridge crossings in the Coastal Plain of South Carolina. Further upstream and downstream of the bridge, there are no defined channels present. Based on observation, it appears that the scour hole beneath the bridge could continue to experience clearwater scour and further degradation.

STEP 6 – Evaluate Channel Response to Change

No significant channel changes directly related to the bridge replacement are expected.

LEVEL 2 – Basic Engineering Analysis

STEP 1 – Evaluate Flood History and Rainfall-Runoff Relations

There are no USGS gages located along Bagshaw Swamp, nor are there any available high water marks from historic floods.

STEP 2 – Evaluate Hydraulic Conditions

A HEC-RAS model of Bagshaw Swamp was constructed using available data, mapping, and surveys. The results of this model were used to verify a proposed new bridge geometry.

STEP 3 – Bed and Bank Material Analysis

In the vicinity of the bridge site, Bagshaw Swamp contains a bed and bank material consisting mostly of silty sand. Stream banks are protected by thick vegetation and trees. Sediment transport capacity in the channel is low.

STEP 4 – Evaluate Watershed Sediment Yield

There are no foreseen changes to the watershed which would modify the sediment supply into Bagshaw Swamp over the life of the proposed new bridge. The watershed is expected to remain mostly rural with forests and farmland.

STEP 5 – Incipient Motion Analysis

Bagshaw Swamp has a silty, sand-bed channel with average particle sizes that are prone to movement during flood discharges producing higher velocities. However, flow velocities (in areas upstream and downstream of the bridge crossing) are typically low in this stream under all but the most extreme flood events. In this case, incipient motion parameters are insignificant, and therefore an incipient motion analysis was not performed.

STEP 6 – Evaluate Armoring Potential

Armoring is not a factor in this stream.

STEP 7 – Evaluate Rating Curve Shifts

The rating curve is expected to remain constant over the life of the proposed new bridge.

STEP 8 – Evaluate Scour Conditions

The existing bridge crossing demonstrate the effects of clearwater contraction scour. The proposed new bridge will have a low scour potential.

APPENDIX G

GREAT SWAMP HEC-RAS ANALYSIS OUTPUT

Great Swamp/New River - Just Downstream of I-95 at Bagshaw Swamp Bridge Crossing

Region ID: SC
Workspace ID: SC20181114155830549000
Clicked Point (Latitude, Longitude): 32.37404, -81.01876
Time: 2018-11-14 10:58:44 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	82.9	square miles
PCTREG1	Percentage of drainage area located in Region 1	0	percent
PCTREG2	Percentage of drainage area located in Region 2	0	percent
PCTREG3	Percentage of drainage area located in Region 3	0	percent
PCTREG4	Percentage of drainage area located in Region 4	100	percent
PCTREG5	Percentage of drainage area located in Region 5	0	percent
LC06IMP	Percentage of impervious area determined from NLCD 2006 impervious dataset	0.45	percent
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	8.74	inches

Peak-Flow Statistics Parameters [Peak Southeast US over 1 sqmi 2009 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.9	square miles	1	9000
PCTREG1	Percent Area in Region 1	0	percent	0	100
PCTREG2	Percent Area in Region 2	0	percent	0	100
PCTREG3	Percent Area in Region 3	0	percent	0	100
PCTREG4	Percent Area in Region 4	100	percent	0	100
PCTREG5	Percent Area in Region 5	0	percent	0	100

Peak-Flow Statistics Parameters [Region 4 rural under 1 sqmi 2014 5030]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.9	square miles	0.1	1
LC06IMP	Percent Impervious NLCD2006	0.45	percent	0.2	34.8
I24H50Y	24 Hour 50 Year Precipitation	8.74	inches	6.51	10.9

Peak-Flow Statistics Flow Report [Peak Southeast US over 1 sqmi 2009 5156]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SEp
2 Year Peak Flood	1060	ft^3/s	611	1840	34.5
5 Year Peak Flood	1960	ft^3/s	1140	3380	34
10 Year Peak Flood	2650	ft^3/s	1520	4640	35.1
25 Year Peak Flood	3570	ft^3/s	1970	6470	37.5
50 Year Peak Flood	4380	ft^3/s	2340	8190	39.6
100 Year Peak Flood	5240	ft^3/s	2710	10100	41.9
200 Year Peak Flood	6030	ft^3/s	3010	12100	44.3
500 Year Peak Flood	7220	ft^3/s	3430	15200	47.7

Peak-Flow Statistics Disclaimers [Region 4 rural under 1 sqmi 2014 5030]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Region 4 rural under 1 sqmi 2014 5030]

Statistic	Value	Unit
2 Year Peak Flood	1030	ft^3/s
5 Year Peak Flood	2000	ft^3/s
10 Year Peak Flood	2840	ft^3/s
25 Year Peak Flood	4100	ft^3/s
50 Year Peak Flood	5180	ft^3/s
100 Year Peak Flood	6390	ft^3/s
200 Year Peak Flood	7760	ft^3/s
500 Year Peak Flood	9720	ft^3/s

Peak-Flow Statistics Citations

Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2009, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina: U.S. Geological Survey Scientific Investigations Report 2009-5156, 226 p. (http://pubs.usgs.gov/sir/2009/5156/)

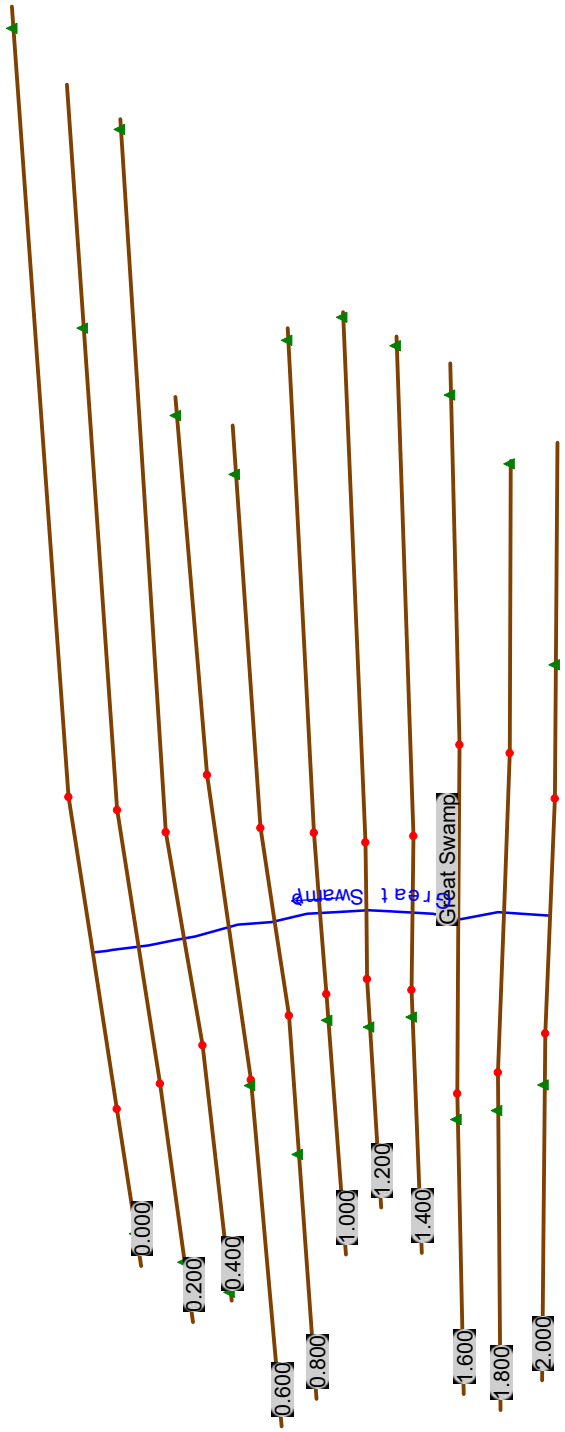
Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2014, Methods for estimating the magnitude and frequency of floods for urban and small, rural streams in Georgia, South Carolina, and North Carolina, 2011 (ver. 1.1, March 2014): U.S. Geological Survey Scientific Investigations Report 2014–5030, 104 p. (http://pubs.usgs.gov/sir/2014/5030/)

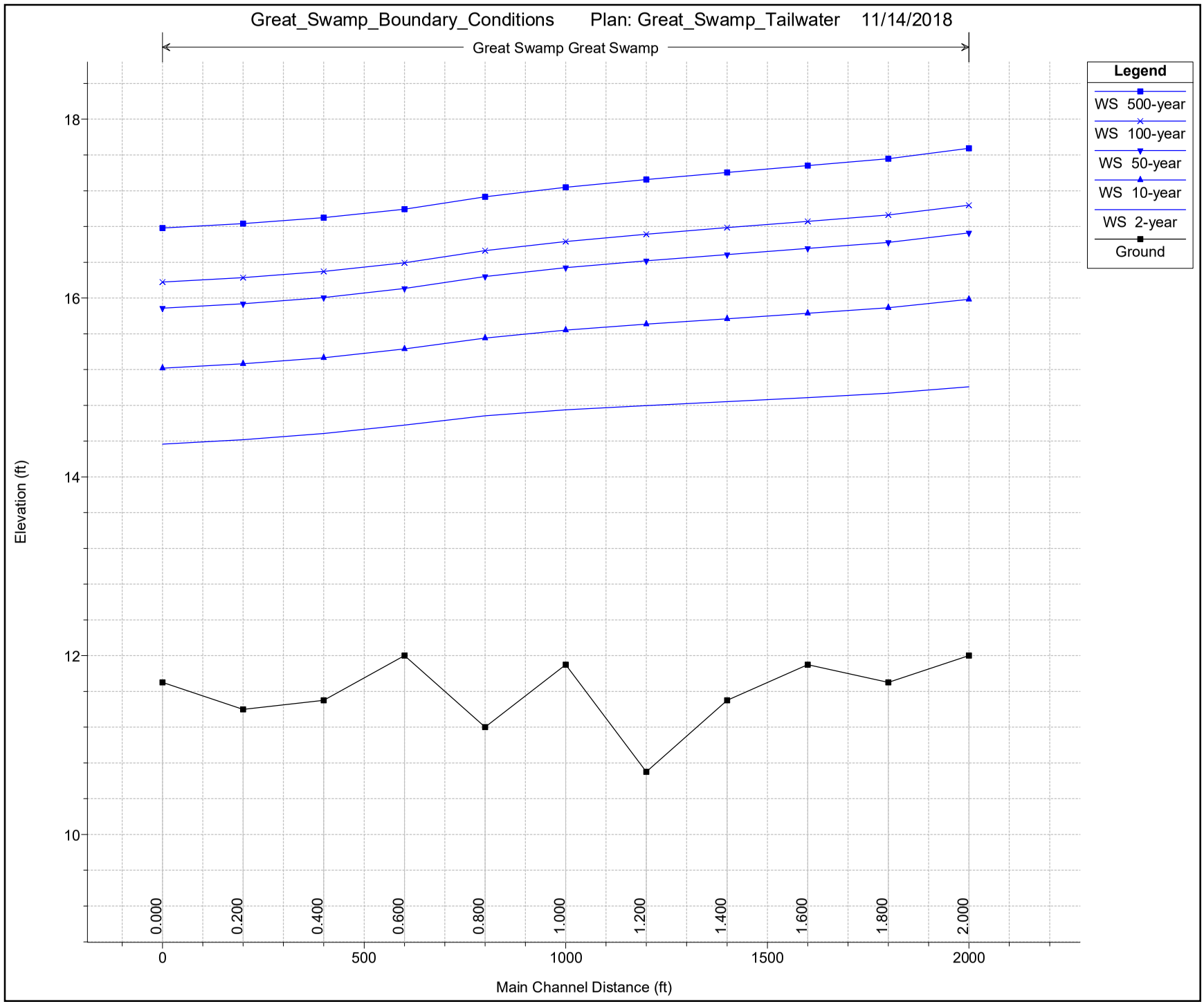
USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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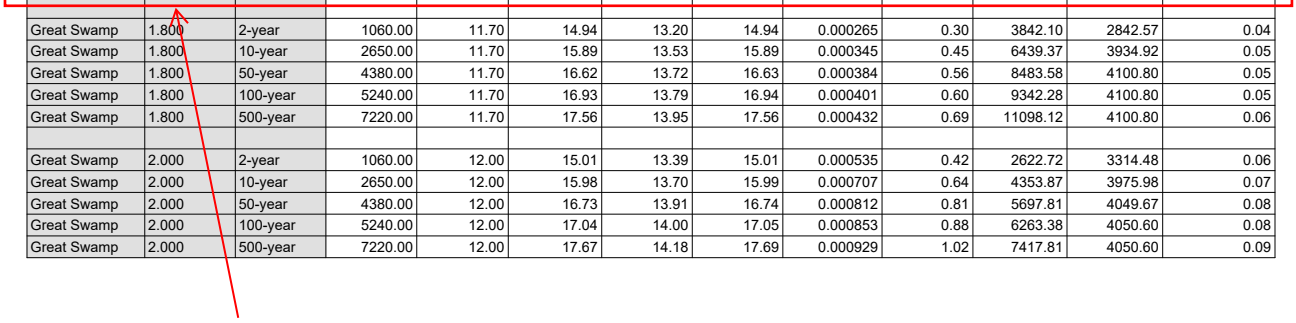
Application Version: 4.2.1


Great Swamp
Great Swamp
0.000
0.200
0.400
0.600
0.800
1.000
1.200
1.400
1.600
1.800
2.000


Great_Swamp_Boundary_Conditions Plan: Great_Swamp_Tailwater 11/14/2018
Great Swamp Great Swamp
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
WS 2-year
Ground
Elevation (ft)
18
16
14
12
10
0.000
0.200
0.400
0.600
0.800
1.000
1.200
1.400
1.600
1.800
2.000
0
500
1000
1500
2000
Main Channel Distance (ft)

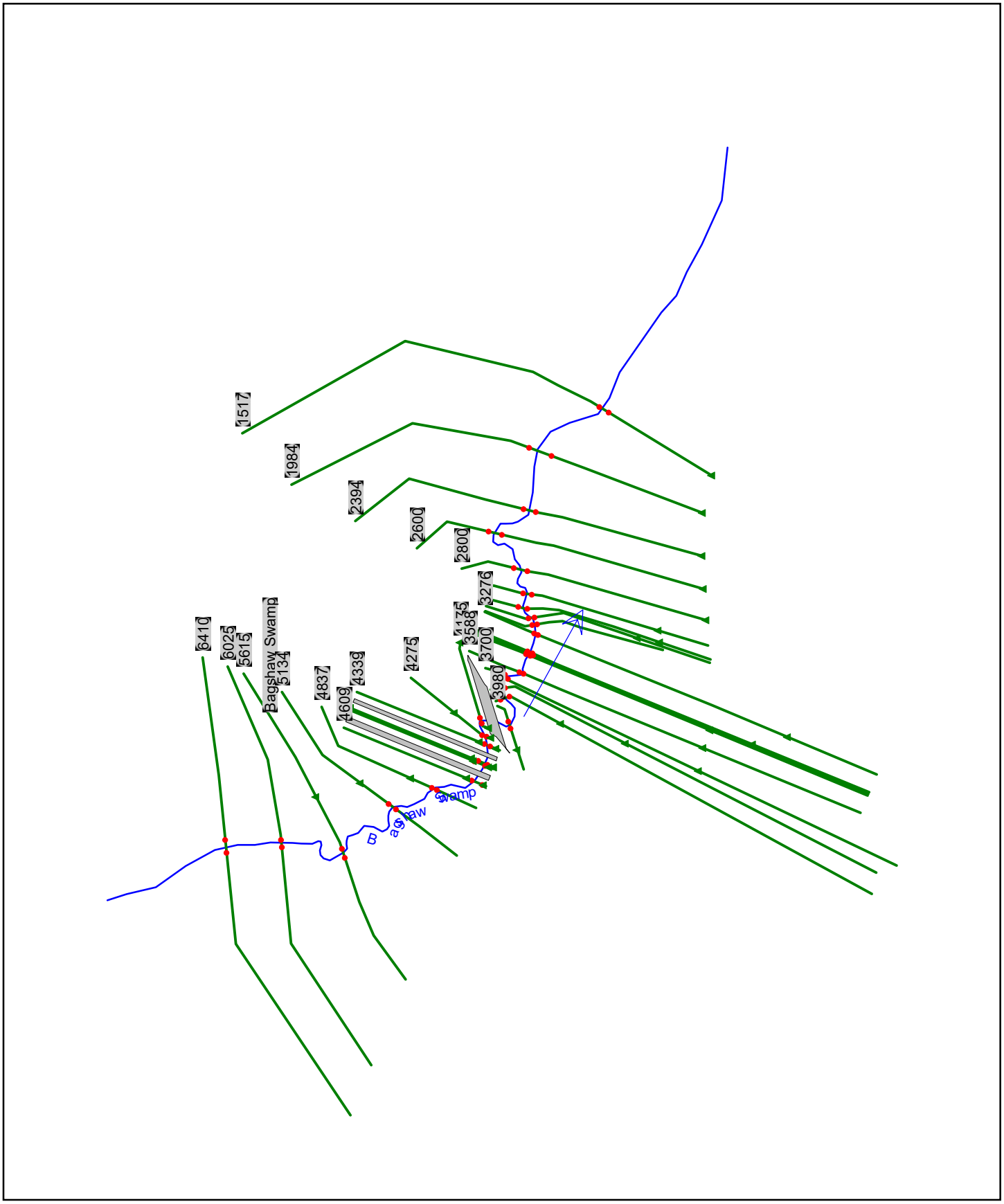
HEC-RAS Plan: Great_Swamp River: Great Swamp Reach: Great Swamp

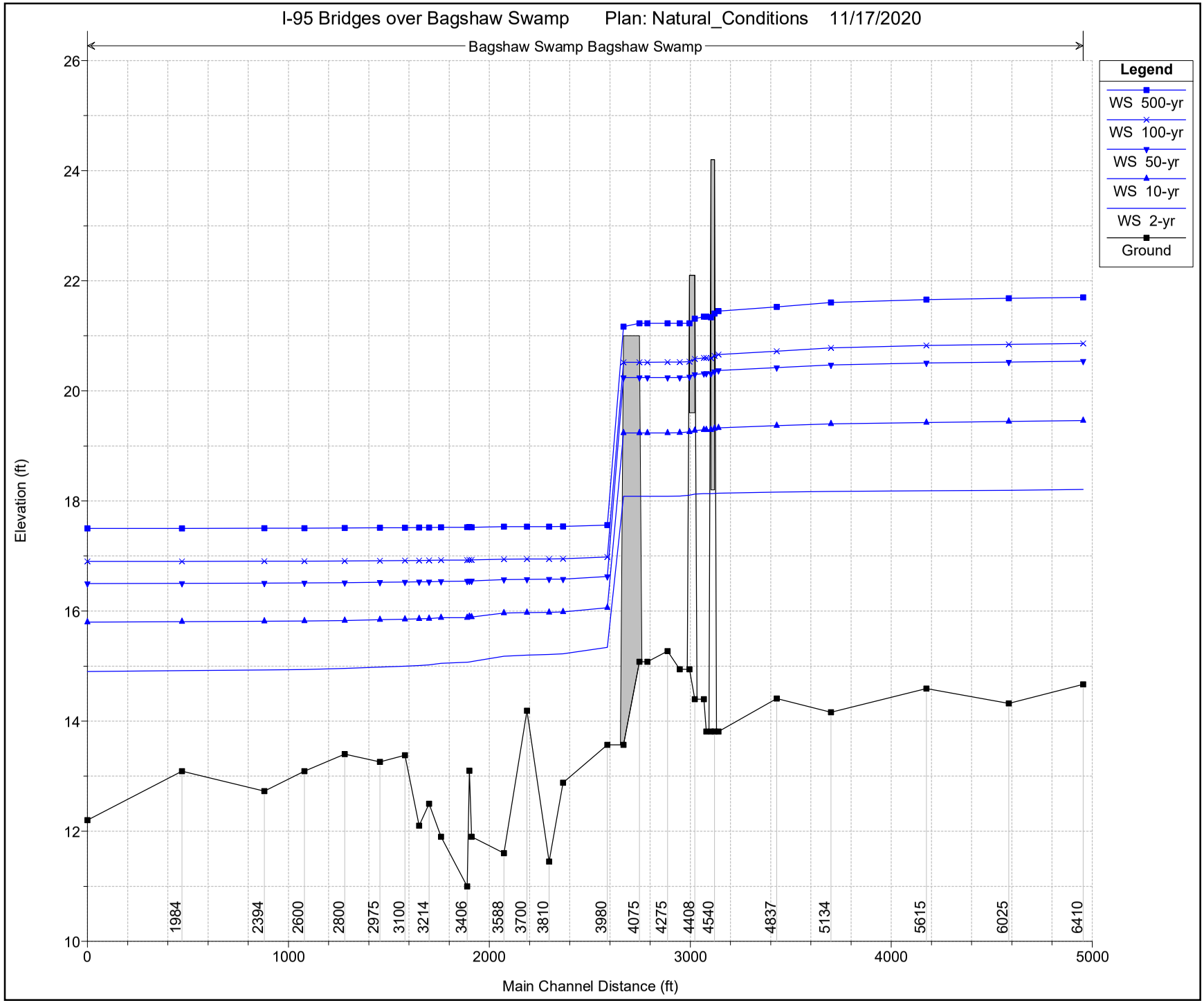
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Great Swamp	0.000	2-year	1060.00	11.70	14.37	12.97	14.37	0.000200	0.22	5475.10	4937.15	0.03
Great Swamp	0.000	10-year	2650.00	11.70	15.21	13.18	15.22	0.000200	0.31	9818.88	5422.14	0.04
Great Swamp	0.000	50-year	4380.00	11.70	15.89	13.33	15.89	0.000200	0.36	13342.26	5474.70	0.04
Great Swamp	0.000	100-year	5240.00	11.70	16.18	13.40	16.18	0.000200	0.39	14867.45	5474.70	0.04
Great Swamp	0.000	500-year	7220.00	11.70	16.78	13.52	16.79	0.000200	0.43	18037.64	5474.70	0.04
Great Swamp	0.200	2-year	1060.00	11.40	14.42	13.02	14.42	0.000325	0.29	4211.53	4178.19	0.04
Great Swamp	0.200	10-year	2650.00	11.40	15.26	13.26	15.27	0.000332	0.40	7613.83	5170.80	0.05
Great Swamp	0.200	50-year	4380.00	11.40	15.94	13.45	15.94	0.000331	0.47	10344.82	5378.00	0.05
Great Swamp	0.200	100-year	5240.00	11.40	16.23	13.53	16.23	0.000332	0.50	11526.95	5378.00	0.05
Great Swamp	0.200	500-year	7220.00	11.40	16.83	13.68	16.84	0.000332	0.56	13983.91	5378.00	0.05
Great Swamp	0.400	2-year	1060.00	11.50	14.48	13.12	14.49	0.000375	0.32	3960.23	3744.02	0.05
Great Swamp	0.400	10-year	2650.00	11.50	15.33	13.40	15.33	0.000360	0.42	7437.42	4577.96	0.05
Great Swamp	0.400	50-year	4380.00	11.50	16.01	13.58	16.01	0.000366	0.50	10706.43	5097.97	0.05
Great Swamp	0.400	100-year	5240.00	11.50	16.30	13.66	16.30	0.000349	0.52	12171.89	5131.38	0.05
Great Swamp	0.400	500-year	7220.00	11.50	16.90	13.80	16.90	0.000329	0.56	15214.61	5131.50	0.05
Great Swamp	0.600	2-year	1060.00	12.00	14.58	13.29	14.58	0.000635	0.39	2835.37	2714.08	0.06
Great Swamp	0.600	10-year	2650.00	12.00	15.43	13.54	15.44	0.000747	0.58	4832.16	3903.03	0.07
Great Swamp	0.600	50-year	4380.00	12.00	16.11	13.73	16.11	0.000809	0.72	6668.44	4345.56	0.07
Great Swamp	0.600	100-year	5240.00	12.00	16.40	13.80	16.40	0.000811	0.77	7491.47	4452.46	0.08
Great Swamp	0.600	500-year	7220.00	12.00	16.99	13.95	17.00	0.000827	0.87	9235.16	4472.70	0.08
Great Swamp	0.800	2-year	1060.00	11.20	14.68	13.23	14.68	0.000408	0.32	3474.88	2796.71	0.05
Great Swamp	0.800	10-year	2650.00	11.20	15.55	13.50	15.56	0.000487	0.48	5880.32	3806.03	0.06
Great Swamp	0.800	50-year	4380.00	11.20	16.24	13.68	16.25	0.000535	0.60	7902.91	4193.88	0.06
Great Swamp	0.800	100-year	5240.00	11.20	16.53	13.75	16.54	0.000546	0.64	8755.53	4205.32	0.06
Great Swamp	0.800	500-year	7220.00	11.20	17.13	13.90	17.14	0.000561	0.73	10530.92	4218.83	0.06
Great Swamp	1.000	2-year	1060.00	11.90	14.75	13.11	14.75	0.000280	0.31	3804.57	2943.53	0.04
Great Swamp	1.000	10-year	2650.00	11.90	15.64	13.39	15.64	0.000391	0.48	6212.29	3766.43	0.05
Great Swamp	1.000	50-year	4380.00	11.90	16.34	13.56	16.34	0.000446	0.60	8209.82	3930.91	0.06
Great Swamp	1.000	100-year	5240.00	11.90	16.63	13.65	16.64	0.000477	0.65	9070.03	4011.00	0.06
Great Swamp	1.000	500-year	7220.00	11.90	17.24	13.79	17.24	0.000501	0.74	10851.33	4011.00	0.06
Great Swamp	1.200	2-year	1060.00	10.70	14.80	13.05	14.80	0.000200	0.26	4405.20	3150.17	0.03
Great Swamp	1.200	10-year	2650.00	10.70	15.71	13.35	15.71	0.000289	0.41	7105.01	3815.92	0.04
Great Swamp	1.200	50-year	4380.00	10.70	16.42	13.53	16.42	0.000331	0.52	9275.38	3872.00	0.05
Great Swamp	1.200	100-year	5240.00	10.70	16.71	13.58	16.72	0.000347	0.56	10189.61	3872.00	0.05
Great Swamp	1.200	500-year	7220.00	10.70	17.33	13.75	17.33	0.000376	0.64	12065.43	3872.00	0.05
Great Swamp	1.400	2-year	1060.00	11.50	14.84	13.08	14.84	0.000236	0.29	4066.50	2990.31	0.04
Great Swamp	1.400	10-year	2650.00	11.50	15.77	13.38	15.77	0.000322	0.44	6709.34	3909.60	0.05
Great Swamp	1.400	50-year	4380.00	11.50	16.49	13.57	16.49	0.000365	0.54	8782.63	3956.03	0.05
Great Swamp	1.400	100-year	5240.00	11.50	16.79	13.65	16.79	0.000382	0.59	9656.14	3961.70	0.05
Great Swamp	1.400	500-year	7220.00	11.50	17.40	13.80	17.41	0.000413	0.68	11446.74	3961.70	0.06
Great Swamp	1.600	2-year	1060.00	11.90	14.89	13.12	14.89	0.000227	0.27	4292.21	3468.06	0.04
Great Swamp	1.600	10-year	2650.00	11.90	15.83	13.40	15.83	0.000284	0.40	7181.44	4428.40	0.04
Great Swamp	1.600	50-year	4380.00	11.90	16.55	13.60	16.56	0.000316	0.50	9449.82	4454.60	0.05
Great Swamp	1.600	100-year	5240.00	11.90	16.86	13.68	16.86	0.000329	0.54	10402.61	4454.60	0.05
Great Swamp	1.600	500-year	7220.00	11.90	17.48	13.83	17.49	0.000354	0.62	12352.67	4454.60	0.05
Great Swamp	1.800	2-year	1060.00	11.70	14.94	13.20	14.94	0.000265	0.30	3842.10	2842.57	0.04
Great Swamp	1.800	10-year	2650.00	11.70	15.89	13.53	15.89	0.000345	0.45	6439.37	3934.92	0.05
Great Swamp	1.800	50-year	4380.00	11.70	16.62	13.72	16.63	0.000384	0.56	8483.58	4100.80	0.05
Great Swamp	1.800	100-year	5240.00	11.70	16.93	13.79	16.94	0.000401	0.60	9342.28	4100.80	0.05
Great Swamp	1.800	500-year	7220.00	11.70	17.56	13.95	17.56	0.000432	0.69	11098.12	4100.80	0.06
Great Swamp	2.000	2-year	1060.00	12.00	15.01	13.39	15.01	0.000535	0.42	2622.72	3314.48	0.06
Great Swamp	2.000	10-year	2650.00	12.00	15.98	13.70	15.99	0.000707	0.64	4353.87	3975.98	0.07
Great Swamp	2.000	50-year	4380.00	12.00	16.73	13.91	16.74	0.000812	0.81	5697.81	4049.67	0.08
Great Swamp	2.000	100-year	5240.00	12.00	17.04	14.00	17.05	0.000853	0.88	6263.38	4050.60	0.08
Great Swamp	2.000	500-year	7220.00	12.00	17.67	14.18	17.69	0.000929	1.02	7417.81	4050.60	0.09

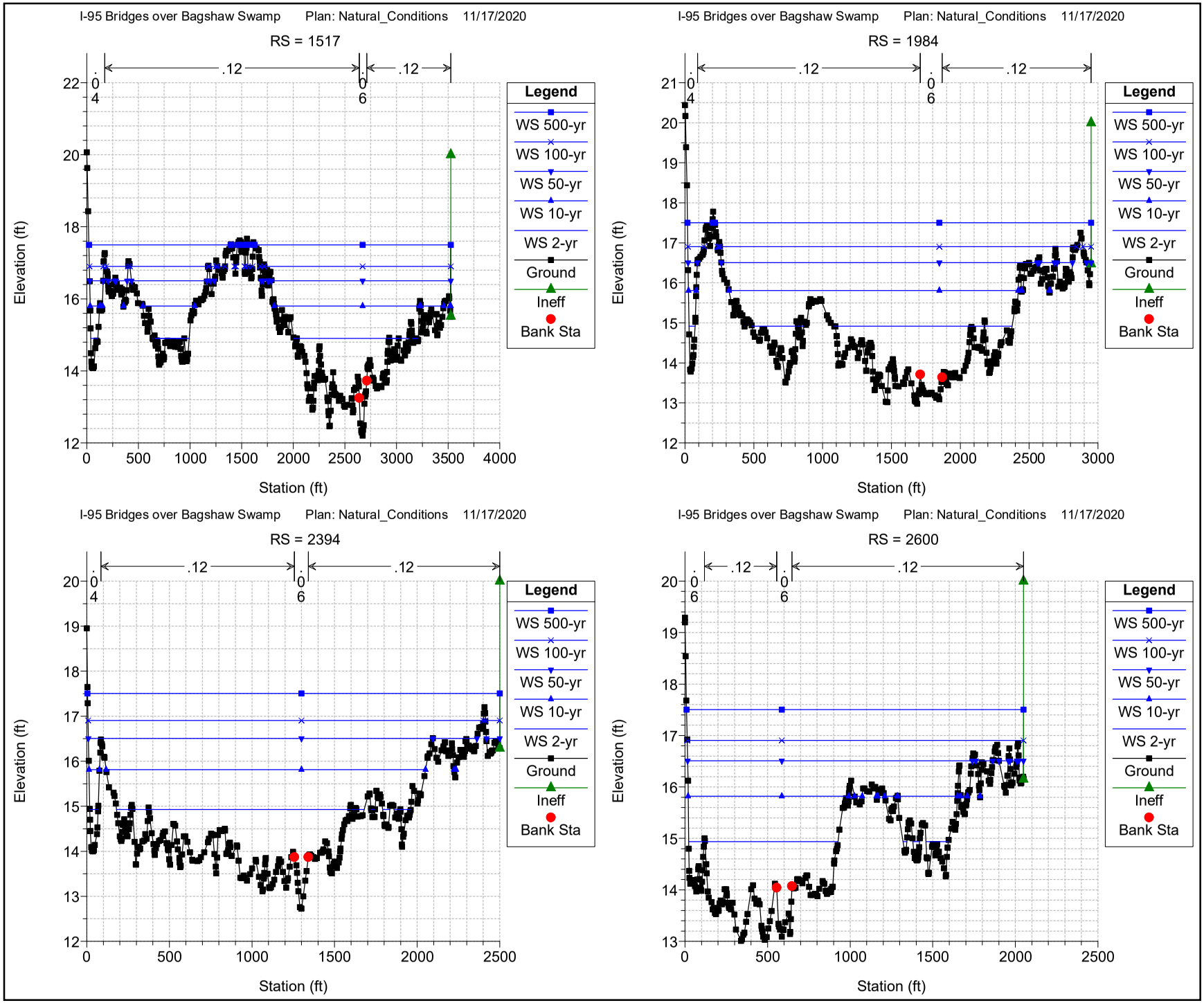


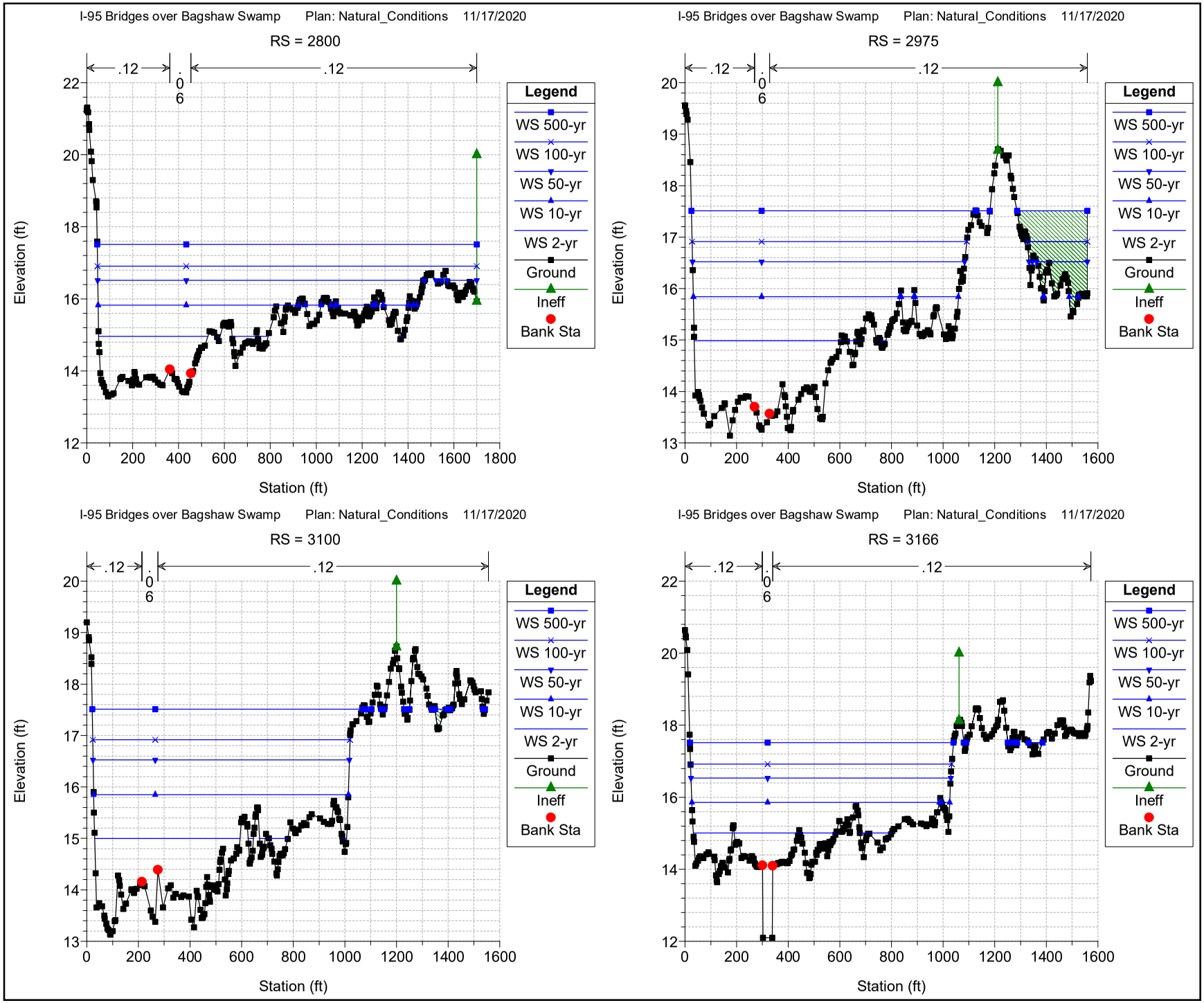
APPENDIX H

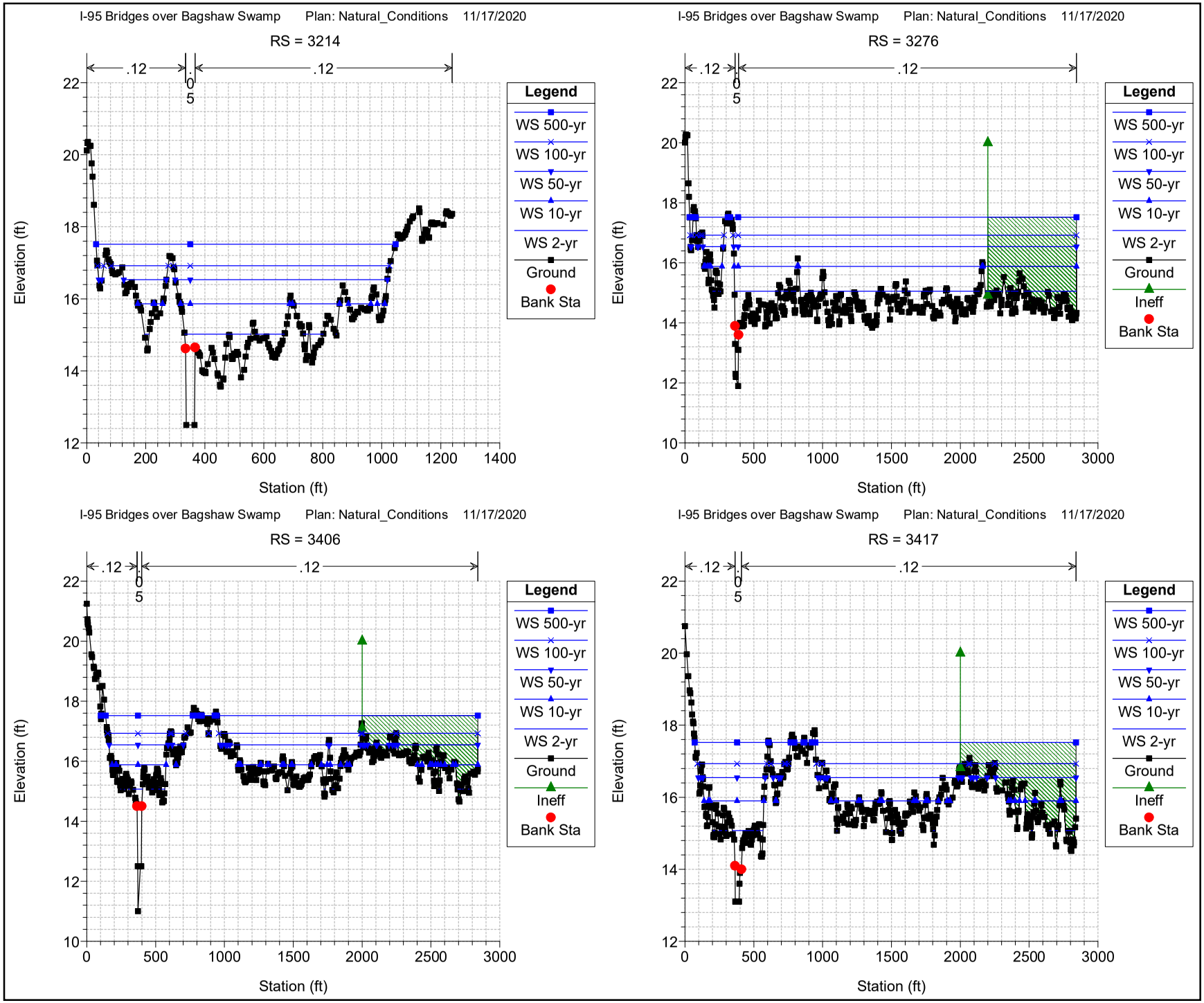
HEC-RAS NATURAL CONDITIONS RESULTS

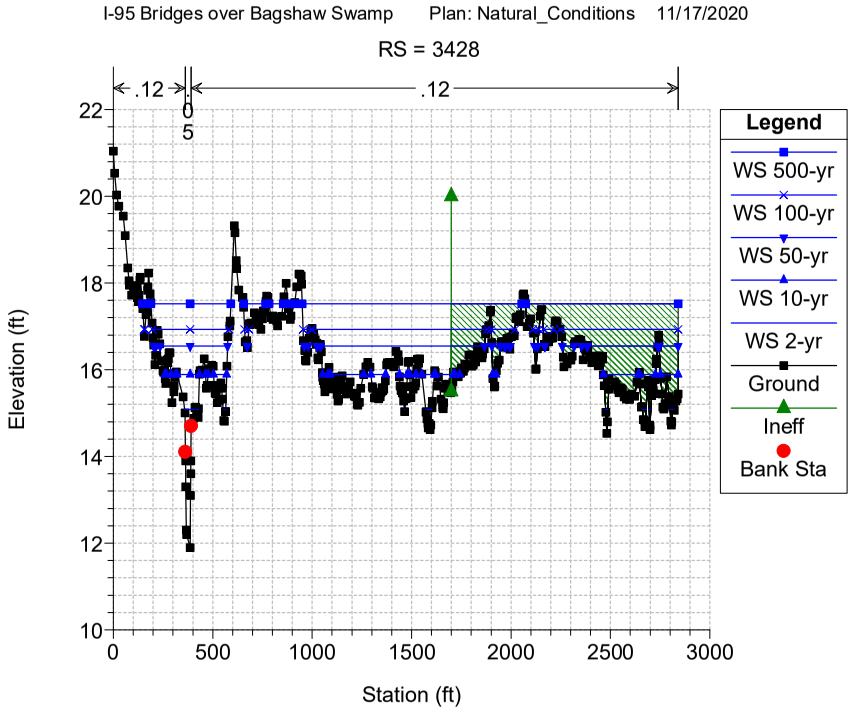

1517
1984
2394
2600
2800
3276
3588
3700
3980
4275
4339
4609
4837
5134
5615
6025
6410
Bagshaw Swamp
Bagshaw Swamp

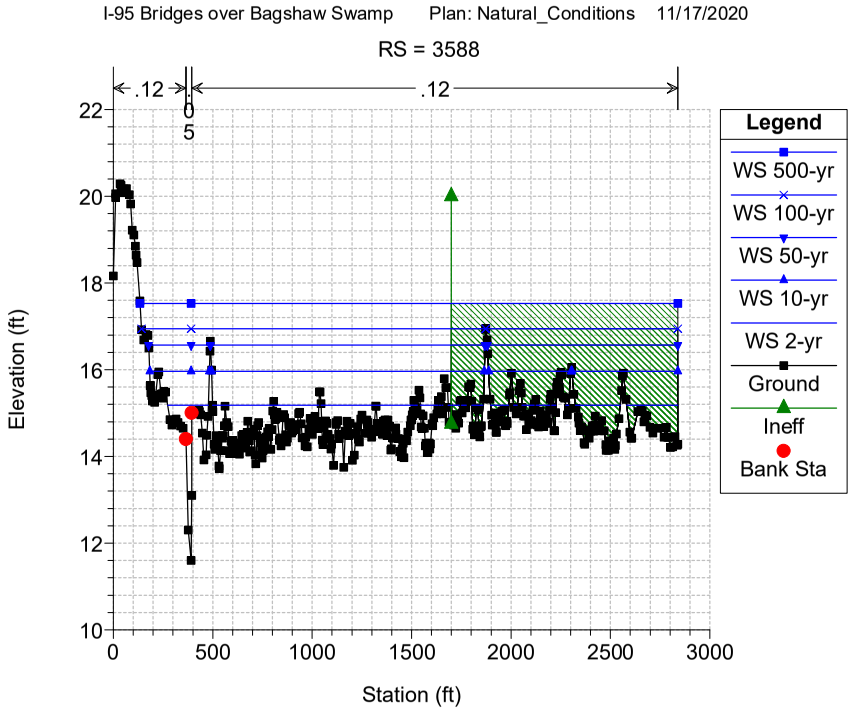

I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
Bagshaw Swamp Bagshaw Swamp
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Elevation (ft)
Main Channel Distance (ft)
26
24
22
20
18
16
14
12
10
0
1000
2000
3000
4000
5000
1984
2394
2600
2800
2975
3100
3214
3406
3588
3700
3810
3980
4075
4275
4408
4540
4837
5134
5615
6025
6410

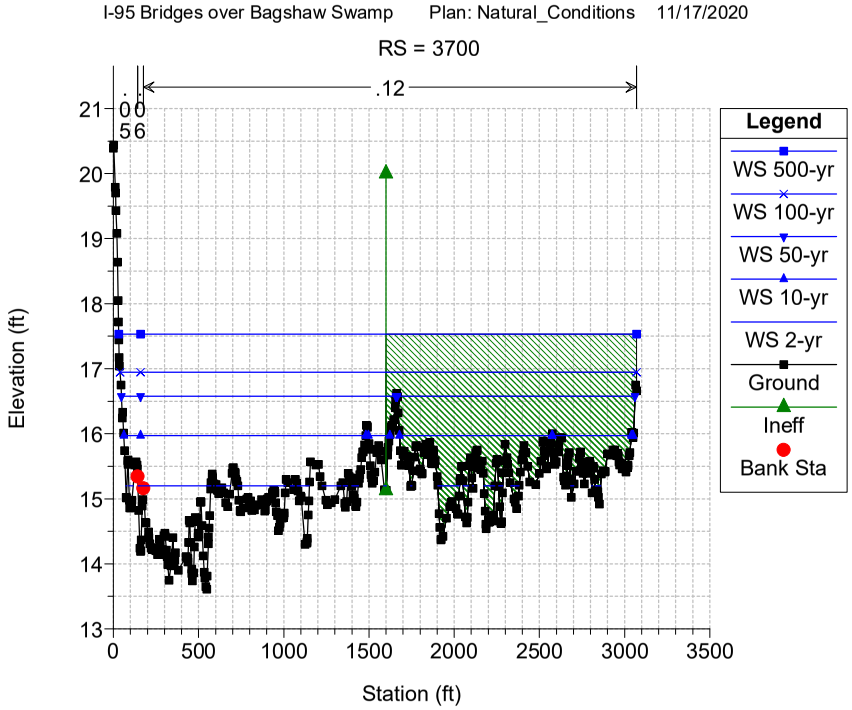

I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 1517
.04
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 1984
.04
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 2394
.04
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 2600
.06
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

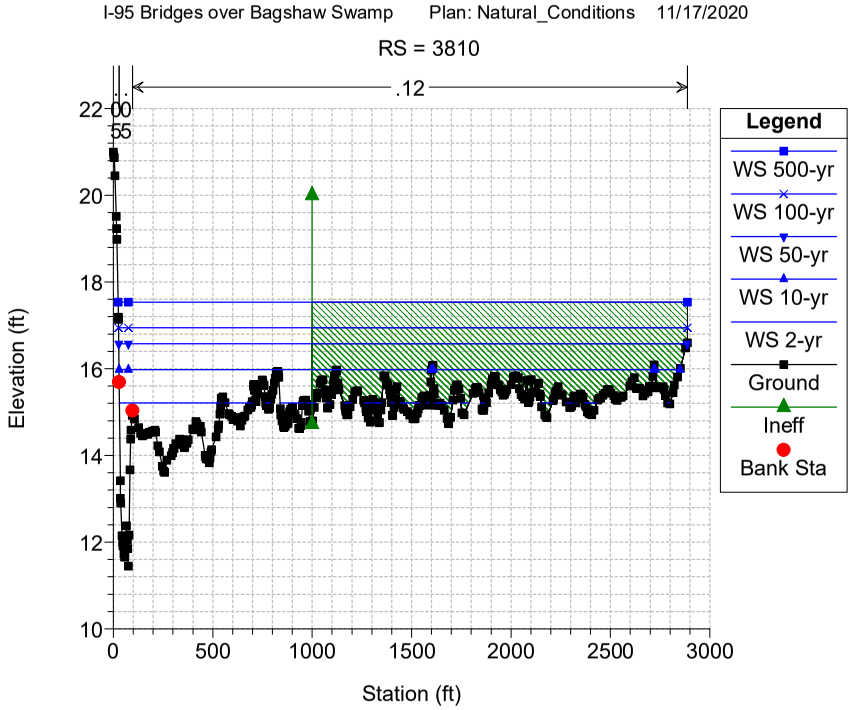

I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 2800
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 2975
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3100
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3166
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta

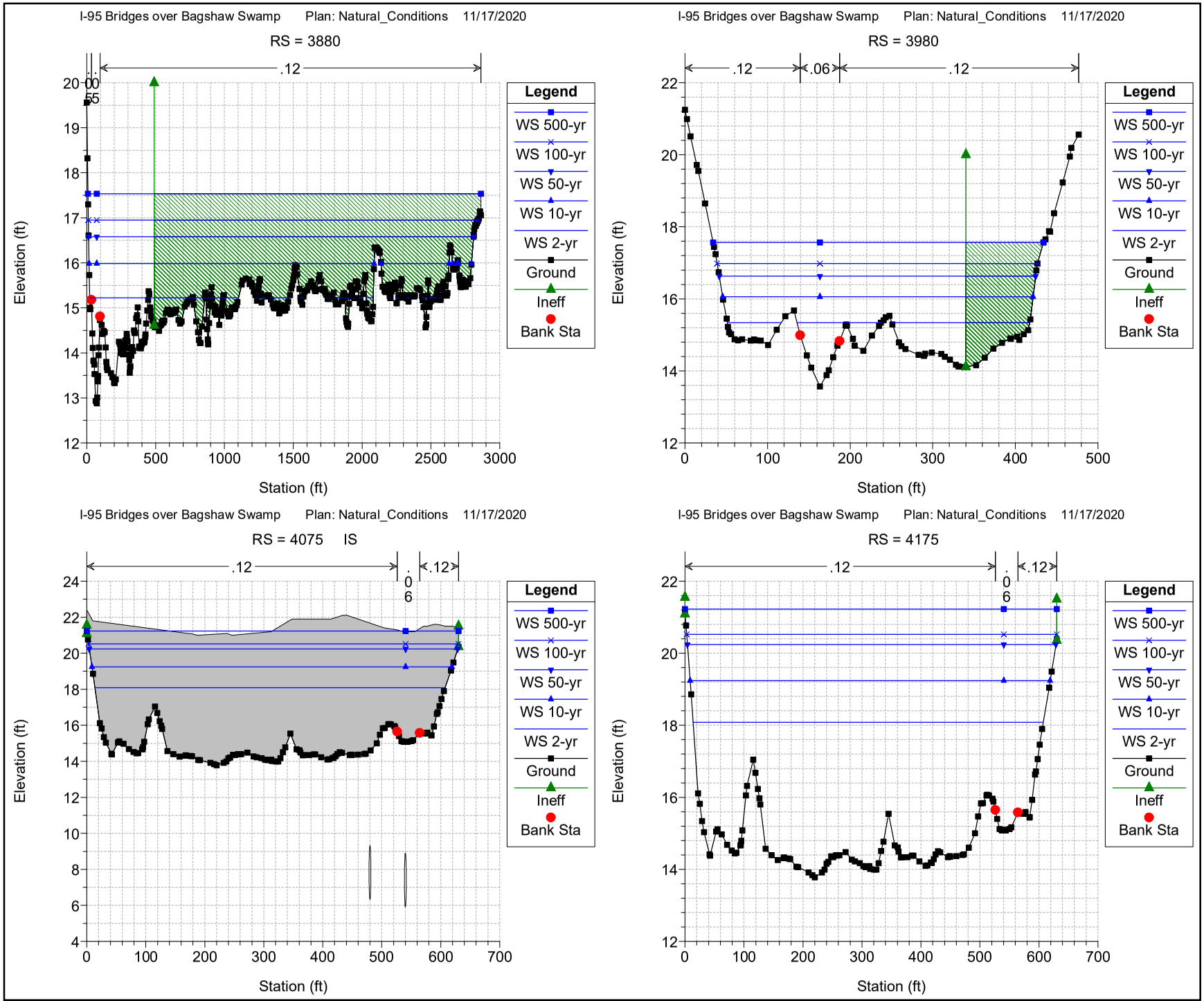

I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3214
.12
.12
0
5
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3276
.12
.12
0
5
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3406
.12
.12
0
5
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3417
.12
.12
0
5
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta

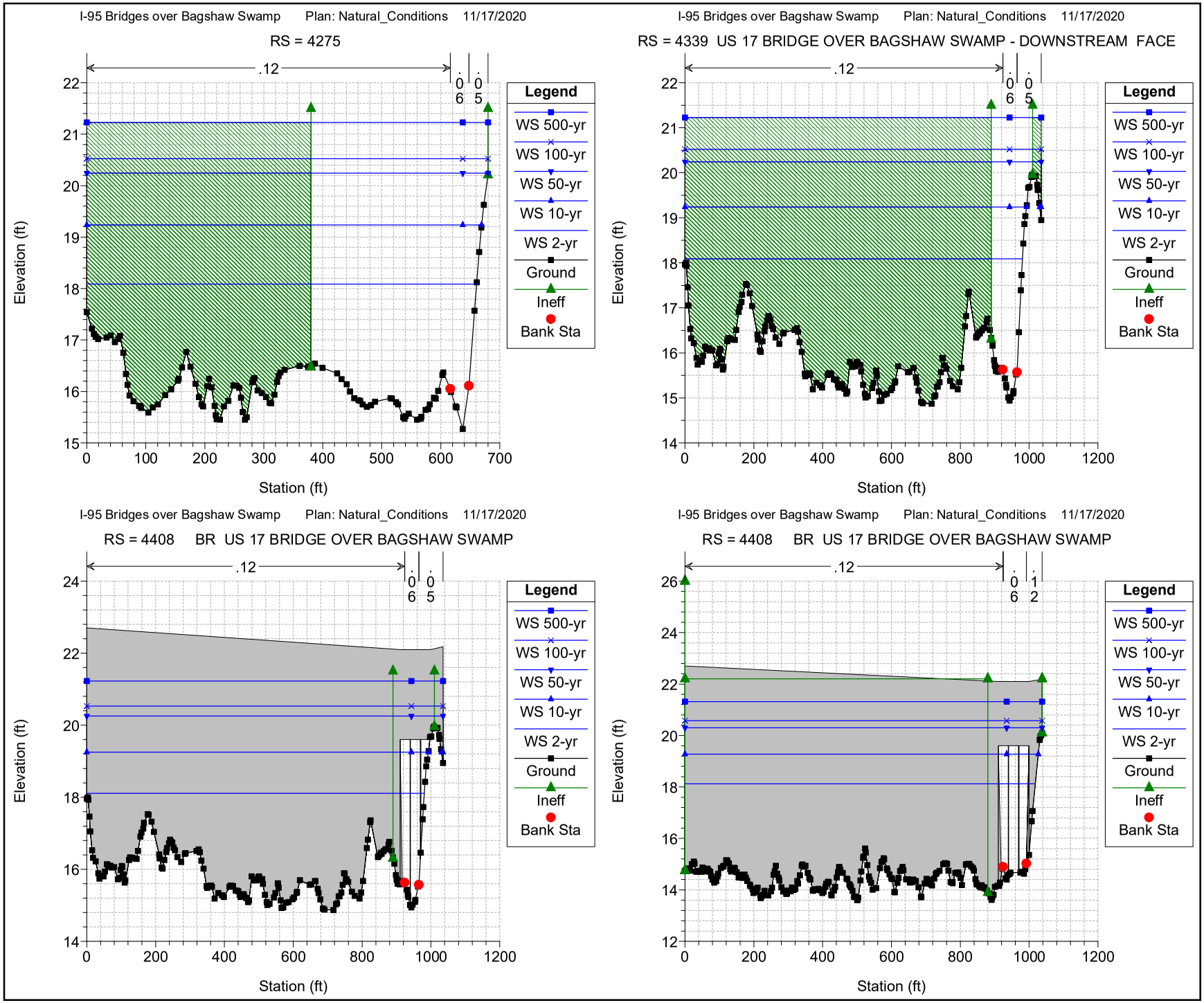

I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3428
.12
.12
0
5
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
22
20
18
16
14
12
10
0
500
1000
1500
2000
2500
3000


I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3588
.12
.12
0
5
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
22
20
18
16
14
12
10
0
500
1000
1500
2000
2500
3000


I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3700
.12
0
6
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
21
20
19
18
17
16
15
14
13
0
500
1000
1500
2000
2500
3000
3500

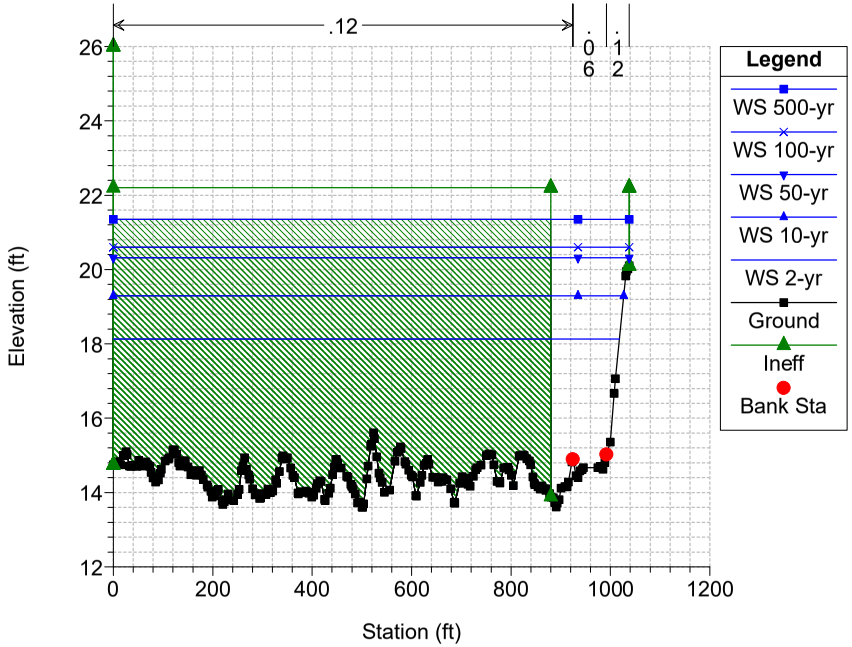

I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3810
.12
0
5
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
22
20
18
16
14
12
10
0
500
1000
1500
2000
2500
3000


I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3880
.12
.00
.55
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 3980
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 4075 IS
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 4175
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta


I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 4275
.12
.06
.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 4339 US 17 BRIDGE OVER BAGSHAW SWAMP - DOWNSTREAM FACE
.12
.06
.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 4408 BR US 17 BRIDGE OVER BAGSHAW SWAMP
.12
.06
.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 4408 BR US 17 BRIDGE OVER BAGSHAW SWAMP
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

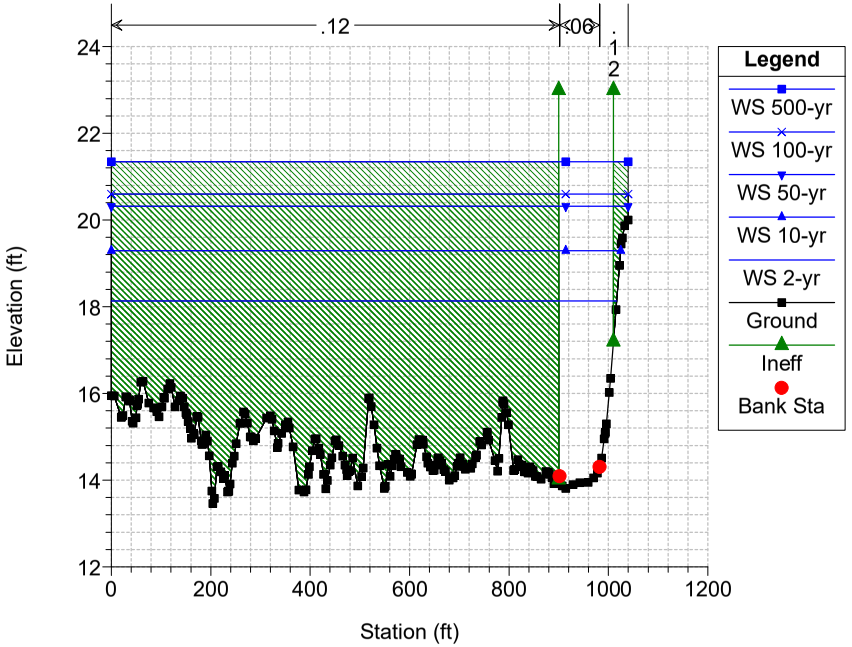
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

RS = 4468 US 17 BRIDGE OVER BAGSHAW SWAMP - UPSTREAM FACE



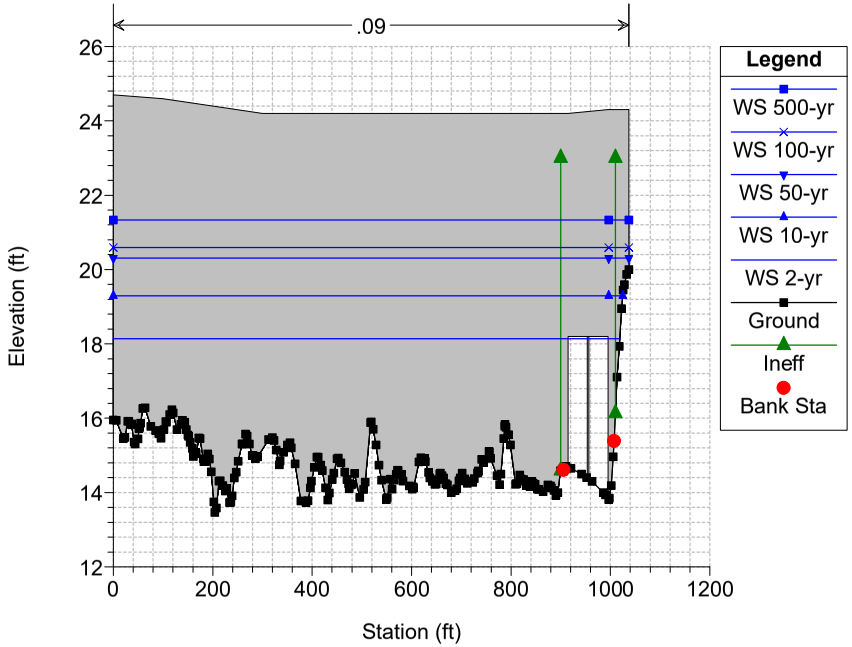
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

RS = 4481 CSX RR BRIDGE OVER BAGSHAW SWAMP- DOWNSTREAM FACE



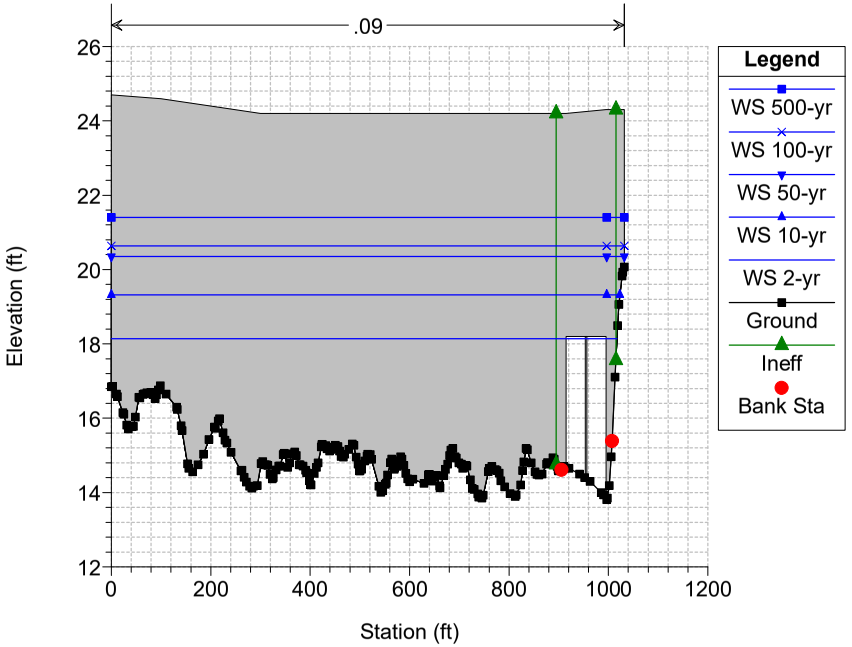
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

RS = 4540 BR CSX RR BRIDGE OVER BAGSHAW SWAMP



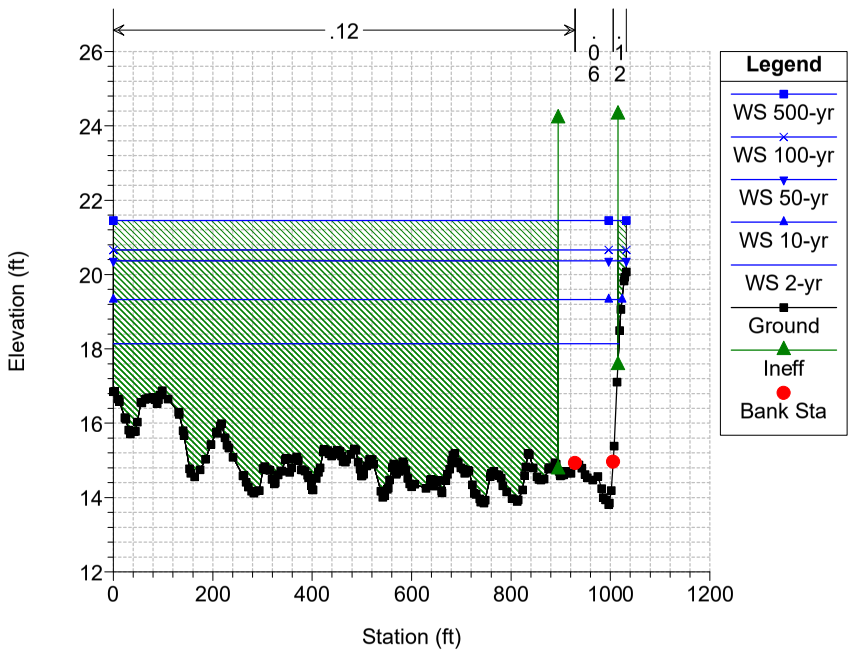
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

RS = 4540 BR CSX RR BRIDGE OVER BAGSHAW SWAMP



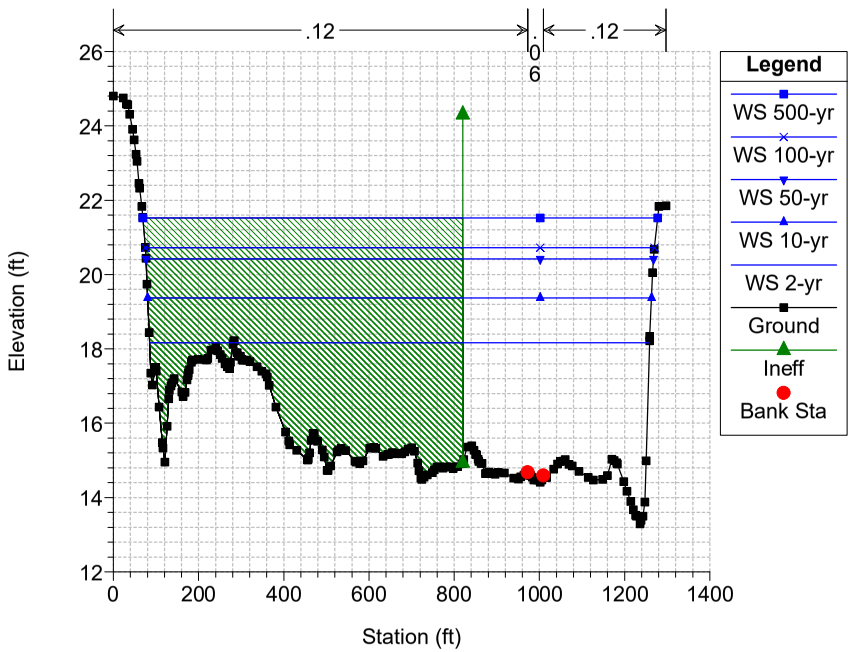
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

RS = 4609 CSX RR BRIDGE OVER BAGSHAW SWAMP - UPSTREAM FACE



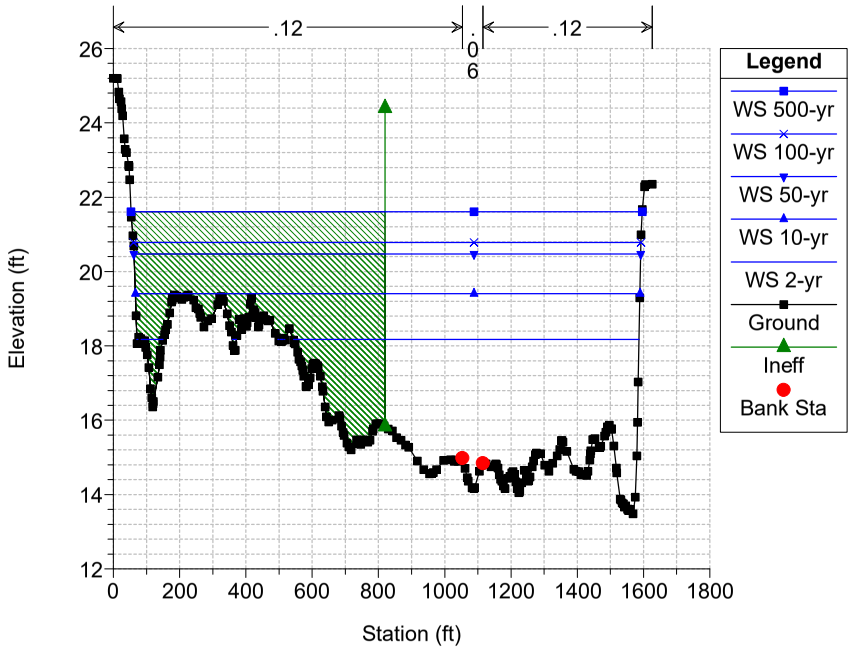
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

RS = 4837



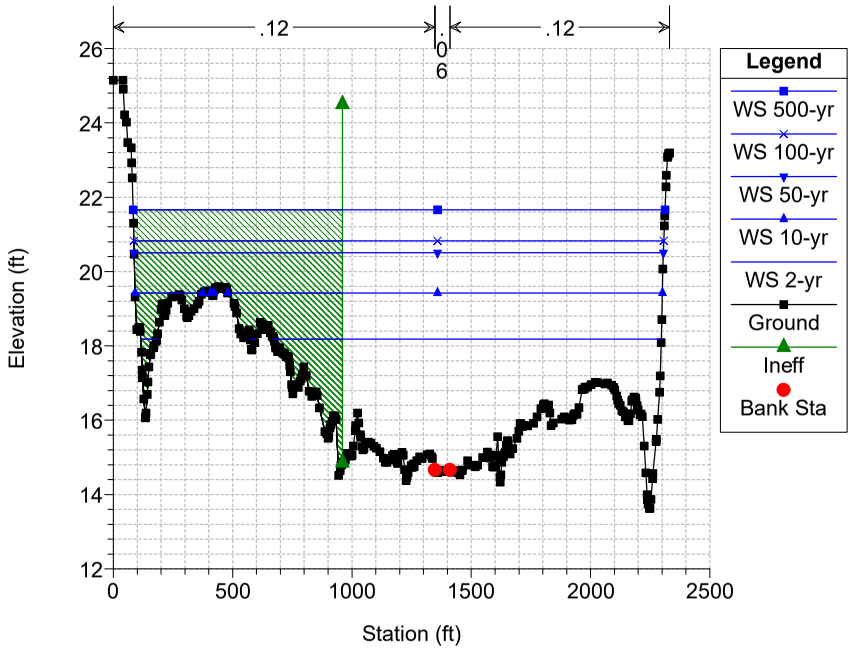
I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

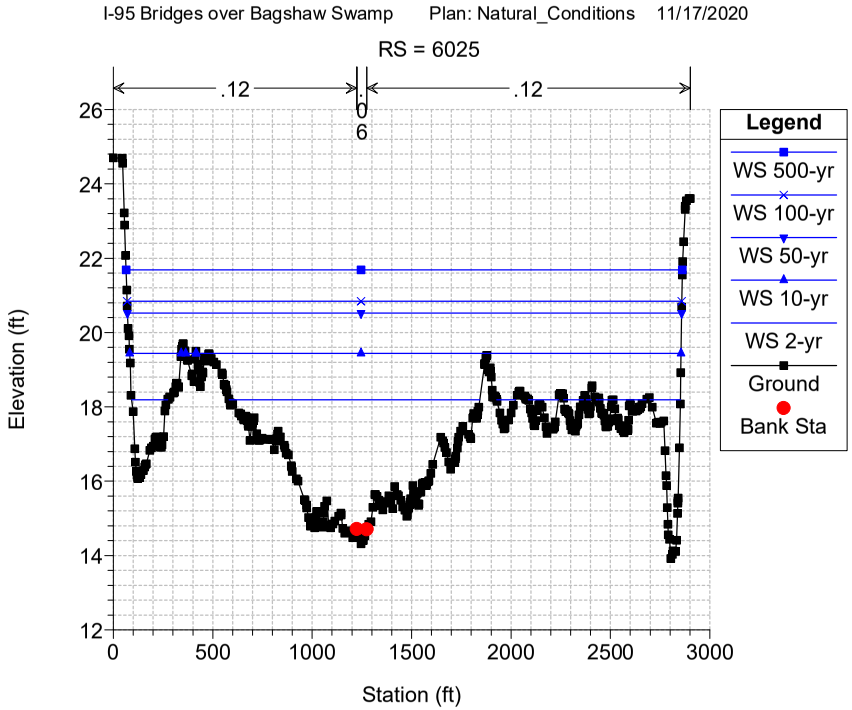
RS = 5134

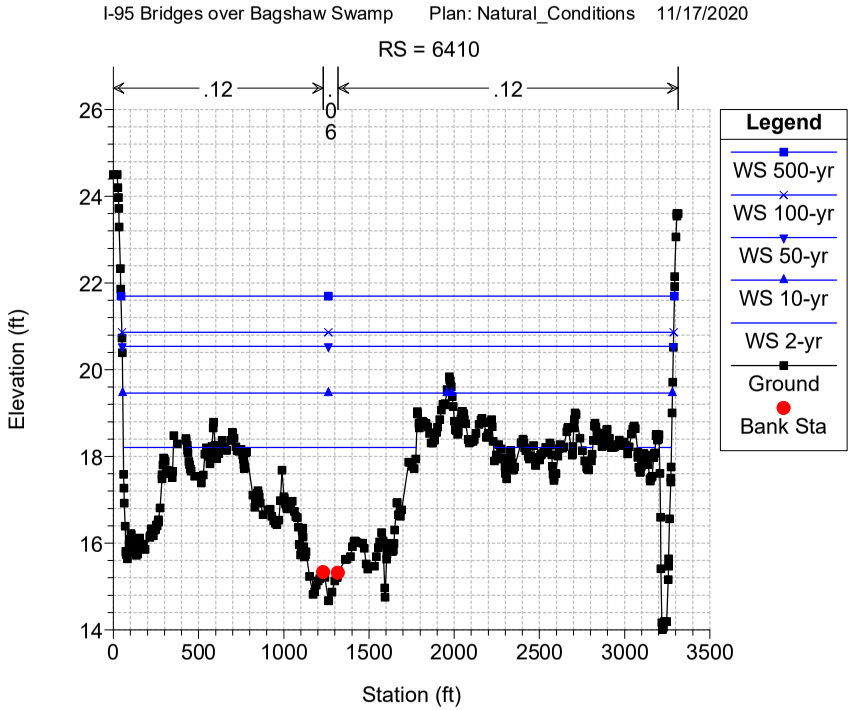


I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020

RS = 5615




I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 6025
.12
.12
0
6
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
26
24
22
20
18
16
14
12
0
500
1000
1500
2000
2500
3000


I-95 Bridges over Bagshaw Swamp Plan: Natural_Conditions 11/17/2020
RS = 6410
.12
.12
0
6
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
26
24
22
20
18
16
14
0
500
1000
1500
2000
2500
3000
3500

HEC-RAS Plan: NATURAL River: Bagshaw Swamp Reach: Bagshaw Swamp

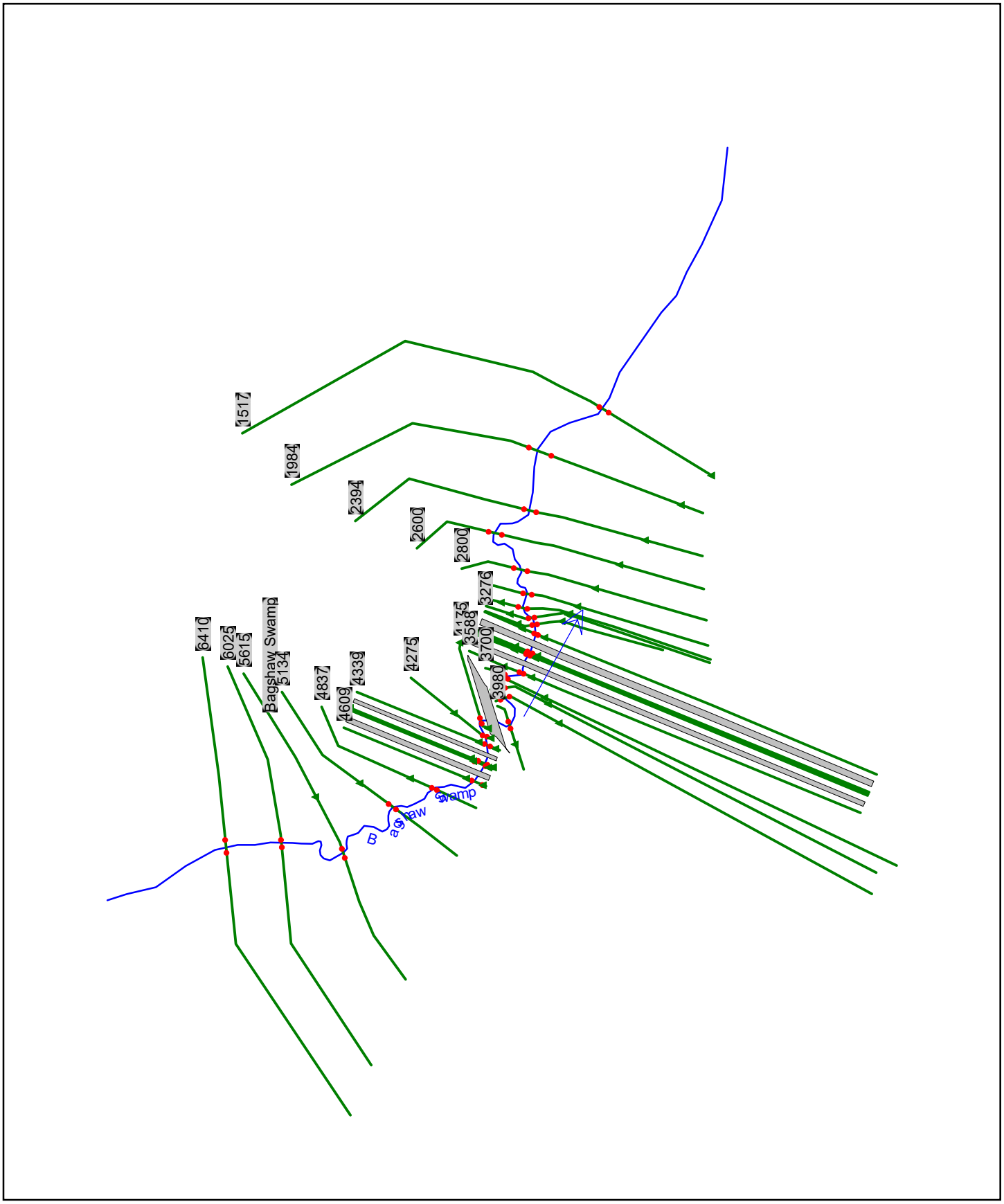
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	1517	2-yr	130.00	12.20	14.90	13.07	14.90	0.000034	0.24	1382.12	1575.94	0.03
Bagshaw Swamp	1517	10-yr	255.00	12.20	15.80	13.37	15.80	0.000018	0.22	3100.11	2258.22	0.02
Bagshaw Swamp	1517	50-yr	330.00	12.20	16.50	13.45	16.50	0.000009	0.18	4905.92	2835.22	0.02
Bagshaw Swamp	1517	100-yr	350.00	12.20	16.90	13.47	16.90	0.000006	0.15	6096.85	3154.95	0.01
Bagshaw Swamp	1517	500-yr	455.00	12.20	17.50	13.54	17.50	0.000005	0.15	8067.26	3443.41	0.01
Bagshaw Swamp	1984	2-yr	130.00	13.09	14.92	13.42	14.92	0.000029	0.19	1532.57	1687.36	0.03
Bagshaw Swamp	1984	10-yr	255.00	13.09	15.81	13.56	15.81	0.000015	0.18	3290.72	2166.79	0.02
Bagshaw Swamp	1984	50-yr	330.00	13.09	16.50	13.62	16.50	0.000008	0.15	4947.00	2617.23	0.01
Bagshaw Swamp	1984	100-yr	350.00	13.09	16.90	13.64	16.90	0.000005	0.13	6023.01	2778.29	0.01
Bagshaw Swamp	1984	500-yr	455.00	13.09	17.50	13.70	17.50	0.000004	0.13	7737.49	2915.12	0.01
Bagshaw Swamp	2394	2-yr	130.00	12.73	14.93	13.55	14.93	0.000038	0.21	1463.87	1693.09	0.03
Bagshaw Swamp	2394	10-yr	255.00	12.73	15.81	13.73	15.81	0.000017	0.19	3142.63	2009.64	0.02
Bagshaw Swamp	2394	50-yr	330.00	12.73	16.51	13.80	16.51	0.000009	0.16	4653.53	2432.41	0.02
Bagshaw Swamp	2394	100-yr	350.00	12.73	16.90	13.84	16.90	0.000006	0.14	5629.15	2479.72	0.01
Bagshaw Swamp	2394	500-yr	455.00	12.73	17.50	13.88	17.50	0.000005	0.14	7121.03	2495.31	0.01
Bagshaw Swamp	2600	2-yr	130.00	13.09	14.94	13.46	14.94	0.000056	0.25	1065.50	1099.48	0.04
Bagshaw Swamp	2600	10-yr	255.00	13.09	15.82	13.61	15.82	0.000030	0.24	2185.88	1506.88	0.03
Bagshaw Swamp	2600	50-yr	330.00	13.09	16.51	13.69	16.51	0.000017	0.22	3405.12	1951.36	0.02
Bagshaw Swamp	2600	100-yr	350.00	13.09	16.91	13.71	16.91	0.000011	0.19	4200.53	2036.22	0.02
Bagshaw Swamp	2600	500-yr	455.00	13.09	17.51	13.74	17.51	0.000009	0.19	5421.00	2040.46	0.02
Bagshaw Swamp	2800	2-yr	130.00	13.40	14.96	13.80	14.96	0.000180	0.40	591.62	653.81	0.06
Bagshaw Swamp	2800	10-yr	255.00	13.40	15.83	13.95	15.83	0.000089	0.39	1380.72	1249.89	0.05
Bagshaw Swamp	2800	50-yr	330.00	13.40	16.51	14.01	16.52	0.000042	0.32	2363.83	1577.42	0.03
Bagshaw Swamp	2800	100-yr	350.00	13.40	16.91	14.02	16.91	0.000026	0.28	3006.69	1653.32	0.03
Bagshaw Swamp	2800	500-yr	455.00	13.40	17.51	14.07	17.51	0.000019	0.26	3995.79	1654.71	0.02
Bagshaw Swamp	2975	2-yr	130.00	13.26	14.98	13.71	14.98	0.000133	0.38	695.41	635.53	0.05
Bagshaw Swamp	2975	10-yr	255.00	13.26	15.84	13.86	15.84	0.000081	0.40	1457.80	1057.62	0.05
Bagshaw Swamp	2975	50-yr	330.00	13.26	16.52	13.90	16.52	0.000045	0.35	2163.41	1263.69	0.04
Bagshaw Swamp	2975	100-yr	350.00	13.26	16.91	13.97	16.91	0.000029	0.31	2578.84	1295.05	0.03
Bagshaw Swamp	2975	500-yr	455.00	13.26	17.51	14.04	17.51	0.000025	0.32	3236.74	1424.52	0.03
Bagshaw Swamp	3100	2-yr	130.00	13.38	15.00	13.78	15.00	0.000194	0.39	649.91	695.71	0.06
Bagshaw Swamp	3100	10-yr	255.00	13.38	15.85	13.98	15.85	0.000102	0.41	1398.58	986.84	0.05
Bagshaw Swamp	3100	50-yr	330.00	13.38	16.53	14.04	16.53	0.000050	0.34	2066.76	993.18	0.04
Bagshaw Swamp	3100	100-yr	350.00	13.38	16.92	14.05	16.92	0.000033	0.30	2455.34	996.84	0.03
Bagshaw Swamp	3100	500-yr	455.00	13.38	17.51	14.14	17.51	0.000029	0.32	3065.51	1161.60	0.03
Bagshaw Swamp	3166	2-yr	130.00	12.10	15.01	12.84	15.01	0.000225	0.72	472.83	665.19	0.08
Bagshaw Swamp	3166	10-yr	255.00	12.10	15.86	13.25	15.86	0.000121	0.63	1213.79	992.17	0.06
Bagshaw Swamp	3166	50-yr	330.00	12.10	16.53	13.46	16.53	0.000060	0.50	1887.23	1006.44	0.04
Bagshaw Swamp	3166	100-yr	350.00	12.10	16.92	13.51	16.92	0.000039	0.42	2280.20	1011.92	0.03
Bagshaw Swamp	3166	500-yr	455.00	12.10	17.52	13.79	17.52	0.000032	0.42	2886.50	1104.54	0.03
Bagshaw Swamp	3214	2-yr	130.00	12.50	15.02		15.04	0.000549	1.20	266.72	404.67	0.14
Bagshaw Swamp	3214	10-yr	255.00	12.50	15.86		15.87	0.000307	1.10	719.35	712.22	0.11
Bagshaw Swamp	3214	50-yr	330.00	12.50	16.53		16.54	0.000156	0.89	1251.79	873.52	0.08
Bagshaw Swamp	3214	100-yr	350.00	12.50	16.92		16.92	0.000092	0.73	1604.67	949.09	0.06
Bagshaw Swamp	3214	500-yr	455.00	12.50	17.52		17.52	0.000068	0.68	2194.49	1015.48	0.05
Bagshaw Swamp	3276	2-yr	130.00	11.90	15.05	13.13	15.05	0.000129	0.65	932.41	2227.73	0.07
Bagshaw Swamp	3276	10-yr	255.00	11.90	15.88	13.70	15.88	0.000039	0.43	2454.86	2575.25	0.04
Bagshaw Swamp	3276	50-yr	330.00	11.90	16.54	14.42	16.54	0.000018	0.33	3757.93	2645.95	0.03
Bagshaw Swamp	3276	100-yr	350.00	11.90	16.93	14.46	16.93	0.000011	0.27	4538.97	2697.05	0.02
Bagshaw Swamp	3276	500-yr	455.00	11.90	17.52	14.60	17.52	0.000009	0.27	5780.47	2774.94	0.02
Bagshaw Swamp	3406	2-yr	130.00	11.00	15.07	12.84	15.10	0.000530	1.32	117.79	184.31	0.14
Bagshaw Swamp	3406	10-yr	255.00	11.00	15.88	13.34	15.90	0.000440	1.42	581.53	1323.64	0.13
Bagshaw Swamp	3406	50-yr	330.00	11.00	16.54	13.60	16.55	0.000157	0.95	1419.30	2249.97	0.08
Bagshaw Swamp	3406	100-yr	350.00	11.00	16.93	13.66	16.93	0.000080	0.72	2011.44	2434.52	0.06
Bagshaw Swamp	3406	500-yr	455.00	11.00	17.52	13.98	17.52	0.000048	0.60	3018.39	2651.61	0.05
Bagshaw Swamp	3417	2-yr	130.00	13.10	15.08	14.00	15.11	0.001308	1.52	130.41	375.53	0.21
Bagshaw Swamp	3417	10-yr	255.00	13.10	15.90	14.36	15.91	0.000497	1.22	680.16	1526.96	0.14
Bagshaw Swamp	3417	50-yr	330.00	13.10	16.55	14.57	16.55	0.000147	0.77	1545.43	2197.81	0.08
Bagshaw Swamp	3417	100-yr	350.00	13.10	16.93	14.61	16.93	0.000073	0.59	2152.79	2497.66	0.06
Bagshaw Swamp	3417	500-yr	455.00	13.10	17.52	14.92	17.52	0.000043	0.50	3196.07	2703.88	0.04
Bagshaw Swamp	3428	2-yr	130.00	11.90	15.08	13.13	15.12	0.000913	1.65	94.76	164.87	0.18
Bagshaw Swamp	3428	10-yr	255.00	11.90	15.89	13.70	15.93	0.000820	1.88	395.98	1114.94	0.18
Bagshaw Swamp	3428	50-yr	330.00	11.90	16.55	14.00	16.56	0.000303	1.28	998.18	1819.27	0.11
Bagshaw Swamp	3428	100-yr	350.00	11.90	16.93	14.08	16.93	0.000154	0.97	1419.96	2131.36	0.08
Bagshaw Swamp	3428	500-yr	455.00	11.90	17.52	14.41	17.53	0.000090	0.81	2178.57	2513.40	0.06
Bagshaw Swamp	3588	2-yr	130.00	11.60	15.18	13.17	15.18	0.000126	0.61	878.07	2207.60	0.07
Bagshaw Swamp	3588	10-yr	255.00	11.60	15.96	13.78	15.97	0.000053	0.47	2014.36	2618.41	0.04
Bagshaw Swamp	3588	50-yr	330.00	11.60	16.57	14.48	16.57	0.000028	0.38	2933.47	2647.71	0.03
Bagshaw Swamp	3588	100-yr	350.00	11.60	16.94	14.54	16.94	0.000019	0.33	3503.67	2696.25	0.03
Bagshaw Swamp	3588	500-yr	455.00	11.60	17.53	14.69	17.53	0.000015	0.32	4423.83	2704.41	0.03
Bagshaw Swamp	3700	2-yr	130.00	14.19	15.20	14.26	15.20	0.000503	0.39	564.91	1468.90	0.09
Bagshaw Swamp	3700	10-yr	255.00	14.19	15.97	14.37	15.97	0.000121	0.33	1643.71	2909.43	0.05
Bagshaw Swamp	3700	50-yr	330.00	14.19	16.58	14.43	16.58	0.000047	0.26	2574.94	3007.14	0.03
Bagshaw Swamp	3700	100-yr	350.00	14.19	16.94	14.45	16.94	0.000027	0.22	3149.82	3030.83	0.03
Bagshaw Swamp	3700	500-yr	455.00	14.19	17.53	14.52	17.53	0.000019	0.22	4071.41	3038.31	0.02
Bagshaw Swamp	3810	2-yr	130.00	11.45	15.21	12.66	15.22	0.000093	0.52	636.09	1398.75	0.06

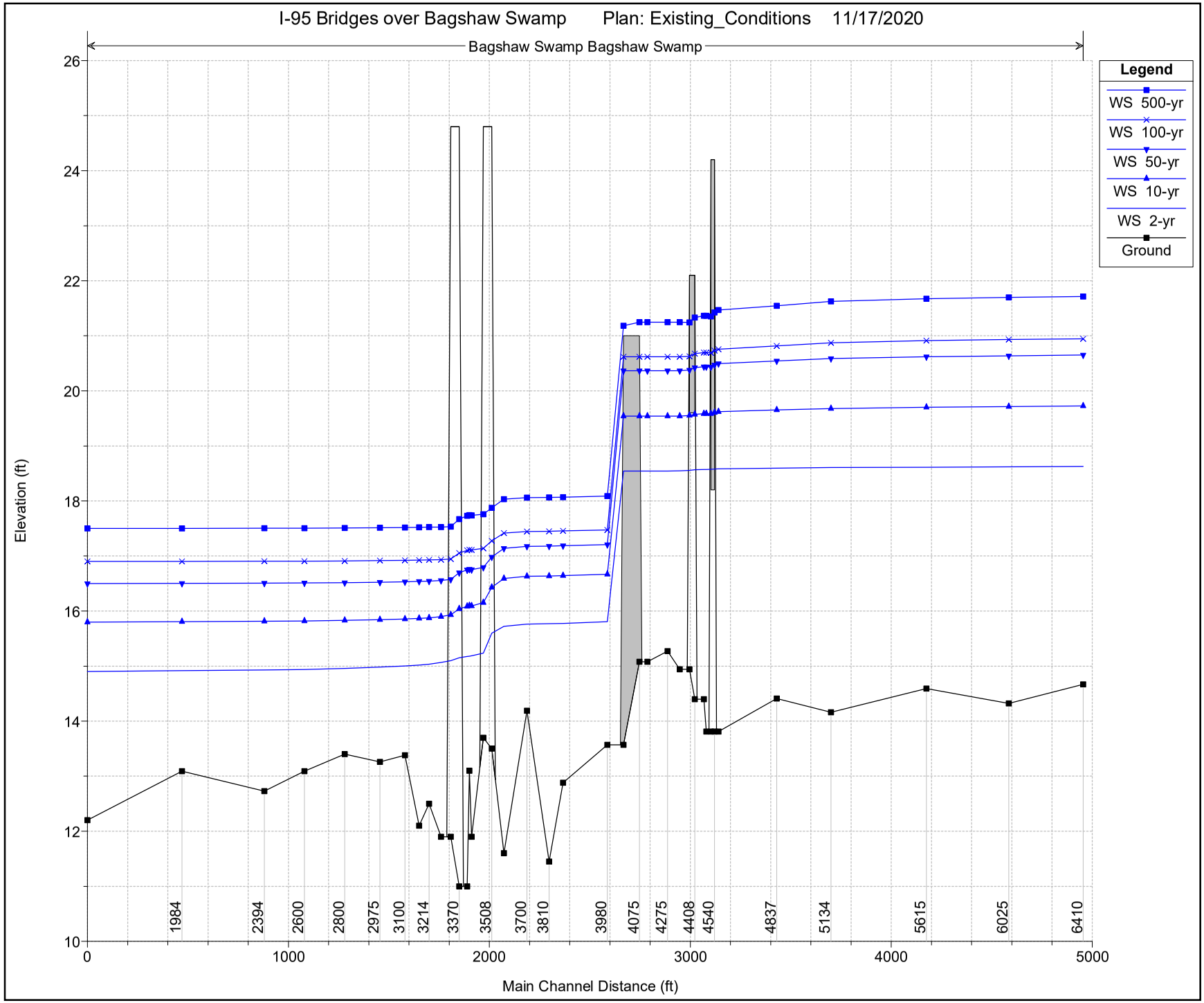
HEC-RAS Plan: NATURAL River: Bagshaw Swamp Reach: Bagshaw Swamp (Continued)

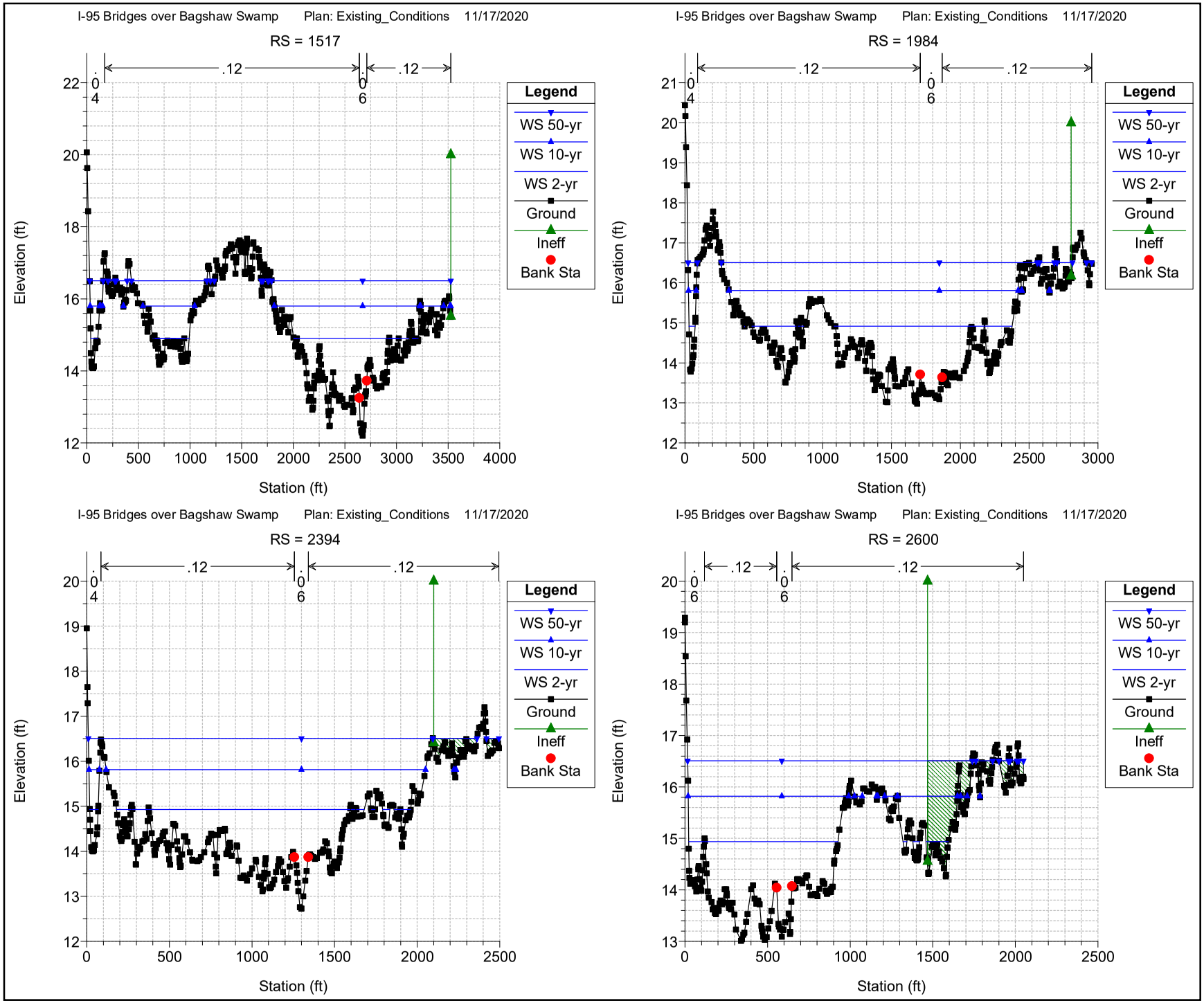
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	3810	10-yr	255.00	11.45	15.98	13.06	15.98	0.000074	0.55	1335.51	2807.72	0.05
Bagshaw Swamp	3810	50-yr	330.00	11.45	16.58	13.26	16.58	0.000045	0.48	1919.01	2858.25	0.04
Bagshaw Swamp	3810	100-yr	350.00	11.45	16.95	13.30	16.95	0.000031	0.42	2277.47	2860.83	0.04
Bagshaw Swamp	3810	500-yr	455.00	11.45	17.53	13.53	17.53	0.000026	0.43	2850.57	2863.09	0.03
Bagshaw Swamp	3880	2-yr	130.00	12.88	15.22	13.90	15.22	0.000224	0.57	493.24	1560.48	0.08
Bagshaw Swamp	3880	10-yr	255.00	12.88	15.98	14.12	15.99	0.000161	0.64	851.80	2696.74	0.08
Bagshaw Swamp	3880	50-yr	330.00	12.88	16.58	14.24	16.58	0.000107	0.61	1136.14	2797.21	0.06
Bagshaw Swamp	3880	100-yr	350.00	12.88	16.95	14.33	16.95	0.000076	0.56	1311.72	2831.74	0.06
Bagshaw Swamp	3880	500-yr	455.00	12.88	17.54	14.45	17.54	0.000068	0.59	1593.91	2855.49	0.05
Bagshaw Swamp	3980	2-yr	130.00	13.57	15.34	14.72	15.36	0.002329	1.31	181.00	333.68	0.22
Bagshaw Swamp	3980	10-yr	255.00	13.57	16.06	14.95	16.07	0.001139	1.27	385.55	376.00	0.16
Bagshaw Swamp	3980	50-yr	330.00	13.57	16.63	15.04	16.64	0.000630	1.13	554.17	383.05	0.13
Bagshaw Swamp	3980	100-yr	350.00	13.57	16.98	15.07	16.99	0.000413	1.00	659.74	388.03	0.11
Bagshaw Swamp	3980	500-yr	455.00	13.57	17.56	15.19	17.57	0.000333	1.02	836.58	399.93	0.10
Bagshaw Swamp	4075		Inl Struct									
Bagshaw Swamp	4175	2-yr	130.00	15.08	18.08	14.39	18.08	0.000005	0.12	1937.76	593.57	0.01
Bagshaw Swamp	4175	10-yr	255.00	15.08	19.24	14.51	19.24	0.000008	0.17	2631.35	610.32	0.02
Bagshaw Swamp	4175	50-yr	330.00	15.08	20.24	14.56	20.24	0.000007	0.18	3252.03	624.65	0.01
Bagshaw Swamp	4175	100-yr	350.00	15.08	20.52	14.58	20.52	0.000006	0.19	3427.31	627.08	0.01
Bagshaw Swamp	4175	500-yr	455.00	15.08	21.23	14.65	21.23	0.000007	0.22	3871.59	630.00	0.02
Bagshaw Swamp	4275	2-yr	140.00	15.27	18.08	16.04	18.09	0.000098	0.44	594.02	660.75	0.05
Bagshaw Swamp	4275	10-yr	260.00	15.27	19.24	16.18	19.24	0.000080	0.52	922.22	669.33	0.05
Bagshaw Swamp	4275	50-yr	330.00	15.27	20.24	16.26	20.24	0.000052	0.49	1218.16	680.00	0.04
Bagshaw Swamp	4275	100-yr	350.00	15.27	20.52	16.29	20.52	0.000047	0.49	1302.11	680.00	0.04
Bagshaw Swamp	4275	500-yr	460.00	15.27	21.23	16.35	21.23	0.000049	0.54	1514.08	680.00	0.04
Bagshaw Swamp	4339	2-yr	140.00	14.94	18.09	15.94	18.10	0.000291	0.85	215.53	980.58	0.09
Bagshaw Swamp	4339	10-yr	260.00	14.94	19.24	16.25	19.25	0.000289	1.06	325.16	996.46	0.09
Bagshaw Swamp	4339	50-yr	330.00	14.94	20.24	16.41	20.25	0.000198	1.02	437.41	1034.93	0.08
Bagshaw Swamp	4339	100-yr	350.00	14.94	20.52	16.44	20.53	0.000176	1.00	470.95	1034.93	0.08
Bagshaw Swamp	4339	500-yr	460.00	14.94	21.23	16.65	21.24	0.000179	1.09	555.64	1034.93	0.08
Bagshaw Swamp	4408		Bridge									
Bagshaw Swamp	4468	2-yr	140.00	14.40	18.13	14.80	18.14	0.000050	0.40	461.58	1018.17	0.04
Bagshaw Swamp	4468	10-yr	260.00	14.40	19.29	14.98	19.30	0.000066	0.56	626.59	1026.66	0.05
Bagshaw Swamp	4468	50-yr	330.00	14.40	20.32	15.07	20.32	0.000055	0.58	782.00	1037.78	0.04
Bagshaw Swamp	4468	100-yr	350.00	14.40	20.60	15.09	20.60	0.000052	0.58	826.77	1037.78	0.04
Bagshaw Swamp	4468	500-yr	460.00	14.40	21.35	15.23	21.35	0.000059	0.68	944.66	1037.78	0.05
Bagshaw Swamp	4481	2-yr	140.00	13.81	18.13	14.41	18.14	0.000035	0.38	416.78	1016.42	0.03
Bagshaw Swamp	4481	10-yr	260.00	13.81	19.29	14.64	19.30	0.000052	0.55	544.23	1024.64	0.04
Bagshaw Swamp	4481	50-yr	330.00	13.81	20.32	14.76	20.32	0.000046	0.58	656.82	1040.00	0.04
Bagshaw Swamp	4481	100-yr	350.00	13.81	20.60	14.79	20.60	0.000045	0.58	688.03	1040.00	0.04
Bagshaw Swamp	4481	500-yr	460.00	13.81	21.35	14.95	21.35	0.000053	0.69	770.20	1040.00	0.04
Bagshaw Swamp	4540		Bridge									
Bagshaw Swamp	4609	2-yr	140.00	13.81	18.14	14.91	18.14	0.000047	0.41	418.16	1017.06	0.04
Bagshaw Swamp	4609	10-yr	260.00	13.81	19.33	15.12	19.33	0.000063	0.56	560.58	1023.33	0.05
Bagshaw Swamp	4609	50-yr	330.00	13.81	20.37	15.22	20.38	0.000053	0.59	685.68	1031.70	0.04
Bagshaw Swamp	4609	100-yr	350.00	13.81	20.66	15.25	20.67	0.000050	0.59	720.47	1031.70	0.04
Bagshaw Swamp	4609	500-yr	460.00	13.81	21.45	15.40	21.46	0.000058	0.69	815.21	1031.70	0.05
Bagshaw Swamp	4837	2-yr	402.00	14.41	18.16	14.85	18.16	0.000070	0.49	1541.30	1169.98	0.05
Bagshaw Swamp	4837	10-yr	1060.00	14.41	19.37	15.23	19.37	0.000184	0.96	2073.64	1182.46	0.08
Bagshaw Swamp	4837	50-yr	1790.00	14.41	20.42	15.52	20.43	0.000270	1.33	2543.08	1191.33	0.10
Bagshaw Swamp	4837	100-yr	2160.00	14.41	20.72	15.64	20.73	0.000334	1.53	2677.18	1195.04	0.11
Bagshaw Swamp	4837	500-yr	3020.00	14.41	21.53	15.97	21.55	0.000435	1.89	3042.59	1208.51	0.13
Bagshaw Swamp	5134	2-yr	402.00	14.16	18.17	14.73	18.17	0.000027	0.31	2564.95	1137.96	0.03
Bagshaw Swamp	5134	10-yr	1060.00	14.16	19.40	15.10	19.40	0.000066	0.58	3508.07	1522.84	0.05
Bagshaw Swamp	5134	50-yr	1790.00	14.16	20.47	15.36	20.47	0.000094	0.79	4332.82	1529.39	0.06
Bagshaw Swamp	5134	100-yr	2160.00	14.16	20.78	15.47	20.79	0.000115	0.91	4572.51	1531.68	0.06
Bagshaw Swamp	5134	500-yr	3020.00	14.16	21.61	15.71	21.61	0.000146	1.11	5211.17	1542.31	0.07
Bagshaw Swamp	5615	2-yr	402.00	14.59	18.18	15.00	18.18	0.000019	0.25	3552.43	1714.22	0.02
Bagshaw Swamp	5615	10-yr	1060.00	14.59	19.43	15.37	19.43	0.000038	0.44	5215.46	2121.97	0.04
Bagshaw Swamp	5615	50-yr	1790.00	14.59	20.51	15.60	20.51	0.000049	0.57	6665.69	2219.14	0.04
Bagshaw Swamp	5615	100-yr	2160.00	14.59	20.82	15.68	20.82	0.000058	0.64	7093.39	2221.83	0.05
Bagshaw Swamp	5615	500-yr	3020.00	14.59	21.66	15.87	21.66	0.000070	0.76	8221.69	2229.58	0.05
Bagshaw Swamp	6025	2-yr	402.00	14.32	18.19		18.19	0.000034	0.34	3394.19	2210.30	0.03
Bagshaw Swamp	6025	10-yr	1060.00	14.32	19.44		19.44	0.000045	0.48	6556.94	2748.00	0.04
Bagshaw Swamp	6025	50-yr	1790.00	14.32	20.52		20.53	0.000040	0.52	9560.23	2787.05	0.04
Bagshaw Swamp	6025	100-yr	2160.00	14.32	20.84		20.85	0.000044	0.56	10453.89	2790.29	0.04
Bagshaw Swamp	6025	500-yr	3020.00	14.32	21.68		21.68	0.000044	0.61	12797.40	2797.96	0.04
Bagshaw Swamp	6410	2-yr	402.00	14.67	18.21		18.21	0.000041	0.35	2947.69	2143.43	0.03
Bagshaw Swamp	6410	10-yr	1060.00	14.67	19.46		19.46	0.000048	0.46	6614.54	3195.05	0.04
Bagshaw Swamp	6410	50-yr	1790.00	14.67	20.54		20.54	0.000038	0.48	10092.17	3233.98	0.04
Bagshaw Swamp	6410	100-yr	2160.00	14.67	20.86		20.86	0.000041	0.51	11132.77	3237.52	0.04
Bagshaw Swamp	6410	500-yr	3020.00	14.67	21.70		21.70	0.000040	0.55	13852.21	3247.40	0.04

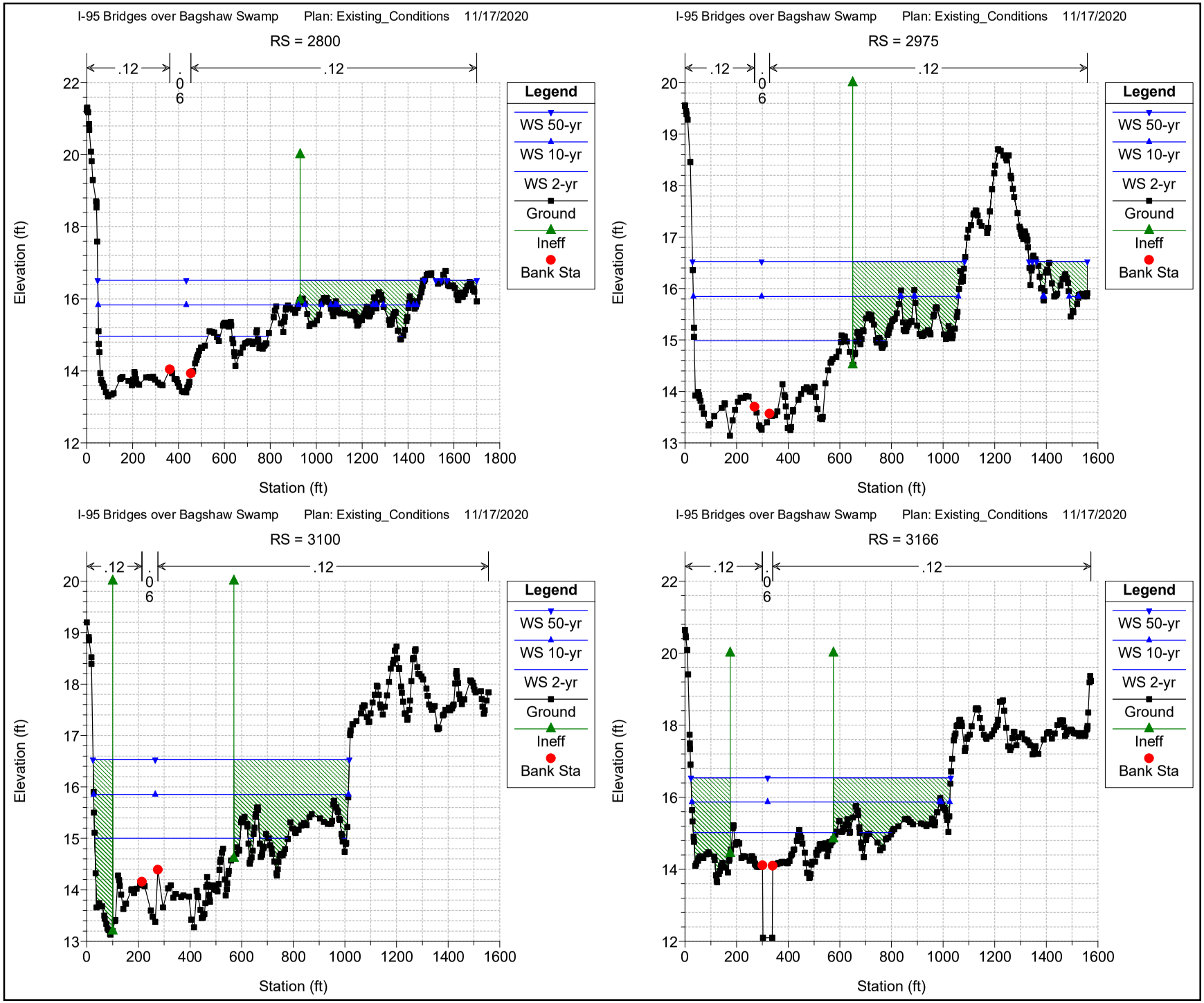
APPENDIX I

HEC-RAS EXISTING CONDITIONS RESULTS


1517
1984
2394
2600
2800
3276
1175
3585
3700
3980
4275
4339
4837
4609
5134
Bagshaw Swamp
5615
6025
6410
Bagshaw Swamp

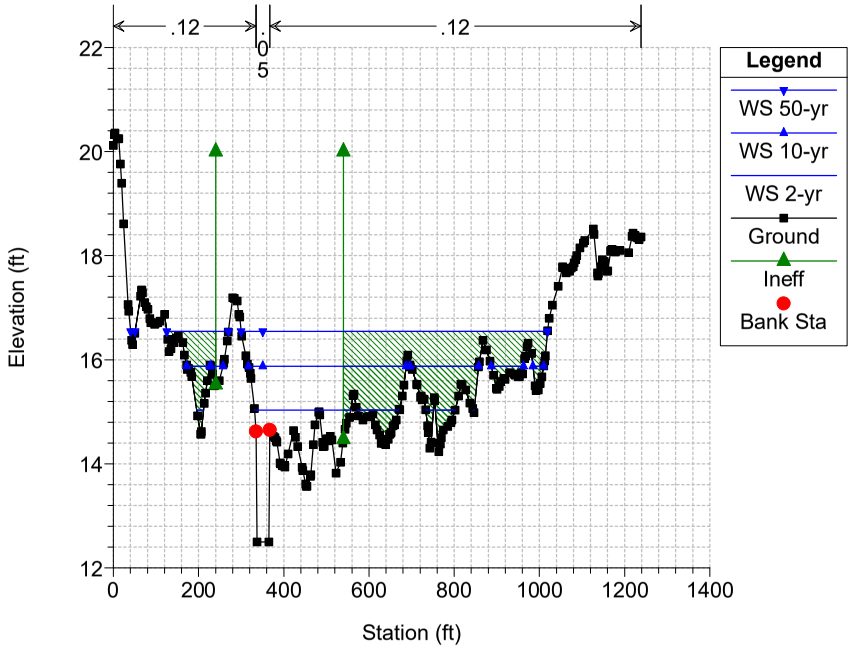

I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
Bagshaw Swamp Bagshaw Swamp
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Elevation (ft)
Main Channel Distance (ft)
26
24
22
20
18
16
14
12
10
0
1000
2000
3000
4000
5000
1984
2394
2600
2800
2975
3100
3214
3370
3508
3700
3810
3980
4075
4275
4408
4540
4837
5134
5615
6025
6410


I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 1517
.12
.12
.04
.06
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 1984
.12
.12
.04
.06
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 2394
.12
.12
.04
.06
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 2600
.12
.12
.06
.06
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 2800
.12
.06
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 2975
.12
.06
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3100
.12
.06
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3166
.12
.06
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

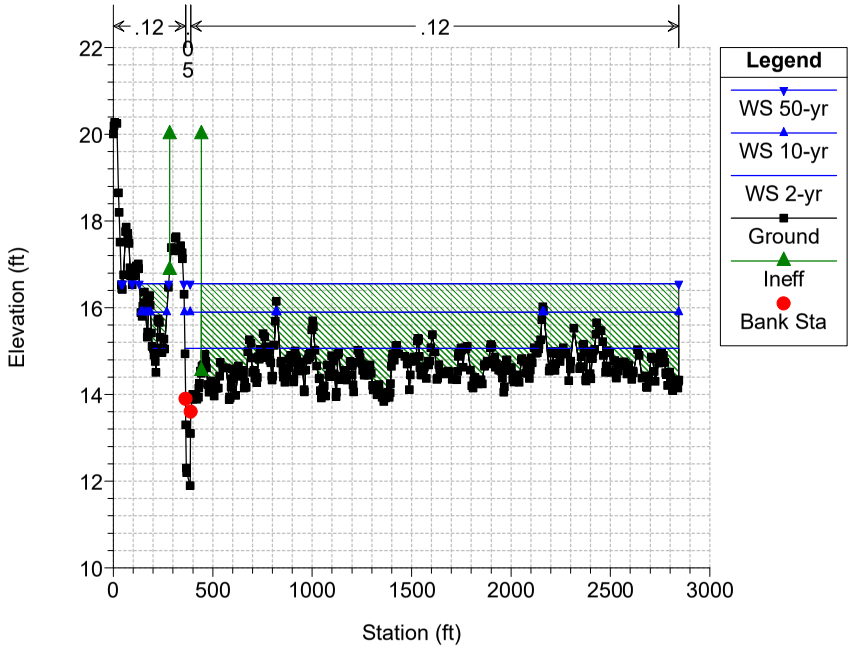
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 3214



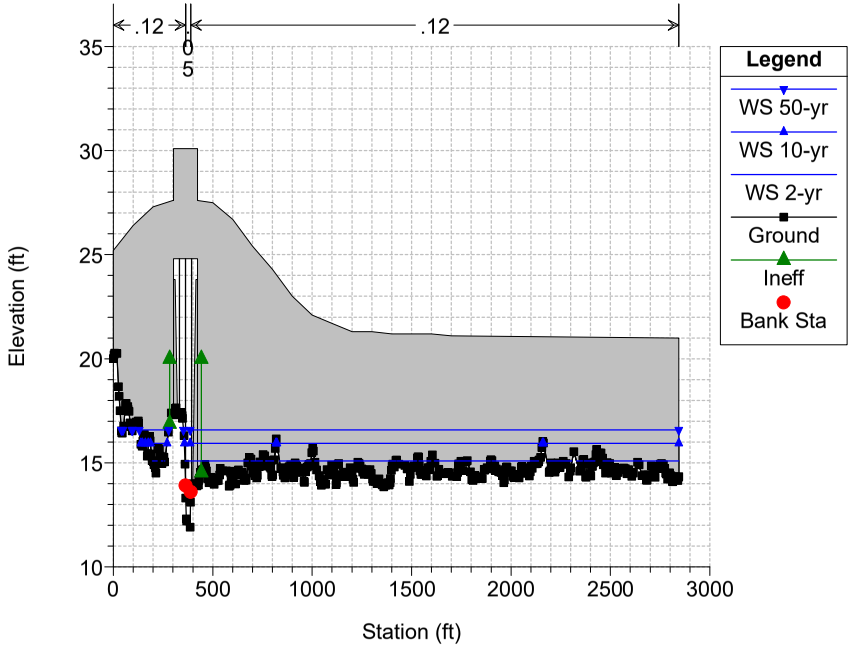
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 3276 I-95 NORTHBOUND BRIDGE - DOWNSTREAM FACE



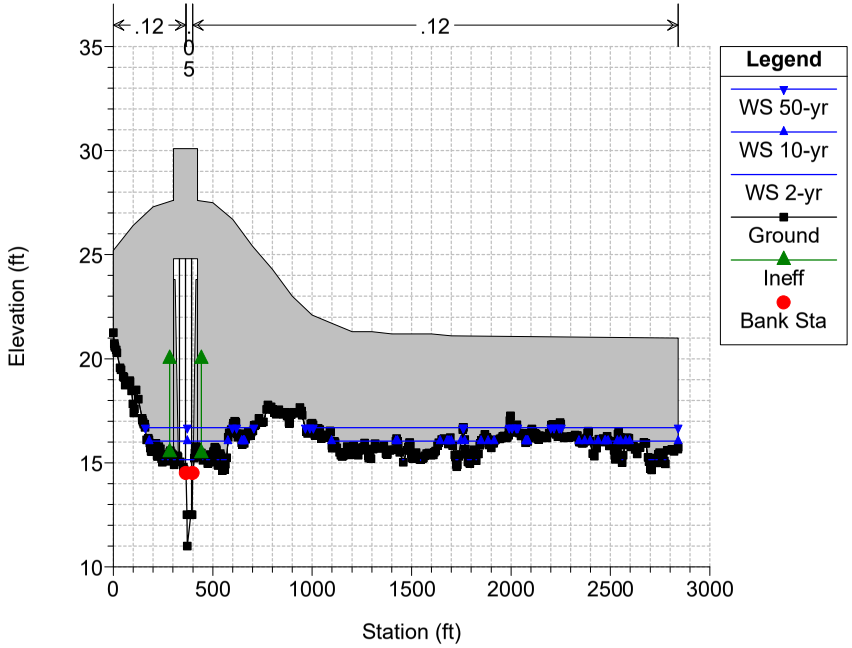
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 3370 BR I-95 NORTHBOUND BRIDGE OVER BAGSHAW SWAMP



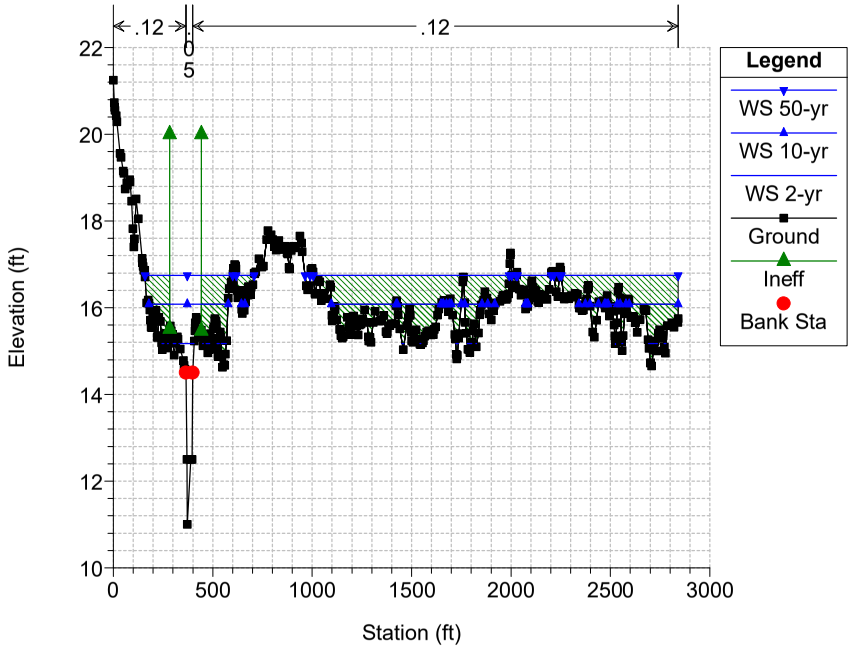
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 3370 BR I-95 NORTHBOUND BRIDGE OVER BAGSHAW SWAMP



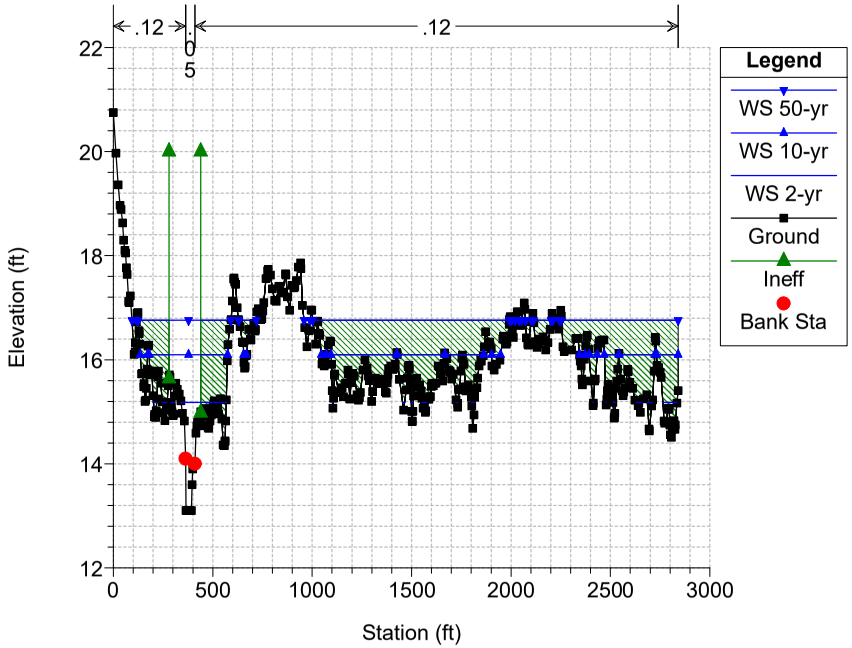
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 3406 I-95 NORTHBOUND BRIDGE - UPSTREAM FACE



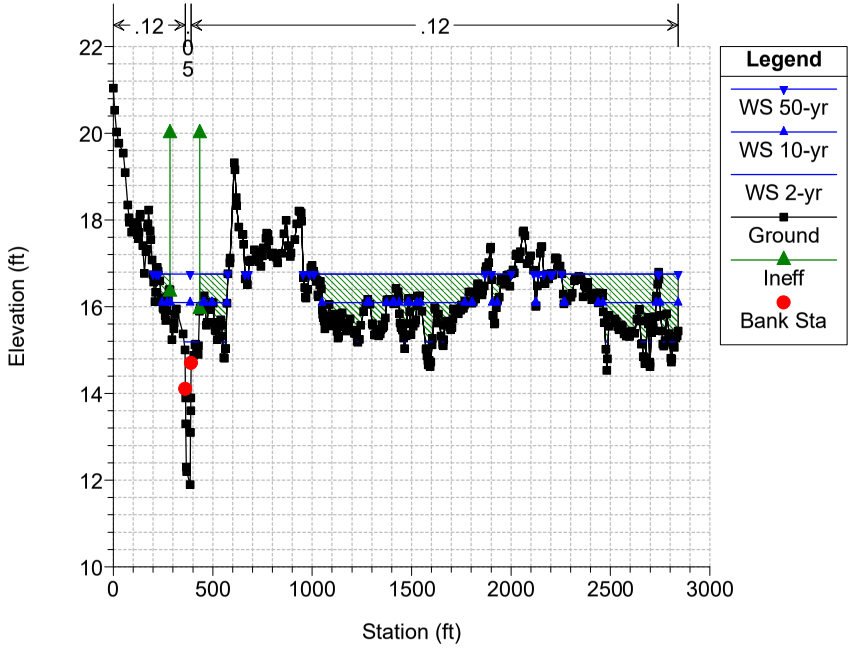
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 3417 I-95 MEDIAN



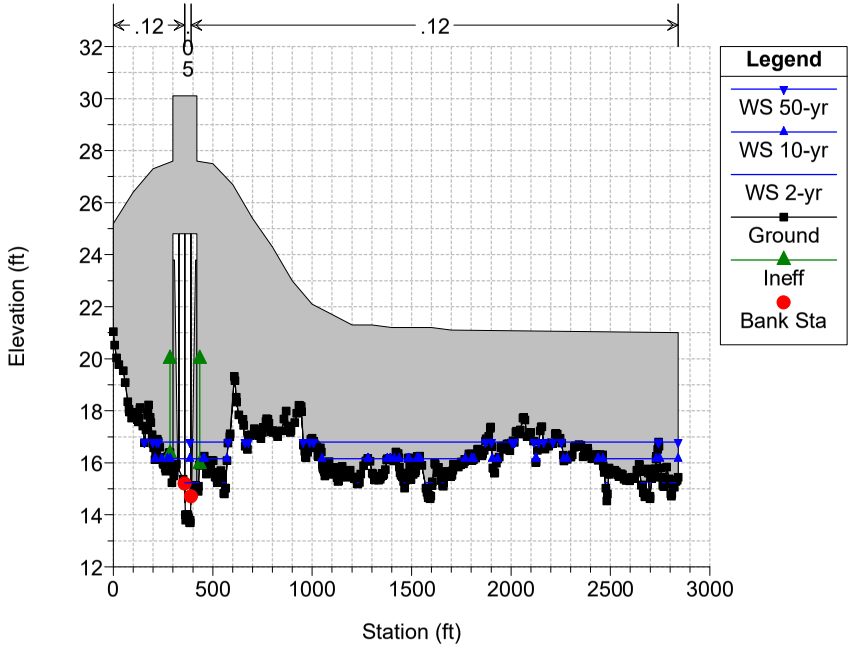
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

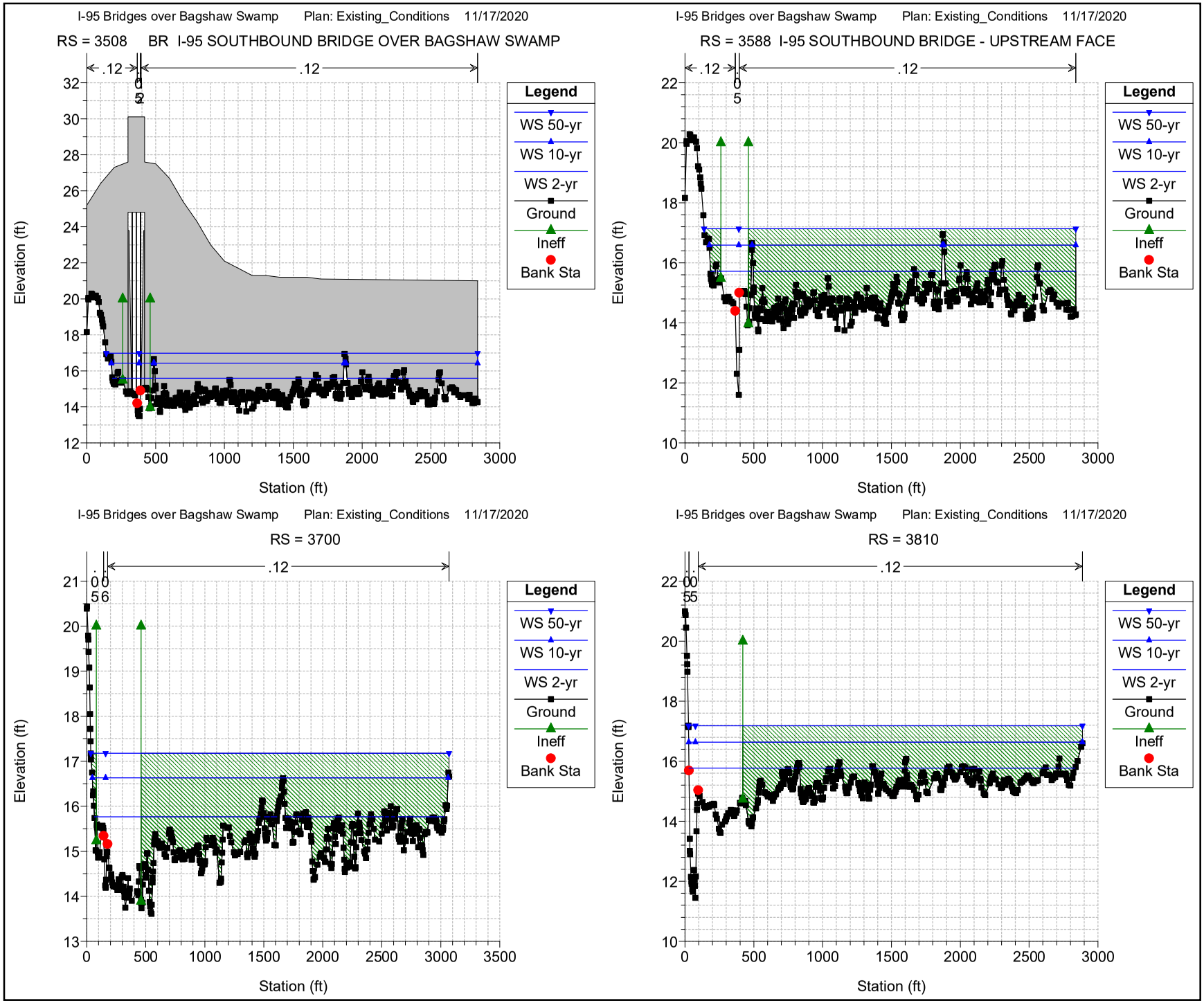
RS = 3428 I-95 SOUTHBOUND BRIDGE - DOWNSTREAM FACE

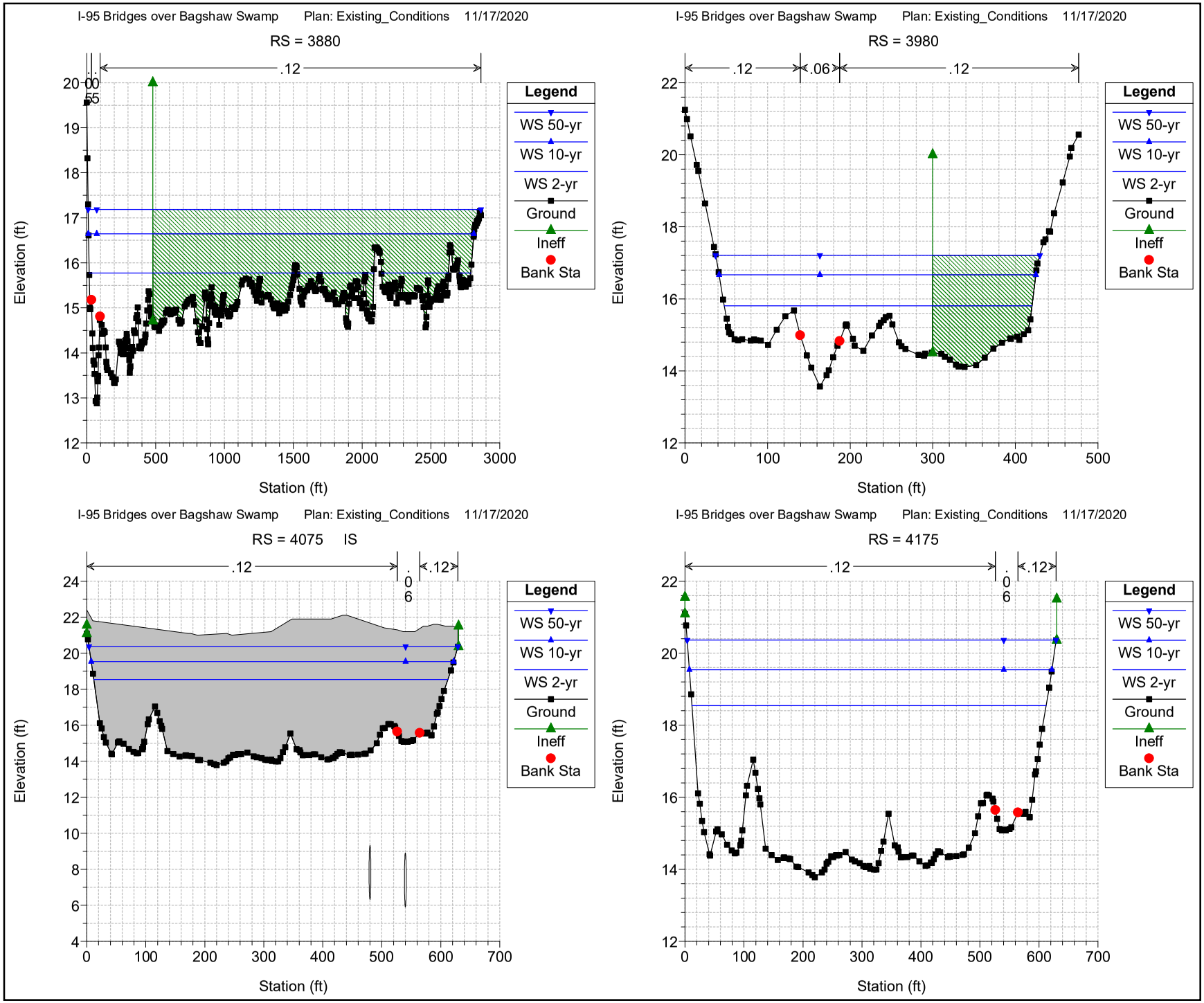


I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 3508 BR I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP

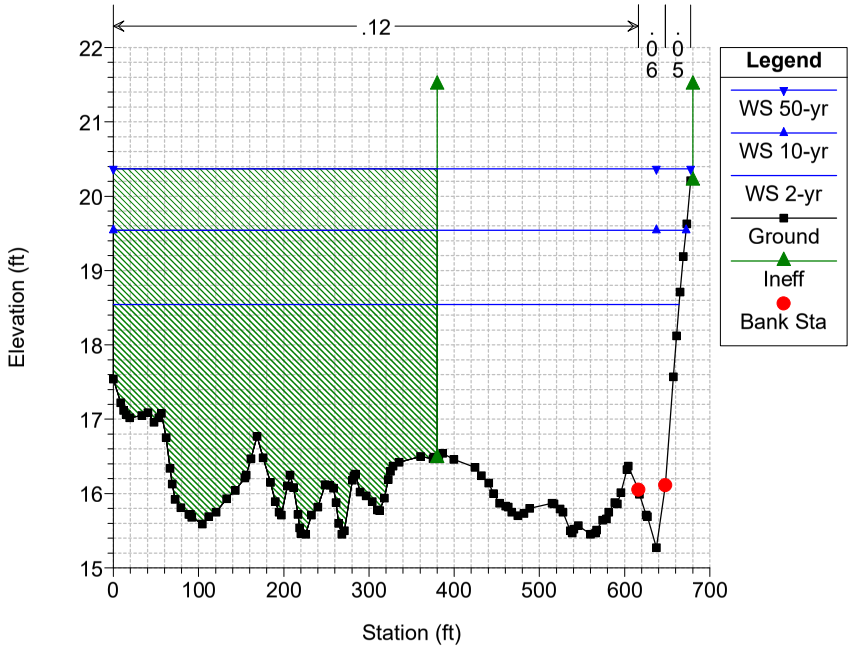



I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3508 BR I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP
.12
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3588 I-95 SOUTHBOUND BRIDGE - UPSTREAM FACE
.12
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3700
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3810
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3880
.12
.00
.55
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3980
.12
.06
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 4075 IS
.12
.06
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 4175
.12
.06
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

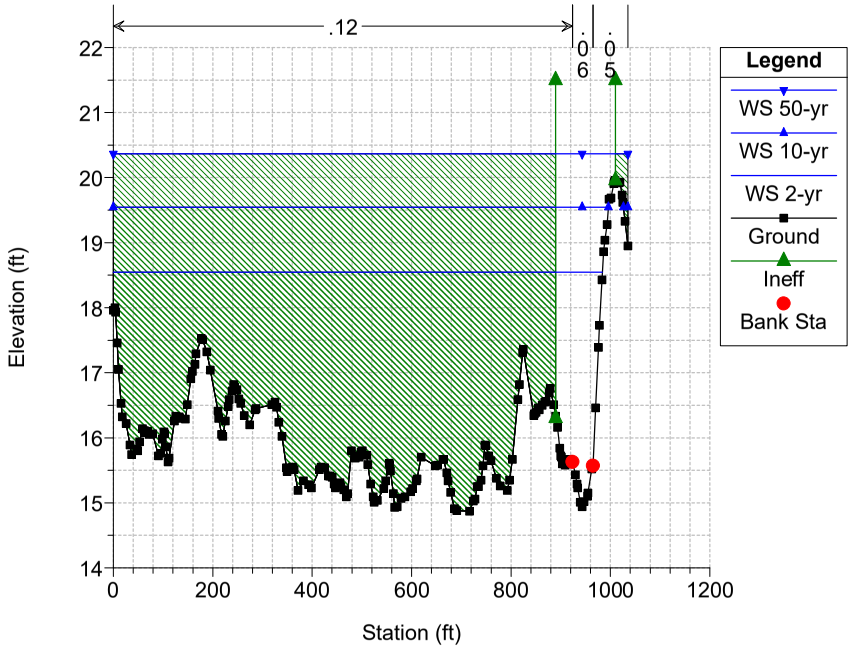
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4275



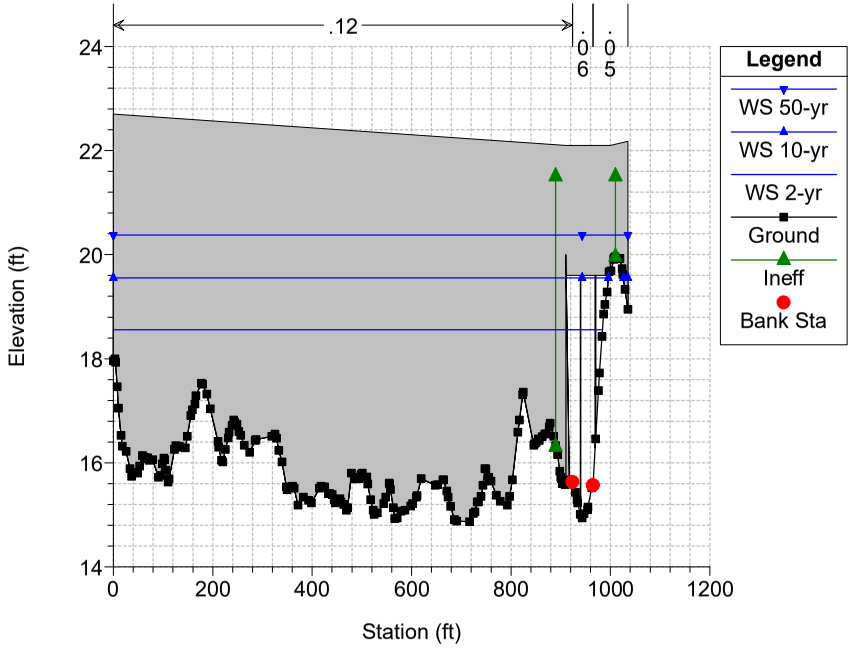
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4339 US 17 BRIDGE OVER BAGSHAW SWAMP - DOWNSTREAM FACE



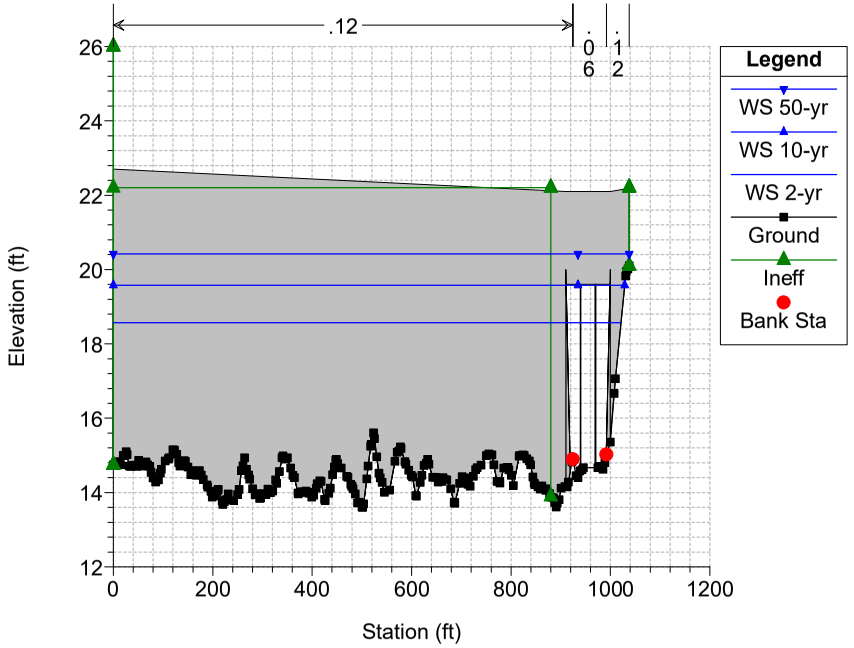
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4408 BR US 17 BRIDGE OVER BAGSHAW SWAMP



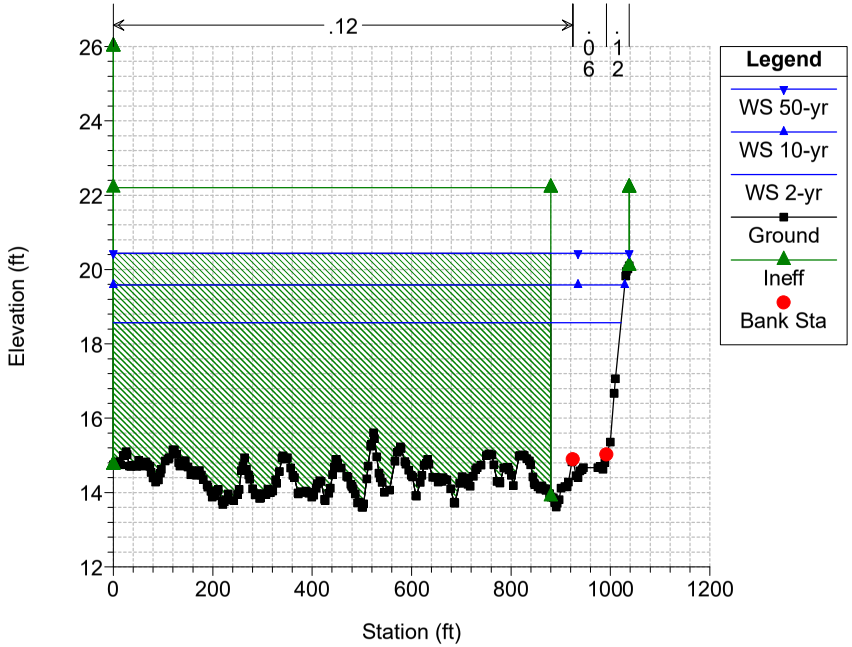
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4408 BR US 17 BRIDGE OVER BAGSHAW SWAMP



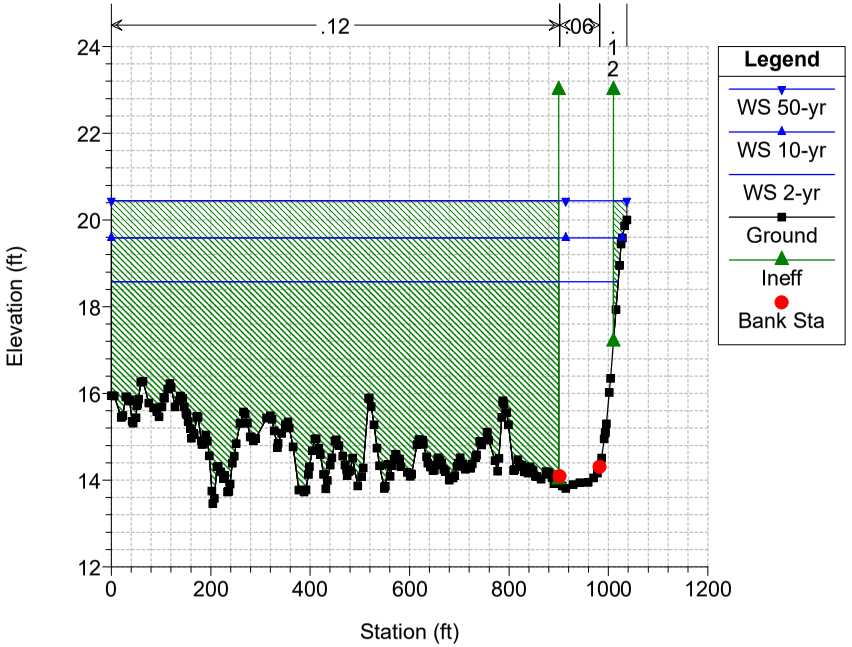
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4468 US 17 BRIDGE OVER BAGSHAW SWAMP - UPSTREAM FACE



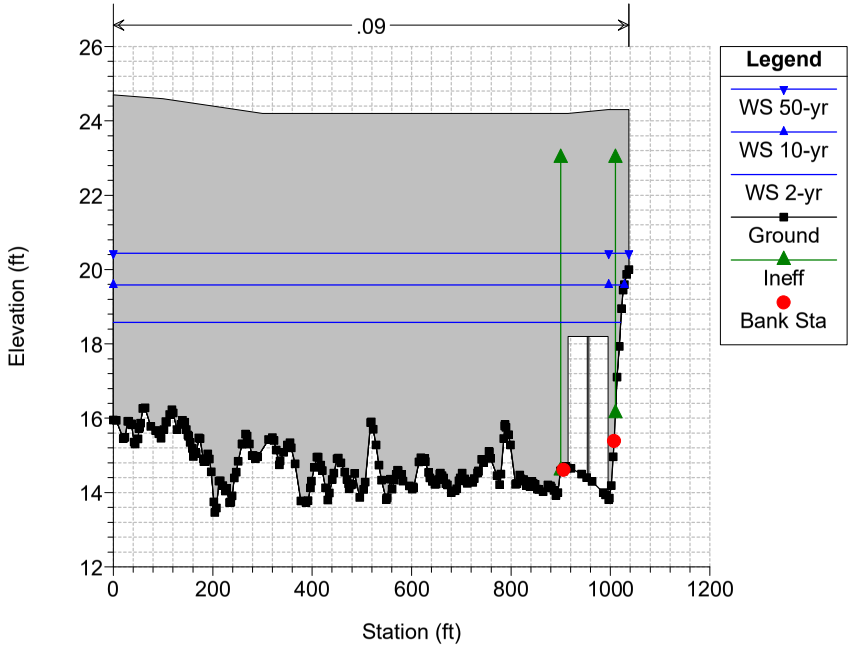
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4481 CSX RR BRIDGE OVER BAGSHAW SWAMP - DOWNSTREAM FACE



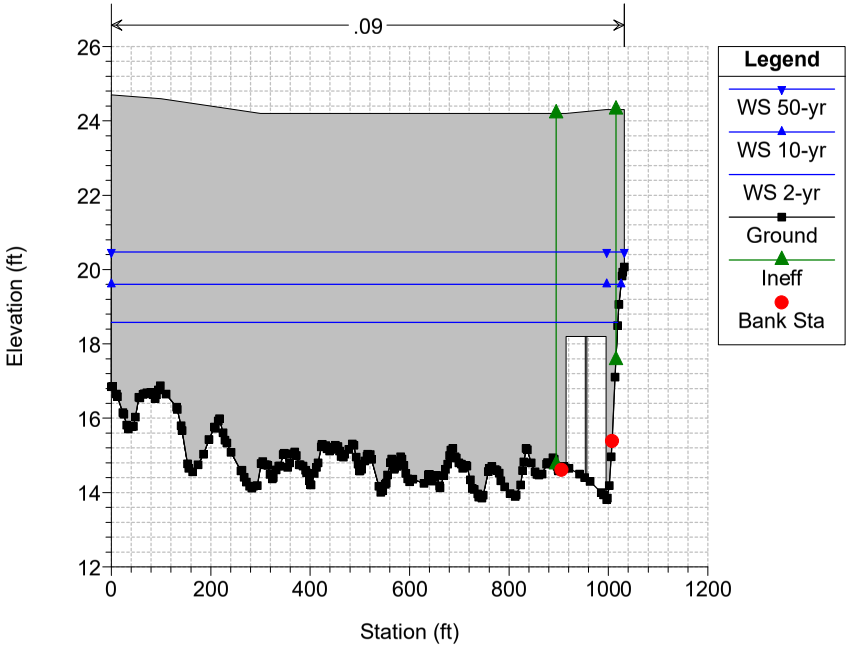
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4540 BR CSX RR BRIDGE OVER BAGSHAW SWAMP



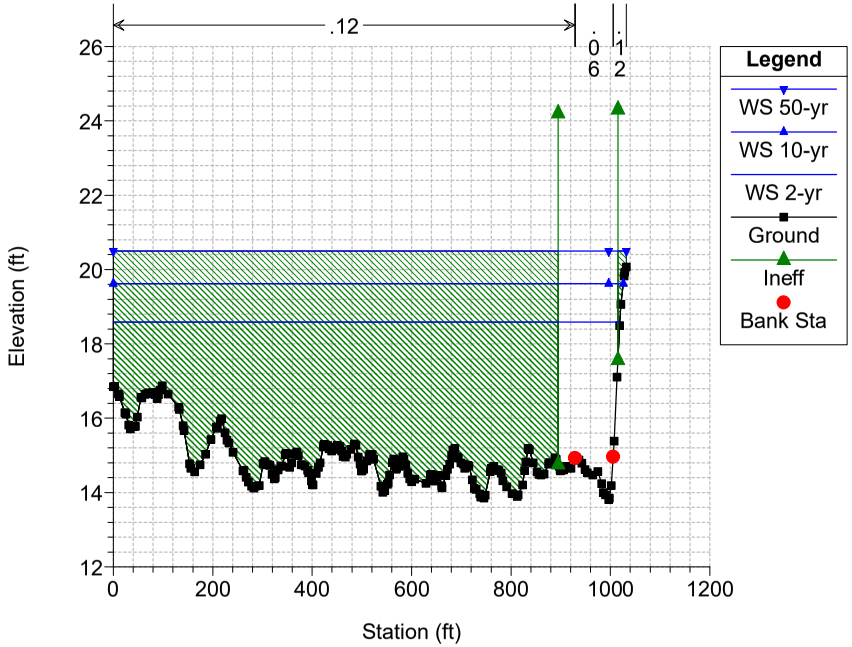
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4540 BR CSX RR BRIDGE OVER BAGSHAW SWAMP



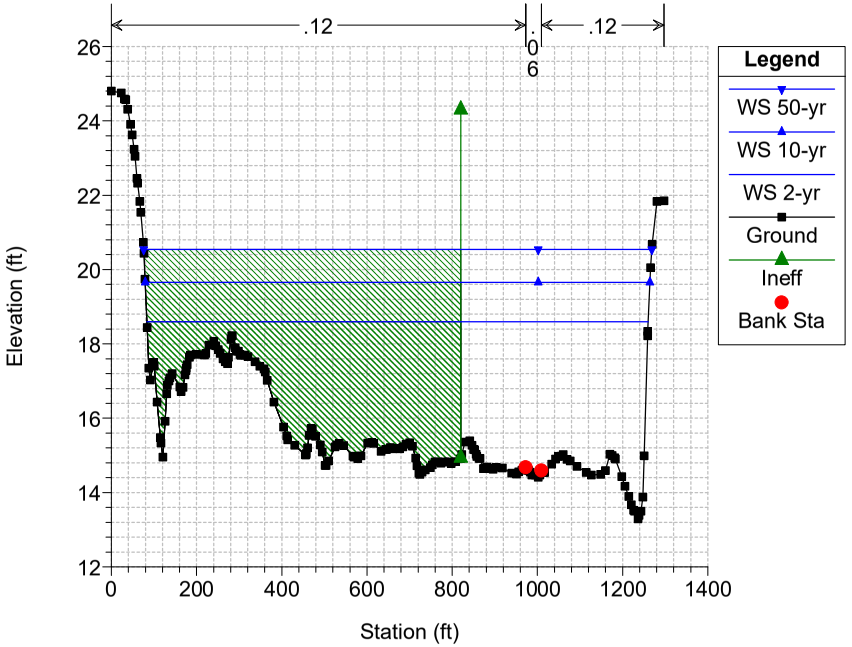
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4609 CSX RR BRIDGE OVER BAGSHAW SWAMP - UPSTREAM FACE



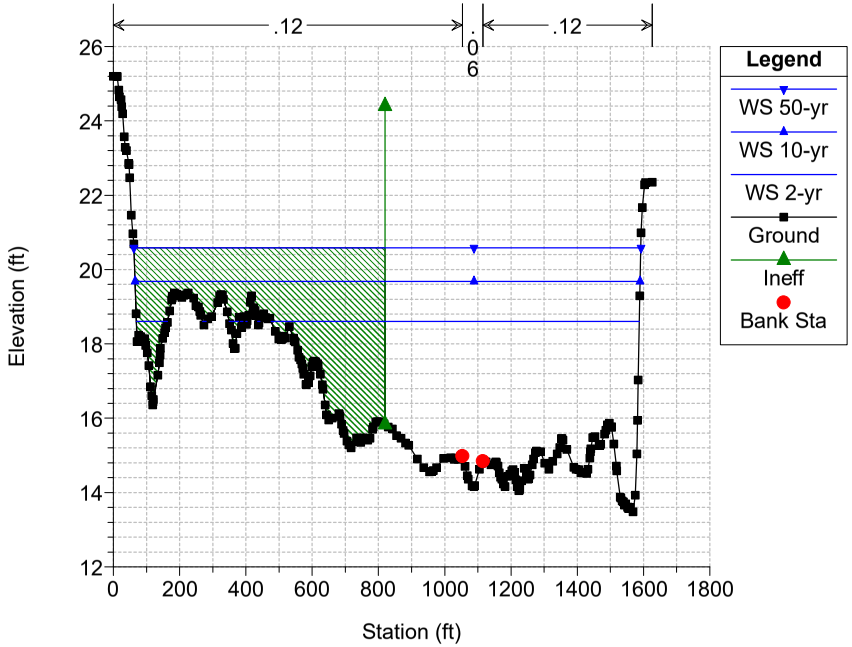
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 4837



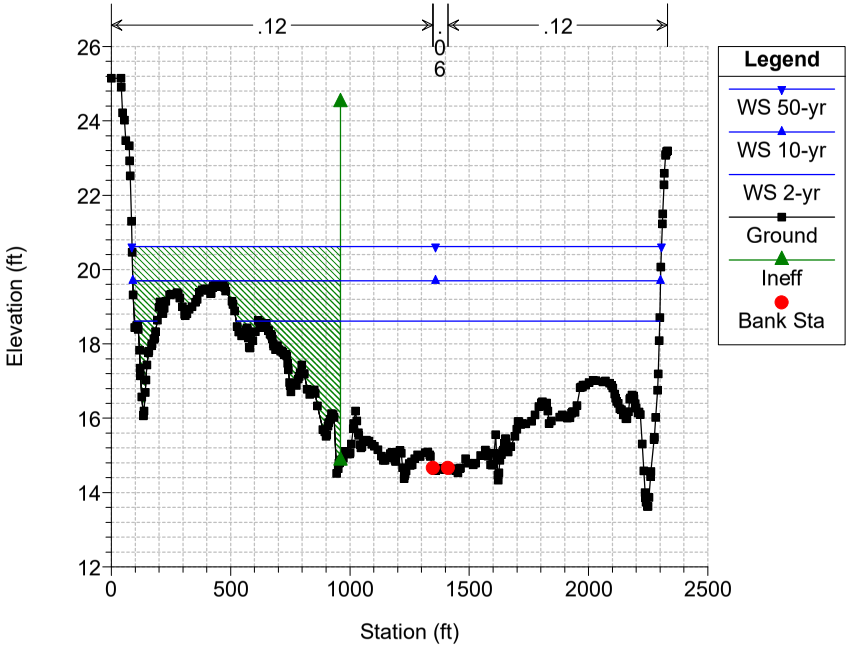
I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

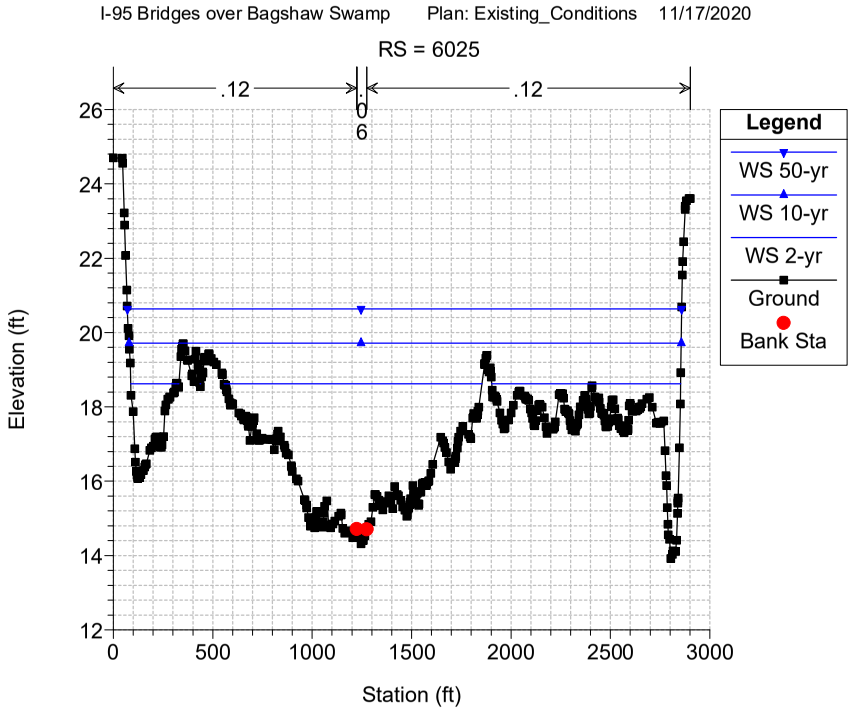
RS = 5134

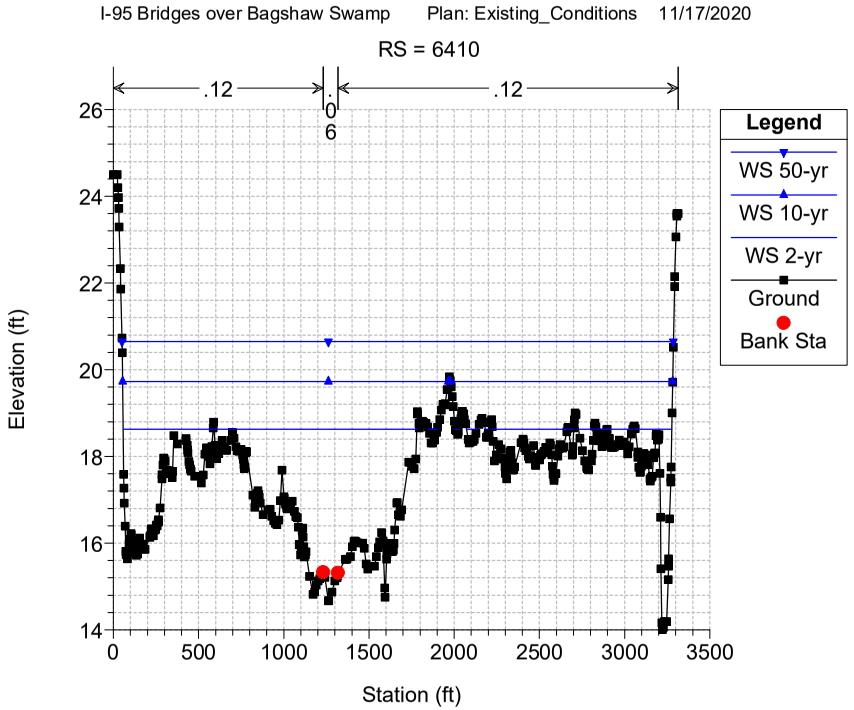


I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020

RS = 5615




I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 6025
.12
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 6410
.12
.12
Legend
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Plan: EXISTING River: Bagshaw Swamp Reach: Bagshaw Swamp

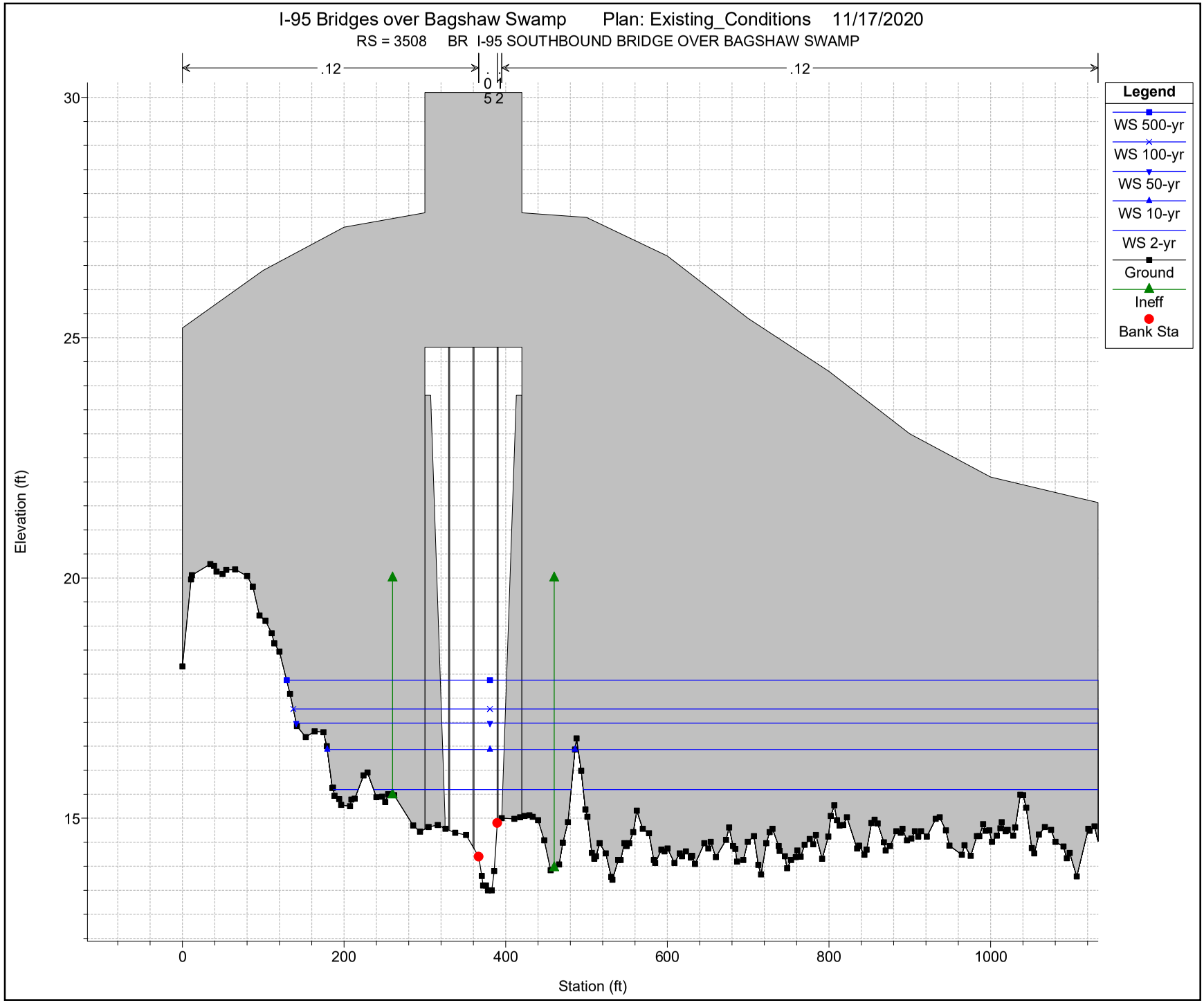
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	1517	2-yr	130.00	12.20	14.90	13.07	14.90	0.000034	0.24	1382.12	1575.94	0.03
Bagshaw Swamp	1517	10-yr	255.00	12.20	15.80	13.37	15.80	0.000018	0.22	3100.11	2258.22	0.02
Bagshaw Swamp	1517	50-yr	330.00	12.20	16.50	13.45	16.50	0.000009	0.18	4905.92	2835.22	0.02
Bagshaw Swamp	1517	100-yr	350.00	12.20	16.90	13.47	16.90	0.000006	0.15	6096.85	3154.95	0.01
Bagshaw Swamp	1517	500-yr	455.00	12.20	17.50	13.54	17.50	0.000005	0.15	8067.26	3443.41	0.01
Bagshaw Swamp	1984	2-yr	130.00	13.09	14.92	13.42	14.92	0.000029	0.19	1532.57	1687.36	0.03
Bagshaw Swamp	1984	10-yr	255.00	13.09	15.81	13.56	15.81	0.000015	0.18	3290.72	2166.79	0.02
Bagshaw Swamp	1984	50-yr	330.00	13.09	16.50	13.62	16.50	0.000008	0.15	4936.19	2621.71	0.01
Bagshaw Swamp	1984	100-yr	350.00	13.09	16.90	13.64	16.90	0.000005	0.13	5986.22	2782.77	0.01
Bagshaw Swamp	1984	500-yr	455.00	13.09	17.50	13.70	17.50	0.000004	0.13	7621.52	2919.60	0.01
Bagshaw Swamp	2394	2-yr	130.00	12.73	14.93	13.55	14.93	0.000038	0.21	1463.87	1693.09	0.03
Bagshaw Swamp	2394	10-yr	255.00	12.73	15.81	13.73	15.81	0.000017	0.19	3141.42	2009.64	0.02
Bagshaw Swamp	2394	50-yr	330.00	12.73	16.51	13.80	16.51	0.000009	0.16	4555.14	2426.71	0.02
Bagshaw Swamp	2394	100-yr	350.00	12.73	16.90	13.84	16.90	0.000006	0.14	5386.15	2474.02	0.01
Bagshaw Swamp	2394	500-yr	455.00	12.73	17.50	13.88	17.50	0.000005	0.15	6640.71	2489.61	0.01
Bagshaw Swamp	2600	2-yr	130.00	13.09	14.94	13.46	14.94	0.000057	0.25	1026.68	1099.50	0.04
Bagshaw Swamp	2600	10-yr	255.00	13.09	15.82	13.61	15.82	0.000033	0.26	1994.91	1506.98	0.03
Bagshaw Swamp	2600	50-yr	330.00	13.09	16.51	13.69	16.51	0.000019	0.23	2975.84	1950.83	0.02
Bagshaw Swamp	2600	100-yr	350.00	13.09	16.91	13.71	16.91	0.000013	0.20	3551.98	2035.65	0.02
Bagshaw Swamp	2600	500-yr	455.00	13.09	17.51	13.74	17.51	0.000011	0.21	4424.12	2039.89	0.02
Bagshaw Swamp	2800	2-yr	130.00	13.40	14.96	13.80	14.96	0.000179	0.40	591.24	654.00	0.06
Bagshaw Swamp	2800	10-yr	255.00	13.40	15.83	13.95	15.83	0.000095	0.40	1256.88	1250.37	0.05
Bagshaw Swamp	2800	50-yr	330.00	13.40	16.52	14.01	16.52	0.000050	0.35	1861.57	1577.67	0.04
Bagshaw Swamp	2800	100-yr	350.00	13.40	16.91	14.02	16.91	0.000034	0.31	2209.81	1653.28	0.03
Bagshaw Swamp	2800	500-yr	455.00	13.40	17.51	14.07	17.51	0.000029	0.33	2738.68	1654.67	0.03
Bagshaw Swamp	2975	2-yr	130.00	13.26	14.98	13.71	14.98	0.000133	0.39	690.13	635.73	0.05
Bagshaw Swamp	2975	10-yr	255.00	13.26	15.84	13.86	15.85	0.000089	0.42	1219.00	1058.03	0.05
Bagshaw Swamp	2975	50-yr	330.00	13.26	16.52	13.90	16.53	0.000057	0.40	1639.97	1264.10	0.04
Bagshaw Swamp	2975	100-yr	350.00	13.26	16.92	13.97	16.92	0.000041	0.36	1883.37	1295.13	0.03
Bagshaw Swamp	2975	500-yr	455.00	13.26	17.51	14.04	17.51	0.000038	0.39	2256.13	1425.88	0.03
Bagshaw Swamp	3100	2-yr	130.00	13.38	15.00	13.87	15.00	0.000286	0.48	507.97	696.50	0.08
Bagshaw Swamp	3100	10-yr	255.00	13.38	15.86	14.12	15.86	0.000162	0.51	909.37	986.88	0.06
Bagshaw Swamp	3100	50-yr	330.00	13.38	16.53	14.16	16.53	0.000101	0.49	1226.97	993.23	0.05
Bagshaw Swamp	3100	100-yr	350.00	13.38	16.92	14.16	16.92	0.000071	0.45	1410.07	996.88	0.04
Bagshaw Swamp	3100	500-yr	455.00	13.38	17.52	14.23	17.52	0.000066	0.48	1690.75	1166.80	0.04
Bagshaw Swamp	3166	2-yr	130.00	12.10	15.02	12.84	15.03	0.000306	0.84	332.73	667.32	0.09
Bagshaw Swamp	3166	10-yr	255.00	12.10	15.87	13.25	15.87	0.000232	0.87	671.20	992.80	0.08
Bagshaw Swamp	3166	50-yr	330.00	12.10	16.54	13.46	16.54	0.000151	0.79	940.09	1006.53	0.07
Bagshaw Swamp	3166	100-yr	350.00	12.10	16.93	13.51	16.93	0.000109	0.71	1095.24	1012.03	0.06
Bagshaw Swamp	3166	500-yr	455.00	12.10	17.52	13.78	17.53	0.000101	0.74	1333.98	1106.44	0.06
Bagshaw Swamp	3214	2-yr	130.00	12.50	15.03	13.37	15.05	0.000597	1.25	210.31	407.65	0.14
Bagshaw Swamp	3214	10-yr	255.00	12.50	15.88	13.90	15.89	0.000507	1.41	394.95	715.70	0.14
Bagshaw Swamp	3214	50-yr	330.00	12.50	16.54	14.22	16.56	0.000343	1.32	566.52	874.45	0.12
Bagshaw Swamp	3214	100-yr	350.00	12.50	16.93	14.29	16.94	0.000247	1.19	672.94	950.03	0.10
Bagshaw Swamp	3214	500-yr	455.00	12.50	17.53	14.62	17.54	0.000227	1.24	848.54	1015.77	0.10
Bagshaw Swamp	3276	2-yr	130.00	11.90	15.07	13.13	15.10	0.000695	1.52	130.27	2246.00	0.16
Bagshaw Swamp	3276	10-yr	255.00	11.90	15.90	13.70	15.95	0.000912	2.07	200.30	2578.57	0.19
Bagshaw Swamp	3276	50-yr	330.00	11.90	16.55	14.11	16.61	0.000781	2.14	257.45	2647.73	0.18
Bagshaw Swamp	3276	100-yr	350.00	11.90	16.93	14.18	16.98	0.000626	2.03	292.24	2698.13	0.17
Bagshaw Swamp	3276	500-yr	455.00	11.90	17.52	14.52	17.58	0.000662	2.26	357.04	2775.78	0.17
Bagshaw Swamp	3370		Bridge									
Bagshaw Swamp	3406	2-yr	130.00	11.00	15.18	12.84	15.20	0.000471	1.27	115.97	268.09	0.13
Bagshaw Swamp	3406	10-yr	255.00	11.00	16.08	13.34	16.12	0.000577	1.69	243.60	1566.80	0.15
Bagshaw Swamp	3406	50-yr	330.00	11.00	16.75	13.60	16.78	0.000458	1.68	349.59	2349.75	0.14
Bagshaw Swamp	3406	100-yr	350.00	11.00	17.10	13.66	17.13	0.000361	1.57	406.80	2502.11	0.13
Bagshaw Swamp	3406	500-yr	455.00	11.00	17.73	13.98	17.76	0.000350	1.67	506.95	2710.96	0.13
Bagshaw Swamp	3417	2-yr	130.00	13.10	15.18	14.00	15.21	0.001155	1.49	108.20	486.59	0.20
Bagshaw Swamp	3417	10-yr	255.00	13.10	16.10	14.36	16.13	0.000839	1.67	244.35	1704.93	0.18
Bagshaw Swamp	3417	50-yr	330.00	13.10	16.76	14.55	16.79	0.000564	1.58	350.42	2365.43	0.15
Bagshaw Swamp	3417	100-yr	350.00	13.10	17.11	14.59	17.14	0.000421	1.46	407.32	2551.43	0.13
Bagshaw Swamp	3417	500-yr	455.00	13.10	17.74	14.80	17.77	0.000381	1.54	507.53	2759.08	0.13
Bagshaw Swamp	3428	2-yr	130.00	11.90	15.19	13.13	15.23	0.000816	1.60	90.66	229.52	0.17
Bagshaw Swamp	3428	10-yr	255.00	11.90	16.09	13.70	16.15	0.000967	2.12	192.62	1316.79	0.20
Bagshaw Swamp	3428	50-yr	330.00	11.90	16.75	14.00	16.81	0.000729	2.06	291.59	2023.92	0.18
Bagshaw Swamp	3428	100-yr	350.00	11.90	17.11	14.08	17.15	0.000561	1.90	345.01	2257.79	0.16
Bagshaw Swamp	3428	500-yr	455.00	11.90	17.74	14.41	17.78	0.000525	2.00	438.92	2600.15	0.15
Bagshaw Swamp	3508		Bridge									
Bagshaw Swamp	3588	2-yr	130.00	11.60	15.72	13.17	15.74	0.000301	1.06	246.42	2555.20	0.10
Bagshaw Swamp	3588	10-yr	255.00	11.60	16.59	13.77	16.61	0.000331	1.31	420.27	2648.73	0.11
Bagshaw Swamp	3588	50-yr	330.00	11.60	17.14	14.09	17.16	0.000297	1.35	529.93	2699.44	0.11
Bagshaw Swamp	3588	100-yr	350.00	11.60	17.42	14.17	17.43	0.000253	1.29	585.11	2702.94	0.10
Bagshaw Swamp	3588	500-yr	455.00	11.60	18.03	14.54	18.05	0.000247	1.38	708.12	2711.82	0.10
Bagshaw Swamp	3700	2-yr	130.00	14.19	15.76	14.33	15.76	0.000214	0.39	509.20	2743.17	0.06
Bagshaw Swamp	3700	10-yr	255.00	14.19	16.63	14.46	16.63	0.000146	0.47	839.11	3015.63	0.06
Bagshaw Swamp	3700	50-yr	330.00	14.19	17.18	14.52	17.18	0.000114	0.49	1045.76	3035.84	0.05

HEC-RAS Plan: EXISTING River: Bagshaw Swamp Reach: Bagshaw Swamp (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	3700	100-yr	350.00	14.19	17.45	14.54	17.45	0.000093	0.47	1148.64	3037.71	0.05
Bagshaw Swamp	3700	500-yr	455.00	14.19	18.06	14.61	18.06	0.000083	0.51	1382.31	3041.78	0.05
Bagshaw Swamp	3810	2-yr	130.00	11.45	15.77	12.66	15.77	0.000046	0.41	659.36	2678.78	0.04
Bagshaw Swamp	3810	10-yr	255.00	11.45	16.64	13.06	16.64	0.000055	0.53	999.51	2860.09	0.05
Bagshaw Swamp	3810	50-yr	330.00	11.45	17.18	13.26	17.18	0.000052	0.57	1213.22	2861.38	0.05
Bagshaw Swamp	3810	100-yr	350.00	11.45	17.45	13.30	17.45	0.000045	0.55	1319.81	2862.68	0.05
Bagshaw Swamp	3810	500-yr	455.00	11.45	18.07	13.53	18.07	0.000046	0.60	1563.85	2865.70	0.05
Bagshaw Swamp	3880	2-yr	130.00	12.88	15.77	13.90	15.78	0.000063	0.38	741.33	2620.28	0.05
Bagshaw Swamp	3880	10-yr	255.00	12.88	16.64	14.12	16.64	0.000060	0.47	1145.77	2800.20	0.05
Bagshaw Swamp	3880	50-yr	330.00	12.88	17.19	14.24	17.19	0.000053	0.49	1400.37	2854.07	0.05
Bagshaw Swamp	3880	100-yr	350.00	12.88	17.46	14.33	17.46	0.000045	0.47	1527.12	2855.15	0.04
Bagshaw Swamp	3880	500-yr	455.00	12.88	18.07	14.45	18.07	0.000043	0.51	1817.61	2857.74	0.04
Bagshaw Swamp	3980	2-yr	130.00	13.57	15.81	14.79	15.82	0.000804	0.97	251.20	372.68	0.13
Bagshaw Swamp	3980	10-yr	255.00	13.57	16.67	15.08	16.68	0.000486	1.00	472.06	383.56	0.11
Bagshaw Swamp	3980	50-yr	330.00	13.57	17.21	15.19	17.22	0.000367	0.99	612.39	392.54	0.10
Bagshaw Swamp	3980	100-yr	350.00	13.57	17.47	15.22	17.48	0.000296	0.94	682.49	398.02	0.09
Bagshaw Swamp	3980	500-yr	455.00	13.57	18.09	15.35	18.09	0.000258	0.98	846.74	414.71	0.09
Bagshaw Swamp	4075		Inl Struct									
Bagshaw Swamp	4175	2-yr	130.00	15.08	18.54	14.39	18.54	0.000004	0.10	2211.50	600.29	0.01
Bagshaw Swamp	4175	10-yr	255.00	15.08	19.54	14.51	19.54	0.000006	0.16	2817.85	614.51	0.01
Bagshaw Swamp	4175	50-yr	330.00	15.08	20.37	14.56	20.37	0.000006	0.18	3330.16	625.50	0.01
Bagshaw Swamp	4175	100-yr	350.00	15.08	20.62	14.58	20.62	0.000006	0.18	3488.64	626.64	0.01
Bagshaw Swamp	4175	500-yr	455.00	15.08	21.25	14.65	21.25	0.000007	0.22	3881.83	629.12	0.02
Bagshaw Swamp	4275	2-yr	140.00	15.27	18.54	16.04	18.54	0.000051	0.36	723.38	663.87	0.04
Bagshaw Swamp	4275	10-yr	260.00	15.27	19.54	16.18	19.54	0.000059	0.47	1010.68	672.09	0.04
Bagshaw Swamp	4275	50-yr	330.00	15.27	20.37	16.26	20.37	0.000047	0.48	1254.59	677.30	0.04
Bagshaw Swamp	4275	100-yr	350.00	15.27	20.62	16.29	20.62	0.000044	0.47	1329.83	677.30	0.04
Bagshaw Swamp	4275	500-yr	460.00	15.27	21.25	16.35	21.25	0.000049	0.54	1515.93	677.30	0.04
Bagshaw Swamp	4339	2-yr	140.00	14.94	18.55	15.94	18.55	0.000168	0.71	257.52	984.01	0.07
Bagshaw Swamp	4339	10-yr	260.00	14.94	19.54	16.25	19.55	0.000219	0.97	356.79	1004.49	0.08
Bagshaw Swamp	4339	50-yr	330.00	14.94	20.37	16.41	20.38	0.000178	0.98	452.44	1034.93	0.08
Bagshaw Swamp	4339	100-yr	350.00	14.94	20.62	16.44	20.63	0.000163	0.97	482.78	1034.93	0.07
Bagshaw Swamp	4339	500-yr	460.00	14.94	21.25	16.65	21.26	0.000177	1.09	557.81	1034.93	0.08
Bagshaw Swamp	4408		Bridge									
Bagshaw Swamp	4468	2-yr	140.00	14.40	18.57	14.80	18.57	0.000034	0.36	523.03	1021.39	0.03
Bagshaw Swamp	4468	10-yr	260.00	14.40	19.58	14.98	19.59	0.000054	0.53	669.80	1028.80	0.04
Bagshaw Swamp	4468	50-yr	330.00	14.40	20.44	15.07	20.44	0.000051	0.57	801.50	1037.78	0.04
Bagshaw Swamp	4468	100-yr	350.00	14.40	20.70	15.09	20.70	0.000049	0.57	842.16	1037.78	0.04
Bagshaw Swamp	4468	500-yr	460.00	14.40	21.37	15.23	21.37	0.000059	0.68	947.59	1037.78	0.05
Bagshaw Swamp	4481	2-yr	140.00	13.81	18.57	14.41	18.58	0.000025	0.34	465.11	1019.48	0.03
Bagshaw Swamp	4481	10-yr	260.00	13.81	19.59	14.64	19.59	0.000043	0.52	576.40	1028.31	0.04
Bagshaw Swamp	4481	50-yr	330.00	13.81	20.44	14.76	20.44	0.000043	0.56	670.41	1036.97	0.04
Bagshaw Swamp	4481	100-yr	350.00	13.81	20.70	14.79	20.70	0.000042	0.58	698.75	1036.97	0.04
Bagshaw Swamp	4481	500-yr	460.00	13.81	21.37	14.95	21.37	0.000053	0.68	772.24	1036.97	0.04
Bagshaw Swamp	4540		Bridge									
Bagshaw Swamp	4609	2-yr	140.00	13.81	18.58	14.91	18.59	0.000032	0.36	471.32	1018.75	0.03
Bagshaw Swamp	4609	10-yr	260.00	13.81	19.62	15.12	19.62	0.000052	0.53	595.59	1025.87	0.04
Bagshaw Swamp	4609	50-yr	330.00	13.81	20.49	15.22	20.50	0.000049	0.57	700.48	1031.70	0.04
Bagshaw Swamp	4609	100-yr	350.00	13.81	20.76	15.25	20.76	0.000048	0.58	732.15	1031.70	0.04
Bagshaw Swamp	4609	500-yr	460.00	13.81	21.47	15.40	21.47	0.000057	0.69	817.43	1031.70	0.05
Bagshaw Swamp	4837	2-yr	402.00	14.41	18.60	14.85	18.60	0.000048	0.44	1733.16	1176.43	0.04
Bagshaw Swamp	4837	10-yr	1060.00	14.41	19.65	15.23	19.66	0.000152	0.91	2199.91	1184.69	0.07
Bagshaw Swamp	4837	50-yr	1790.00	14.41	20.54	15.52	20.55	0.000253	1.30	2596.80	1192.73	0.09
Bagshaw Swamp	4837	100-yr	2160.00	14.41	20.82	15.64	20.83	0.000318	1.51	2719.63	1196.61	0.11
Bagshaw Swamp	4837	500-yr	3020.00	14.41	21.54	15.97	21.56	0.000432	1.89	3050.75	1208.81	0.13
Bagshaw Swamp	5134	2-yr	402.00	14.16	18.61	14.73	18.61	0.000018	0.27	2897.15	1262.84	0.02
Bagshaw Swamp	5134	10-yr	1060.00	14.16	19.68	15.10	19.68	0.000054	0.55	3722.93	1524.55	0.04
Bagshaw Swamp	5134	50-yr	1790.00	14.16	20.59	15.36	20.59	0.000088	0.78	4423.00	1530.11	0.06
Bagshaw Swamp	5134	100-yr	2160.00	14.16	20.87	15.47	20.88	0.000109	0.89	4643.19	1532.63	0.06
Bagshaw Swamp	5134	500-yr	3020.00	14.16	21.62	15.71	21.63	0.000145	1.11	5224.52	1542.48	0.07
Bagshaw Swamp	5615	2-yr	402.00	14.59	18.61	15.00	18.61	0.000012	0.21	4126.46	1867.55	0.02
Bagshaw Swamp	5615	10-yr	1060.00	14.59	19.70	15.37	19.70	0.000031	0.41	5583.87	2212.48	0.03
Bagshaw Swamp	5615	50-yr	1790.00	14.59	20.62	15.60	20.62	0.000046	0.55	6819.89	2220.11	0.04
Bagshaw Swamp	5615	100-yr	2160.00	14.59	20.91	15.68	20.91	0.000055	0.63	7213.93	2222.58	0.04
Bagshaw Swamp	5615	500-yr	3020.00	14.59	21.68	15.87	21.68	0.000070	0.76	8244.38	2229.75	0.05
Bagshaw Swamp	6025	2-yr	402.00	14.32	18.62		18.62	0.000018	0.27	4411.41	2487.91	0.02
Bagshaw Swamp	6025	10-yr	1060.00	14.32	19.71		19.71	0.000033	0.43	7304.80	2776.55	0.03
Bagshaw Swamp	6025	50-yr	1790.00	14.32	20.64		20.64	0.000036	0.50	9875.22	2788.33	0.04
Bagshaw Swamp	6025	100-yr	2160.00	14.32	20.93		20.93	0.000040	0.54	10699.82	2791.03	0.04
Bagshaw Swamp	6025	500-yr	3020.00	14.32	21.70		21.70	0.000044	0.61	12843.67	2798.14	0.04
Bagshaw Swamp	6410	2-yr	402.00	14.67	18.63		18.63	0.000023	0.28	4023.88	2864.23	0.03
Bagshaw Swamp	6410	10-yr	1060.00	14.67	19.73		19.73	0.000033	0.40	7466.39	3216.81	0.03
Bagshaw Swamp	6410	50-yr	1790.00	14.67	20.65		20.65	0.000034	0.46	10452.87	3235.15	0.03
Bagshaw Swamp	6410	100-yr	2160.00	14.67	20.95		20.95	0.000038	0.50	11414.34	3238.54	0.04

HEC-RAS Plan: EXISTING River: Bagshaw Swamp Reach: Bagshaw Swamp (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	6410	500-yr	3020.00	14.67	21.72		21.72	0.000039	0.55	13905.31	3247.59	0.04


I-95 Bridges over Bagshaw Swamp Plan: Existing_Conditions 11/17/2020
RS = 3508 BR I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP
.12
.01
.52
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
30
25
20
15
0
200
400
600
800
1000
Station (ft)

Plan: EXISTING Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 2-yr

E.G. US. (ft)	15.74	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	15.72	E.G. Elev (ft)	15.67	15.41
Q Total (cfs)	130.00	W.S. Elev (ft)	15.60	15.23
Q Bridge (cfs)	130.00	Crit W.S. (ft)	14.84	14.81
Q Weir (cfs)		Max Chl Dpth (ft)	2.10	1.53
Weir Sta Lft (ft)		Vel Total (ft/s)	1.55	3.27
Weir Sta Rgt (ft)		Flow Area (sq ft)	83.62	39.72
Weir Submerg		Froude # Chl	0.32	0.54
Weir Max Depth (ft)		Specif Force (cu ft)	68.08	38.72
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	1.22	1.10
Min El Prs (ft)	24.80	W.P. Total (ft)	74.70	39.12
Delta EG (ft)	0.51	Conv. Total (cfs)	2263.1	1242.5
Delta WS (ft)	0.54	Top Width (ft)	68.46	36.02
BR Open Area (sq ft)	870.12	Frctn Loss (ft)	0.23	0.12
BR Open Vel (ft/s)	3.27	C & E Loss (ft)	0.03	0.07
BR Sluice Coef		Shear Total (lb/sq ft)	0.23	0.69
BR Sel Method	Energy only	Power Total (lb/ft s)	0.36	2.27

Plan: EXISTING Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 10-yr

E.G. US. (ft)	16.61	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	16.59	E.G. Elev (ft)	16.54	16.33
Q Total (cfs)	255.00	W.S. Elev (ft)	16.43	16.15
Q Bridge (cfs)	255.00	Crit W.S. (ft)	15.28	15.30
Q Weir (cfs)		Max Chl Dpth (ft)	2.93	2.45
Weir Sta Lft (ft)		Vel Total (ft/s)	1.79	2.73
Weir Sta Rgt (ft)		Flow Area (sq ft)	142.13	93.53
Weir Submerg		Froude # Chl	0.33	0.43
Weir Max Depth (ft)		Specif Force (cu ft)	172.73	109.72
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	1.98	1.32
Min El Prs (ft)	24.80	W.P. Total (ft)	83.50	78.65
Delta EG (ft)	0.45	Conv. Total (cfs)	4574.7	3140.6
Delta WS (ft)	0.50	Top Width (ft)	71.87	70.72
BR Open Area (sq ft)	870.12	Frctn Loss (ft)	0.18	0.12
BR Open Vel (ft/s)	2.73	C & E Loss (ft)	0.02	0.06
BR Sluice Coef		Shear Total (lb/sq ft)	0.33	0.49
BR Sel Method	Energy only	Power Total (lb/ft s)	0.59	1.33

Plan: EXISTING Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 50-yr

E.G. US. (ft)	17.16	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	17.14	E.G. Elev (ft)	17.09	16.94
Q Total (cfs)	330.00	W.S. Elev (ft)	16.98	16.79
Q Bridge (cfs)	330.00	Crit W.S. (ft)	15.48	15.57
Q Weir (cfs)		Max Chl Dpth (ft)	3.48	3.09
Weir Sta Lft (ft)		Vel Total (ft/s)	1.81	2.36
Weir Sta Rgt (ft)		Flow Area (sq ft)	182.19	139.84
Weir Submerg		Froude # Chl	0.31	0.35
Weir Max Depth (ft)		Specif Force (cu ft)	267.57	188.34
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	2.46	1.91
Min El Prs (ft)	24.80	W.P. Total (ft)	89.29	85.43
Delta EG (ft)	0.35	Conv. Total (cfs)	6412.5	4995.0
Delta WS (ft)	0.39	Top Width (ft)	74.11	73.35
BR Open Area (sq ft)	870.12	Frctn Loss (ft)	0.14	0.09
BR Open Vel (ft/s)	2.36	C & E Loss (ft)	0.01	0.05
BR Sluice Coef		Shear Total (lb/sq ft)	0.34	0.45
BR Sel Method	Energy only	Power Total (lb/ft s)	0.61	1.05

Plan: EXISTING Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 100-yr

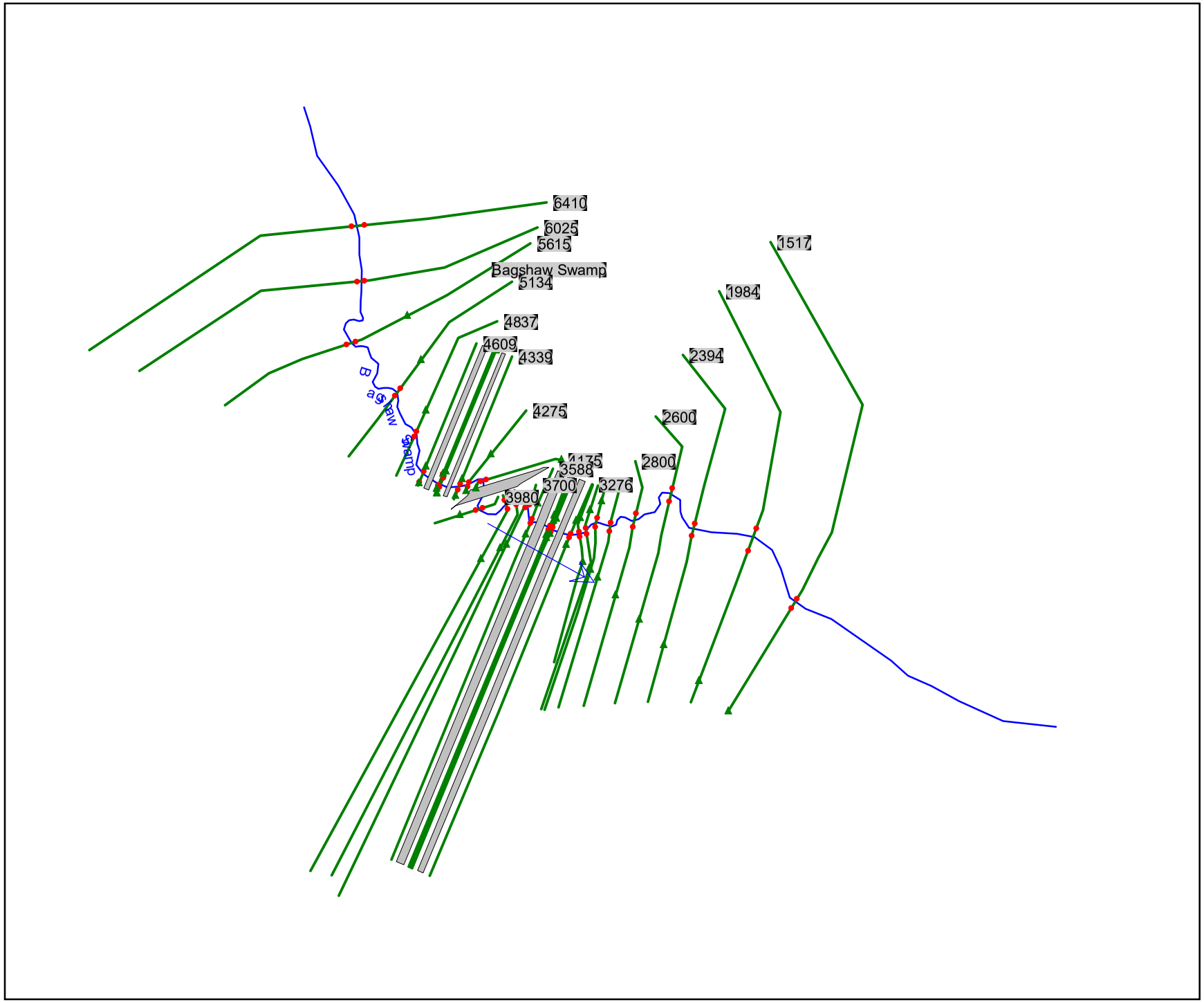
E.G. US. (ft)	17.43	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	17.42	E.G. Elev (ft)	17.37	17.26
Q Total (cfs)	350.00	W.S. Elev (ft)	17.27	17.14
Q Bridge (cfs)	350.00	Crit W.S. (ft)	15.54	15.65
Q Weir (cfs)		Max Chl Dpth (ft)	3.77	3.44
Weir Sta Lft (ft)		Vel Total (ft/s)	1.71	2.12
Weir Sta Rgt (ft)		Flow Area (sq ft)	204.14	165.38
Weir Submerg		Froude # Chl	0.28	0.30
Weir Max Depth (ft)		Specif Force (cu ft)	324.41	239.46
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	2.71	2.21
Min El Prs (ft)	24.80	W.P. Total (ft)	92.39	89.07
Delta EG (ft)	0.28	Conv. Total (cfs)	7487.2	6126.4
Delta WS (ft)	0.31	Top Width (ft)	75.31	74.76
BR Open Area (sq ft)	870.12	Frctn Loss (ft)	0.11	0.07
BR Open Vel (ft/s)	2.12	C & E Loss (ft)	0.01	0.04
BR Sluice Coef		Shear Total (lb/sq ft)	0.30	0.38
BR Sel Method	Energy only	Power Total (lb/ft s)	0.52	0.80

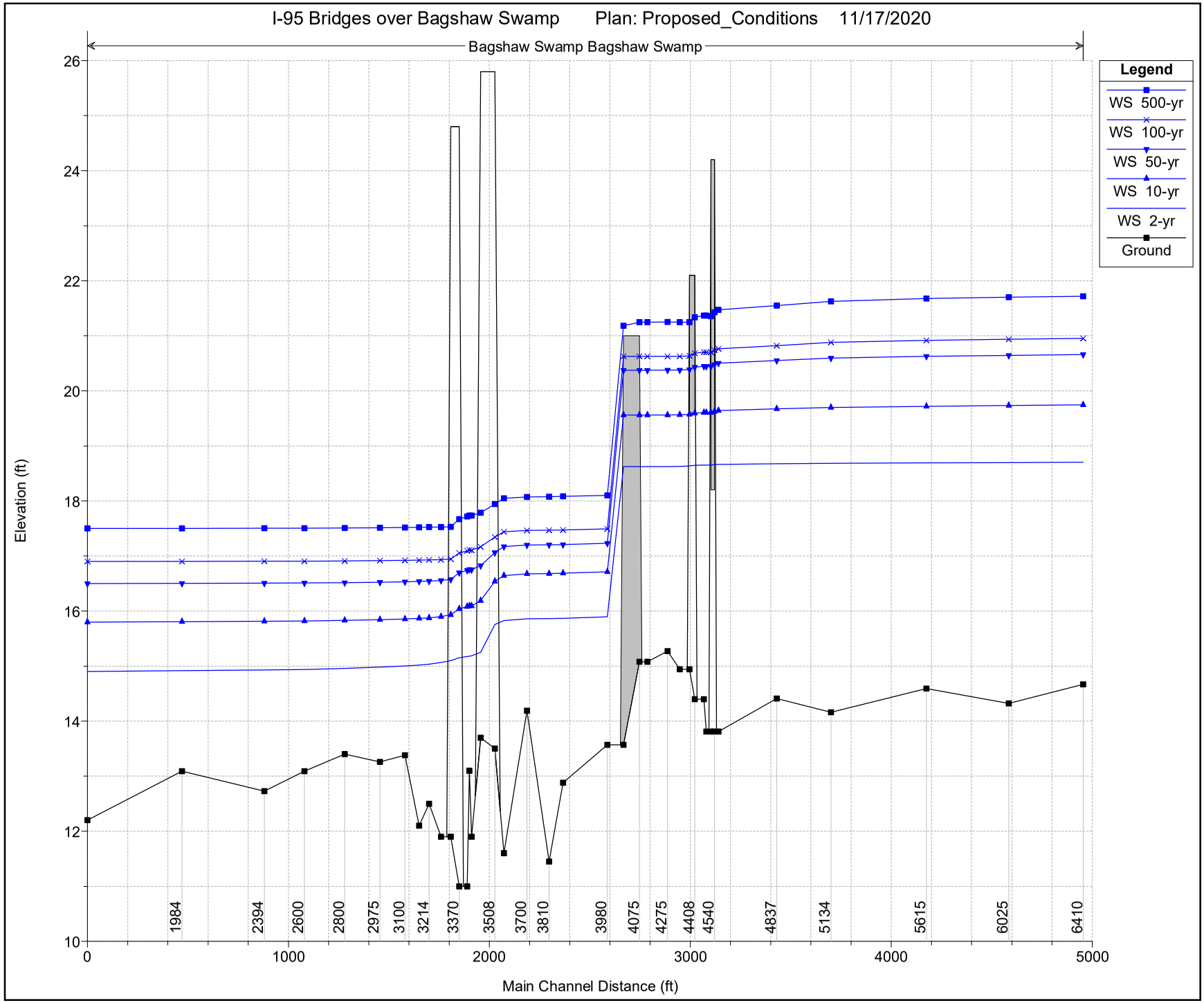
Plan: EXISTING Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 500-yr

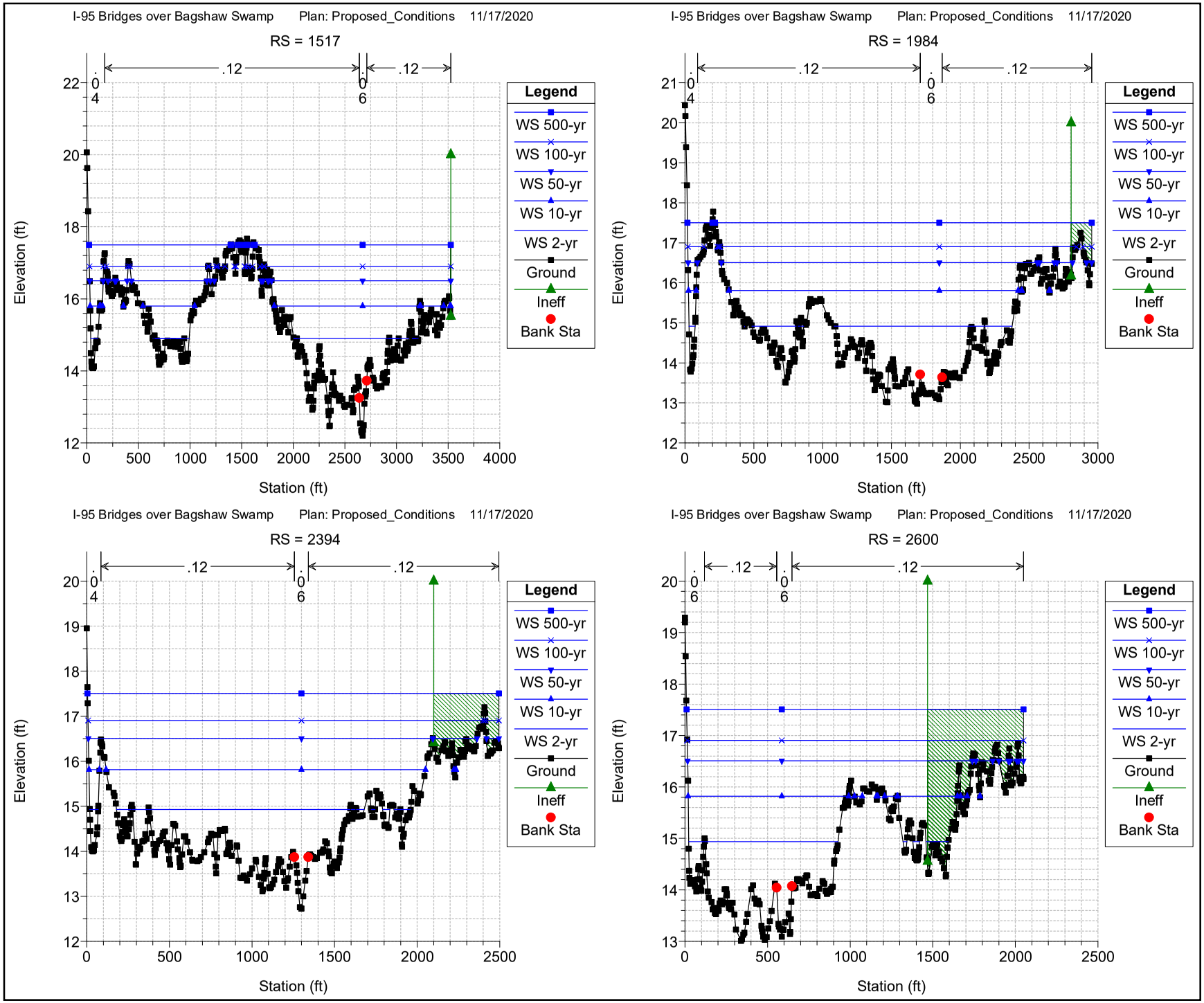
E.G. US. (ft)	18.05	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	18.03	E.G. Elev (ft)	17.99	17.88
Q Total (cfs)	455.00	W.S. Elev (ft)	17.87	17.76
Q Bridge (cfs)	455.00	Crit W.S. (ft)	15.78	15.98
Q Weir (cfs)		Max Chl Dpth (ft)	4.37	4.06
Weir Sta Lft (ft)		Vel Total (ft/s)	1.82	2.14
Weir Sta Rgt (ft)		Flow Area (sq ft)	250.02	212.58
Weir Submerg		Froude # Chl	0.28	0.28
Weir Max Depth (ft)		Specif Force (cu ft)	470.13	365.41
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	3.22	2.75
Min El Prs (ft)	24.80	W.P. Total (ft)	98.72	95.62
Delta EG (ft)	0.27	Conv. Total (cfs)	9863.4	8372.0
Delta WS (ft)	0.29	Top Width (ft)	77.77	77.30
BR Open Area (sq ft)	870.12	Frctn Loss (ft)	0.10	0.06
BR Open Vel (ft/s)	2.14	C & E Loss (ft)	0.00	0.04
BR Sluice Coef		Shear Total (lb/sq ft)	0.34	0.41
BR Sel Method	Energy only	Power Total (lb/ft s)	0.61	0.88

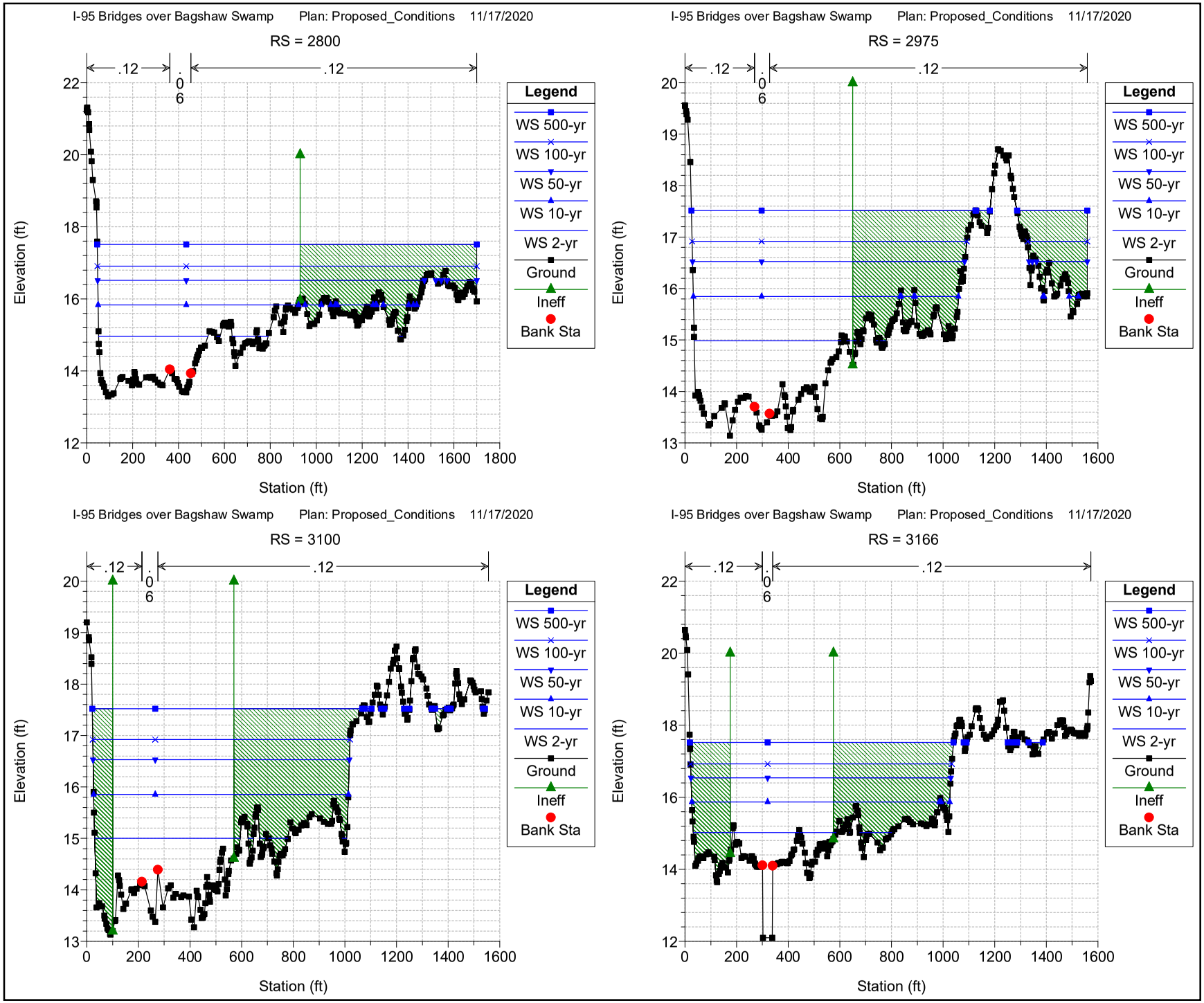
APPENDIX J

HEC-RAS PROPOSED CONDITIONS RESULTS


6410
6025
5615
Bagshaw Swamp
5134
4837
4609
4339
4275
4135
3588
3700
3980
3276
2800
2600
2394
1984
1517
Bagshaw Swamp

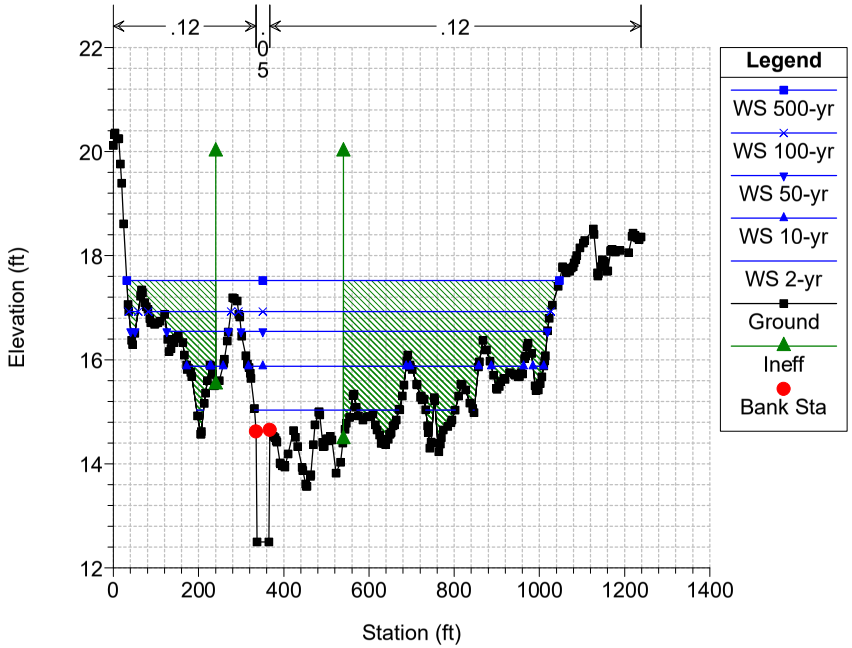

I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
Bagshaw Swamp Bagshaw Swamp
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Elevation (ft)
Main Channel Distance (ft)
26
24
22
20
18
16
14
12
10
0
1000
2000
3000
4000
5000
1984
2394
2600
2800
2975
3100
3214
3370
3508
3700
3810
3980
4075
4275
4408
4540
4837
5134
5615
6025
6410


I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 1517
.12
.12
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 1984
.12
.12
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 2394
.12
.12
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 2600
.12
.12
.06
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta


I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 2800
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 2975
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3100
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3166
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta

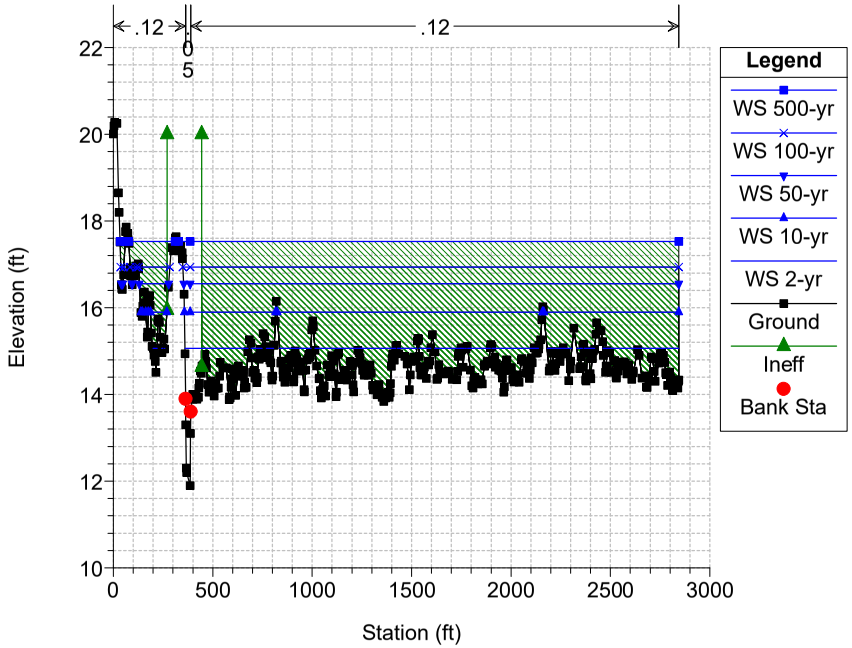
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 3214



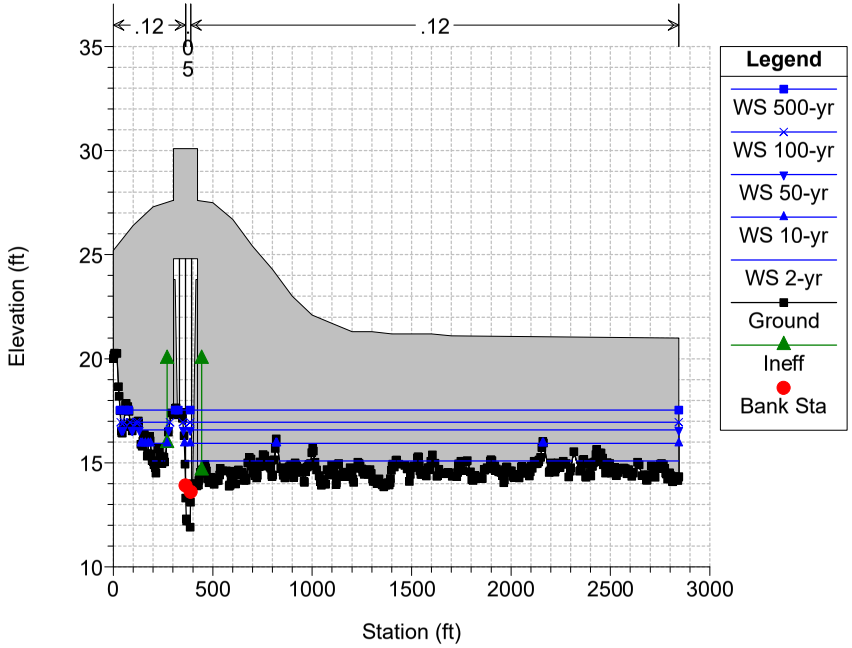
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 3276 I-95 NORTHBOUND BRIDGE - DOWNSTREAM FACE



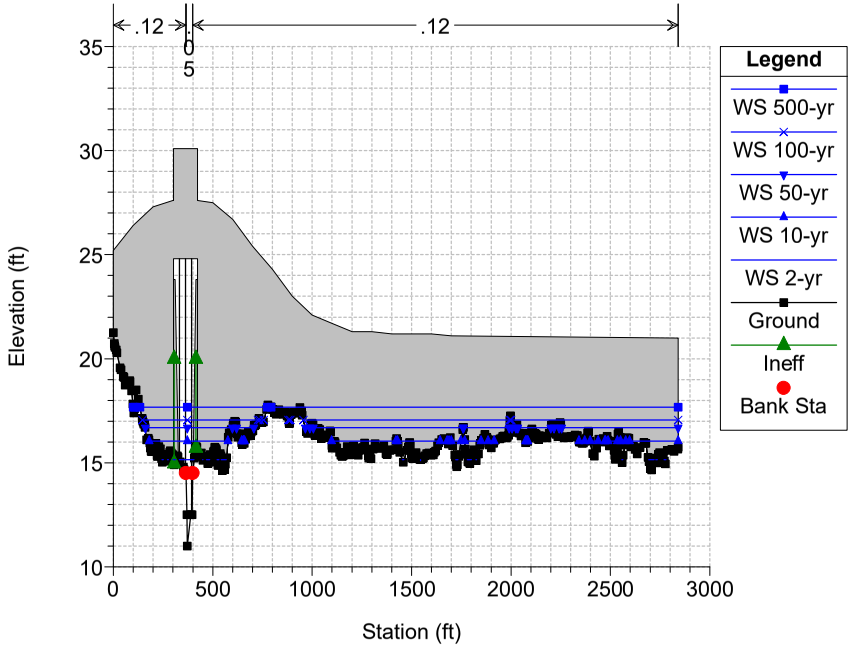
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 3370 BR I-95 NORTHBOUND BRIDGE OVER BAGSHAW SWAMP



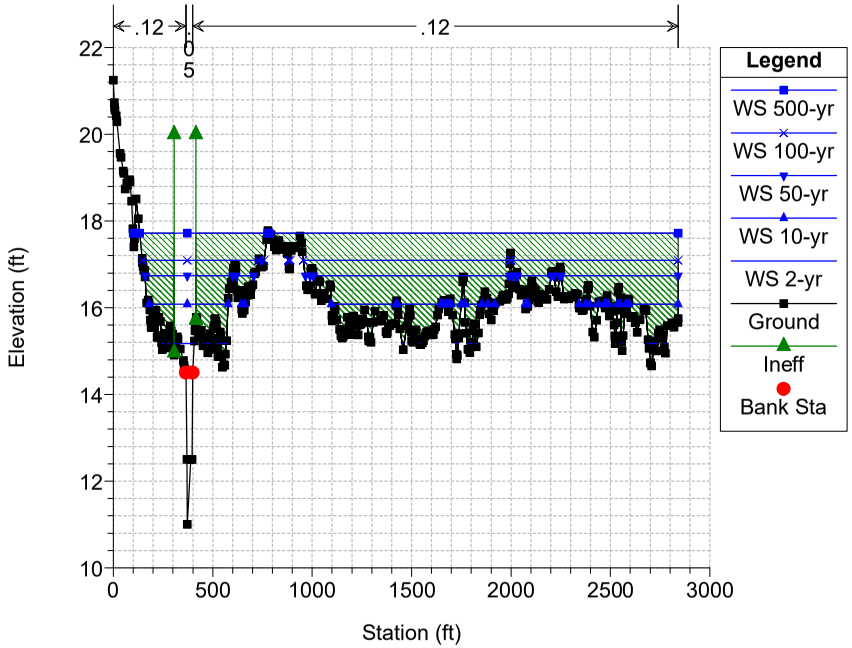
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 3370 BR I-95 NORTHBOUND BRIDGE OVER BAGSHAW SWAMP



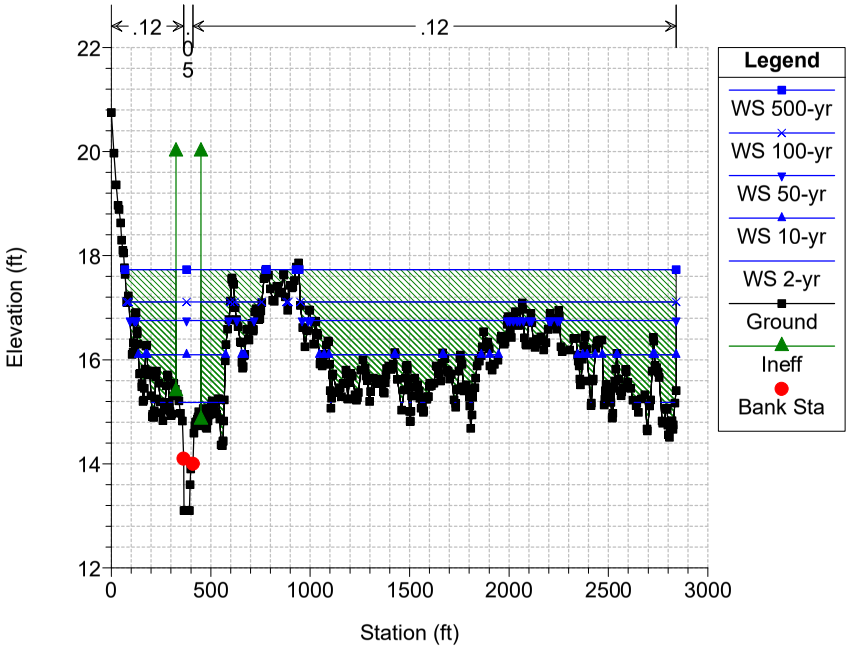
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 3406 I-95 NORTHBOUND BRIDGE - UPSTREAM FACE



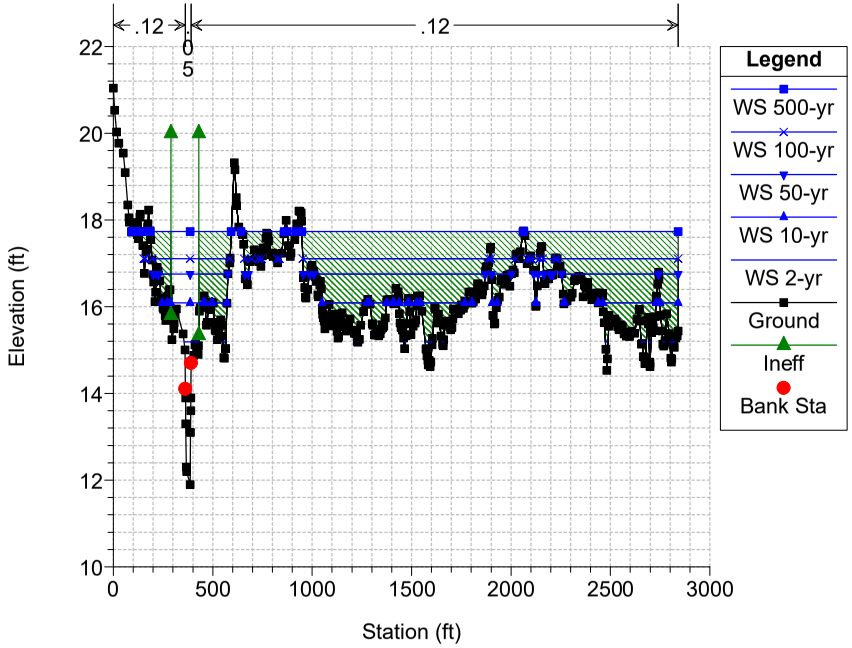
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 3417 I-95 MEDIAN



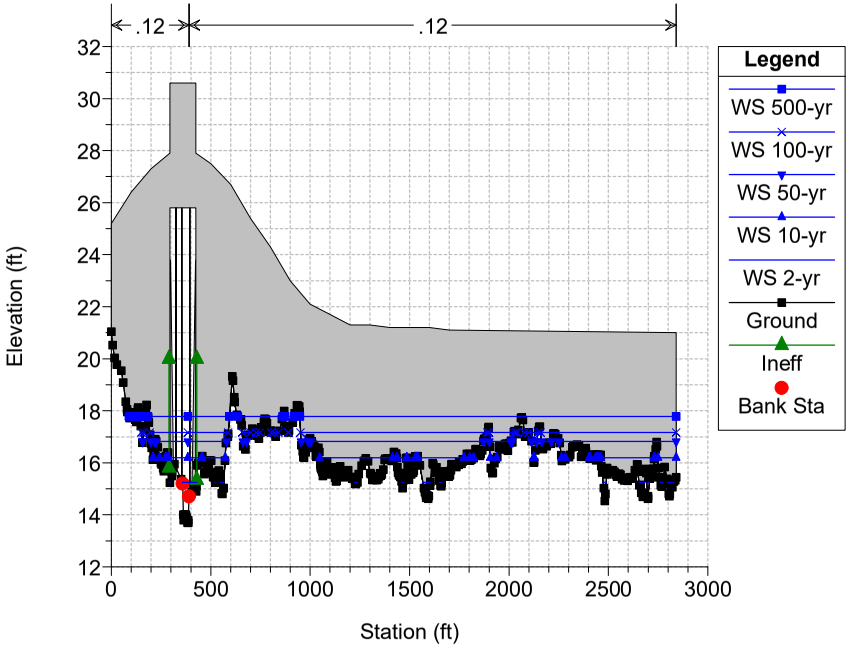
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

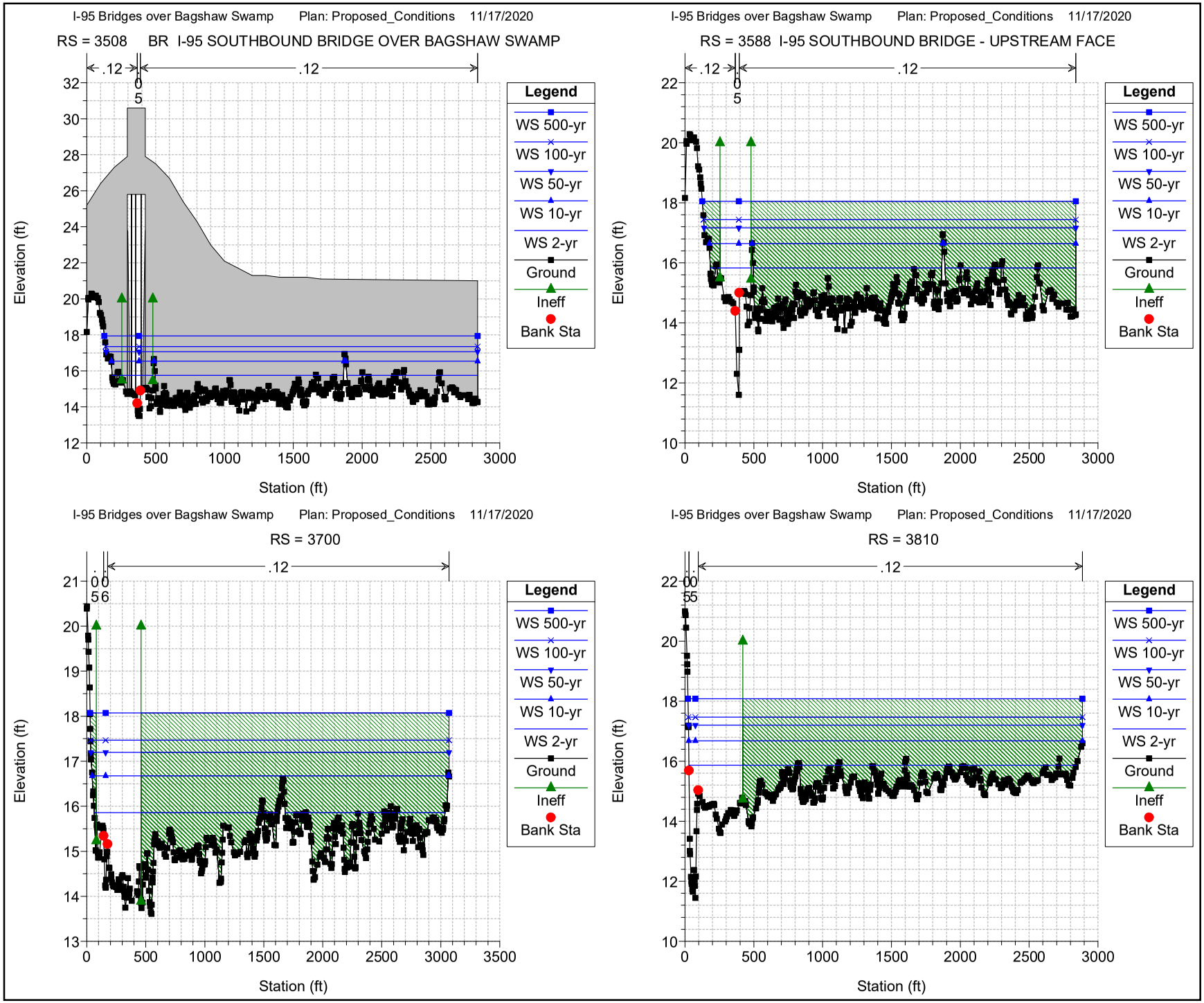
RS = 3428 I-95 SOUTHBOUND BRIDGE - DOWNSTREAM FACE

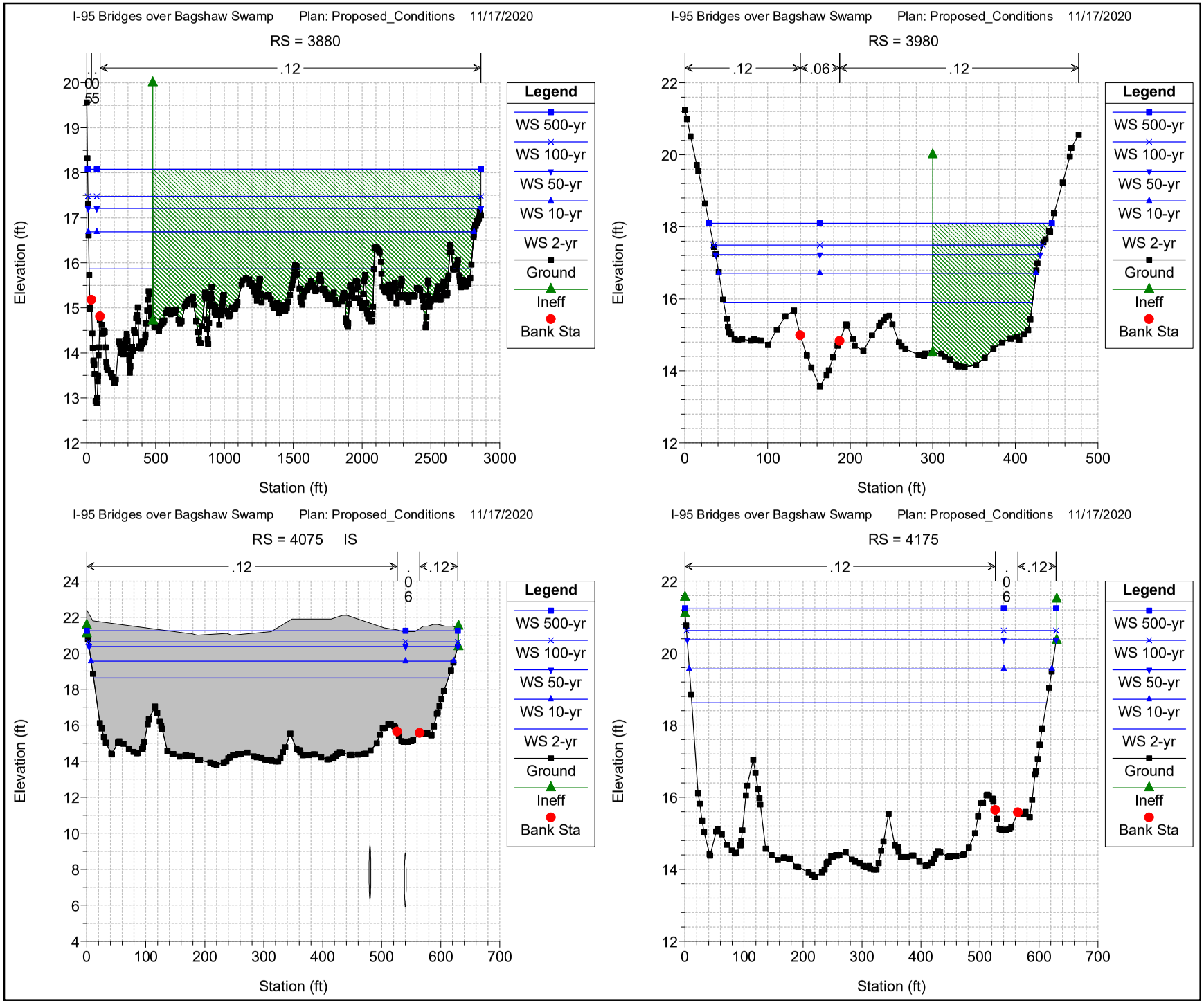


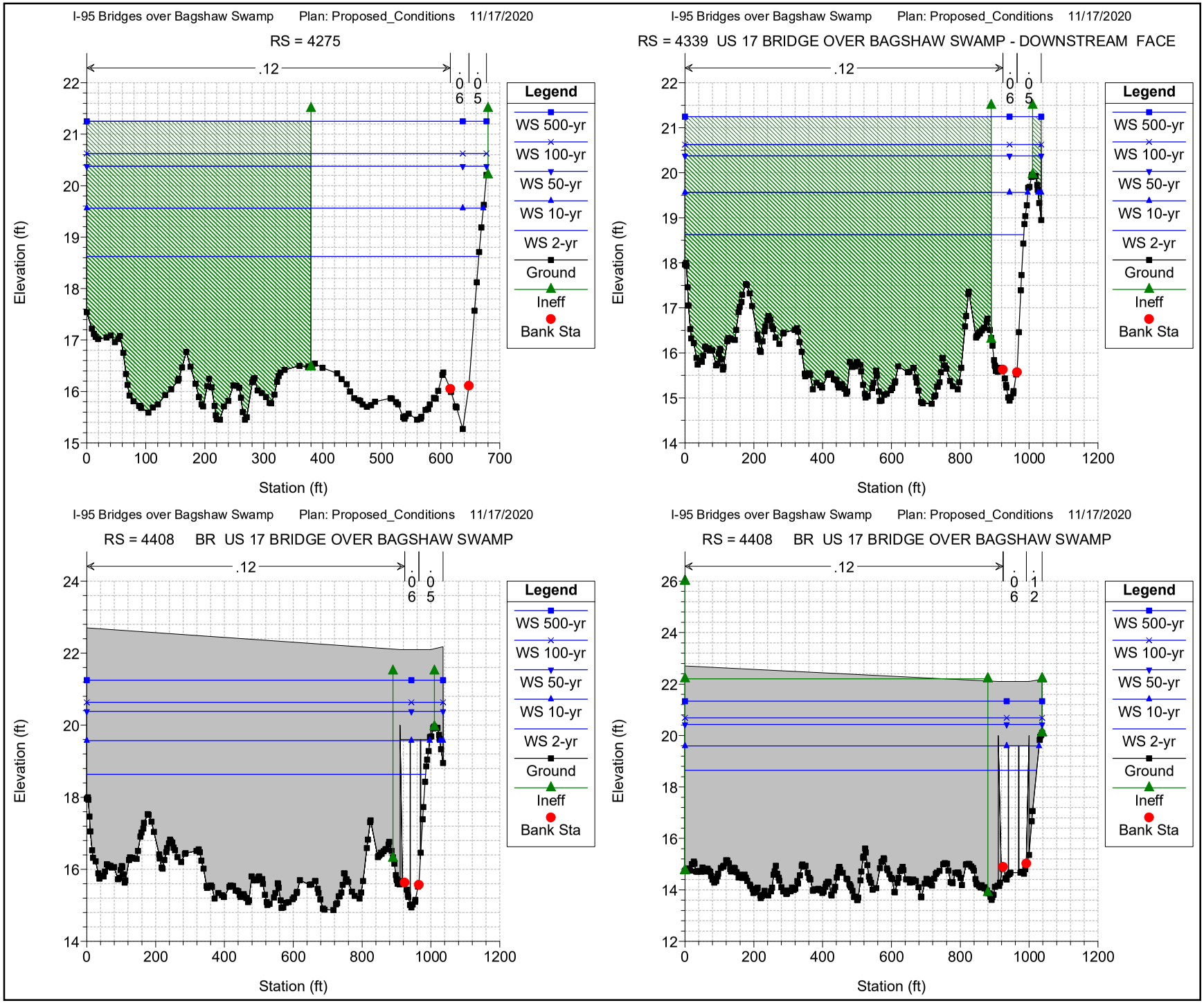
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 3508 BR I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP



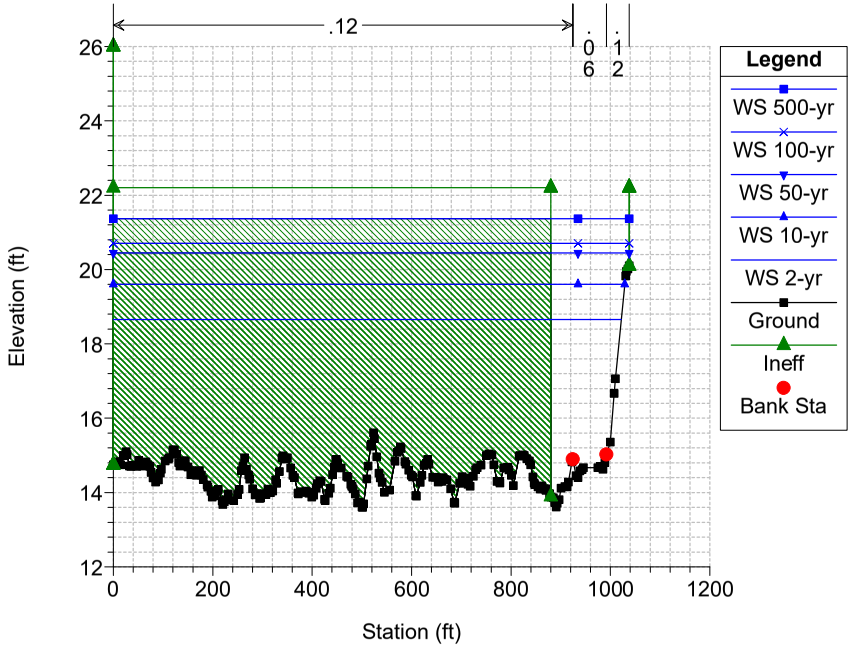

I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3508 BR I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP
.12
.12
0.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3588 I-95 SOUTHBOUND BRIDGE - UPSTREAM FACE
.12
.12
0.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3700
.12
.12
0.056
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3810
.12
.12
0.055
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3880
.12
.00
.55
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3980
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4075 IS
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4175
.12
.06
.12
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta


I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4275
.12
.06
.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4339 US 17 BRIDGE OVER BAGSHAW SWAMP - DOWNSTREAM FACE
.12
.06
.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4408 BR US 17 BRIDGE OVER BAGSHAW SWAMP
.12
.06
.05
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4408 BR US 17 BRIDGE OVER BAGSHAW SWAMP
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

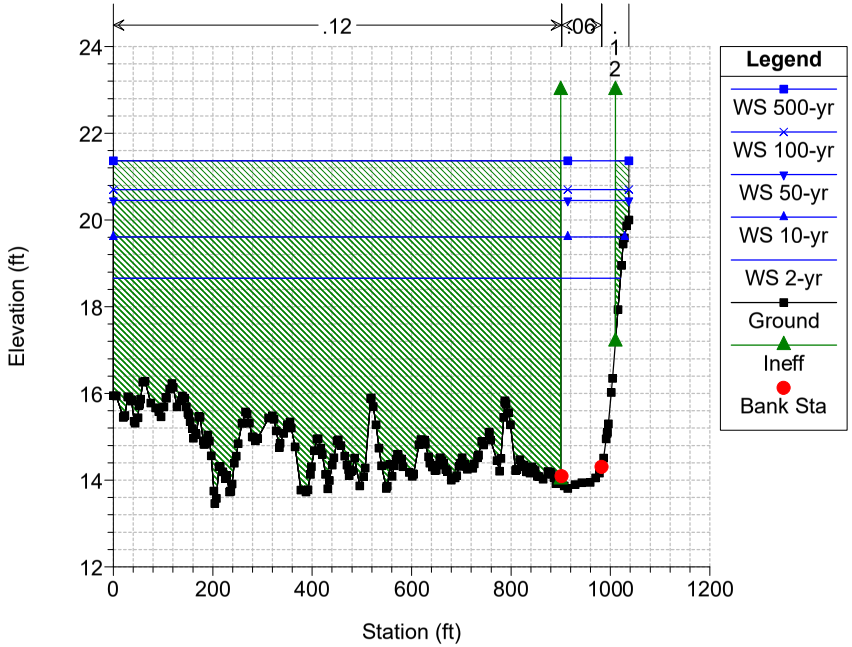
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 4468 US 17 BRIDGE OVER BAGSHAW SWAMP - UPSTREAM FACE



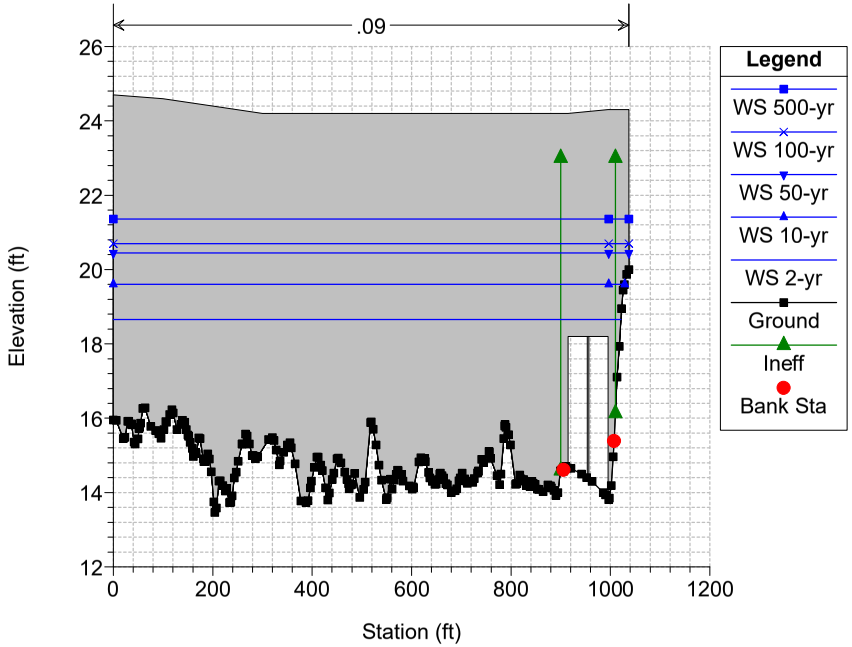
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 4481 CSX RR BRIDGE OVER BAGSHAW SWAMP - DOWNSTREAM FACE



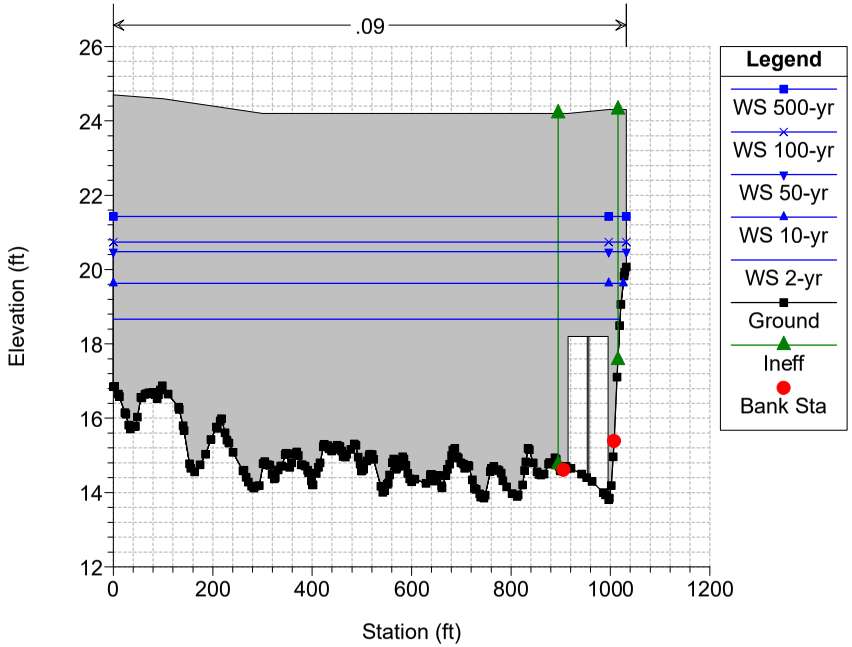
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

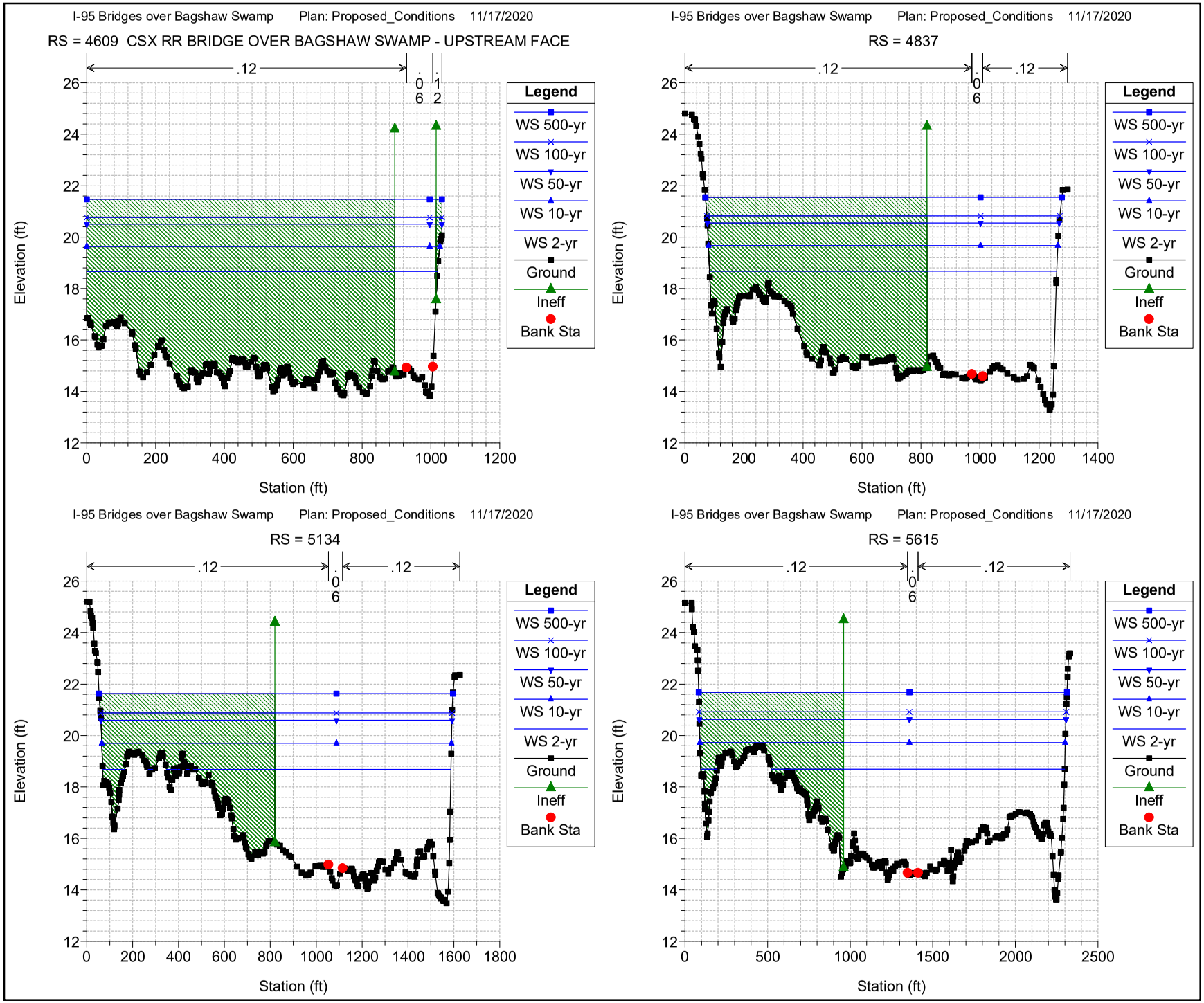
RS = 4540 BR CSX RR BRIDGE OVER BAGSHAW SWAMP

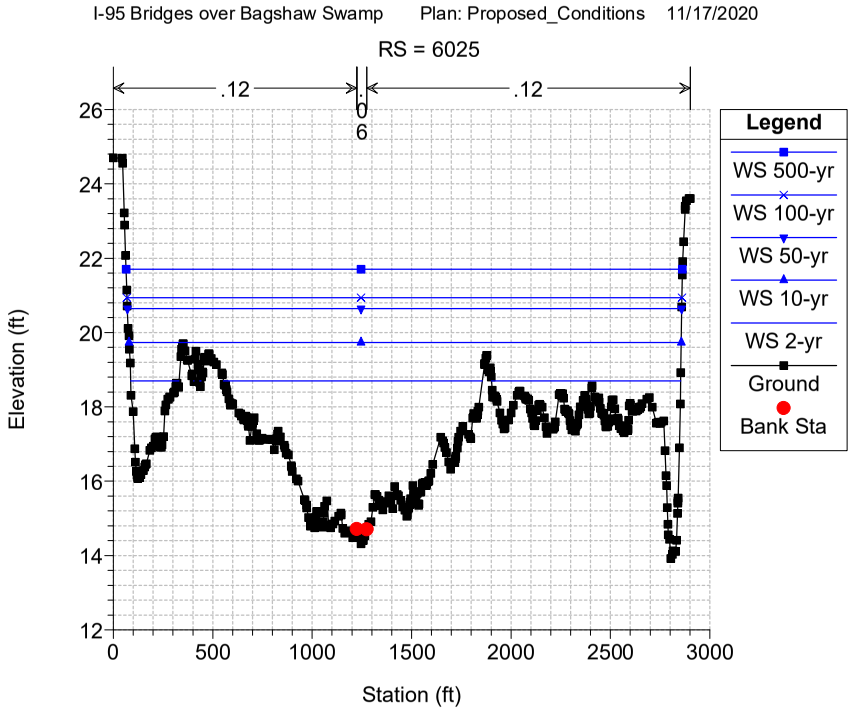


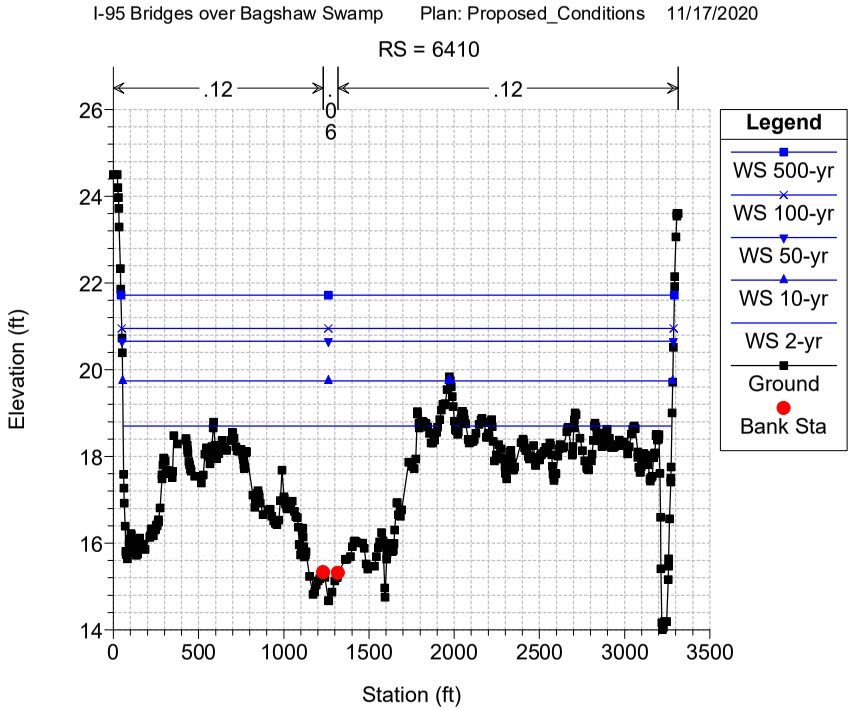
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020

RS = 4540 BR CSX RR BRIDGE OVER BAGSHAW SWAMP




I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4609 CSX RR BRIDGE OVER BAGSHAW SWAMP - UPSTREAM FACE
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 4837
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 5134
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 5615
.12
.06
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 6025
.12
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 6410
.12
.12
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 10-yr
WS 2-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Plan: PROPOSED River: Bagshaw Swamp Reach: Bagshaw Swamp

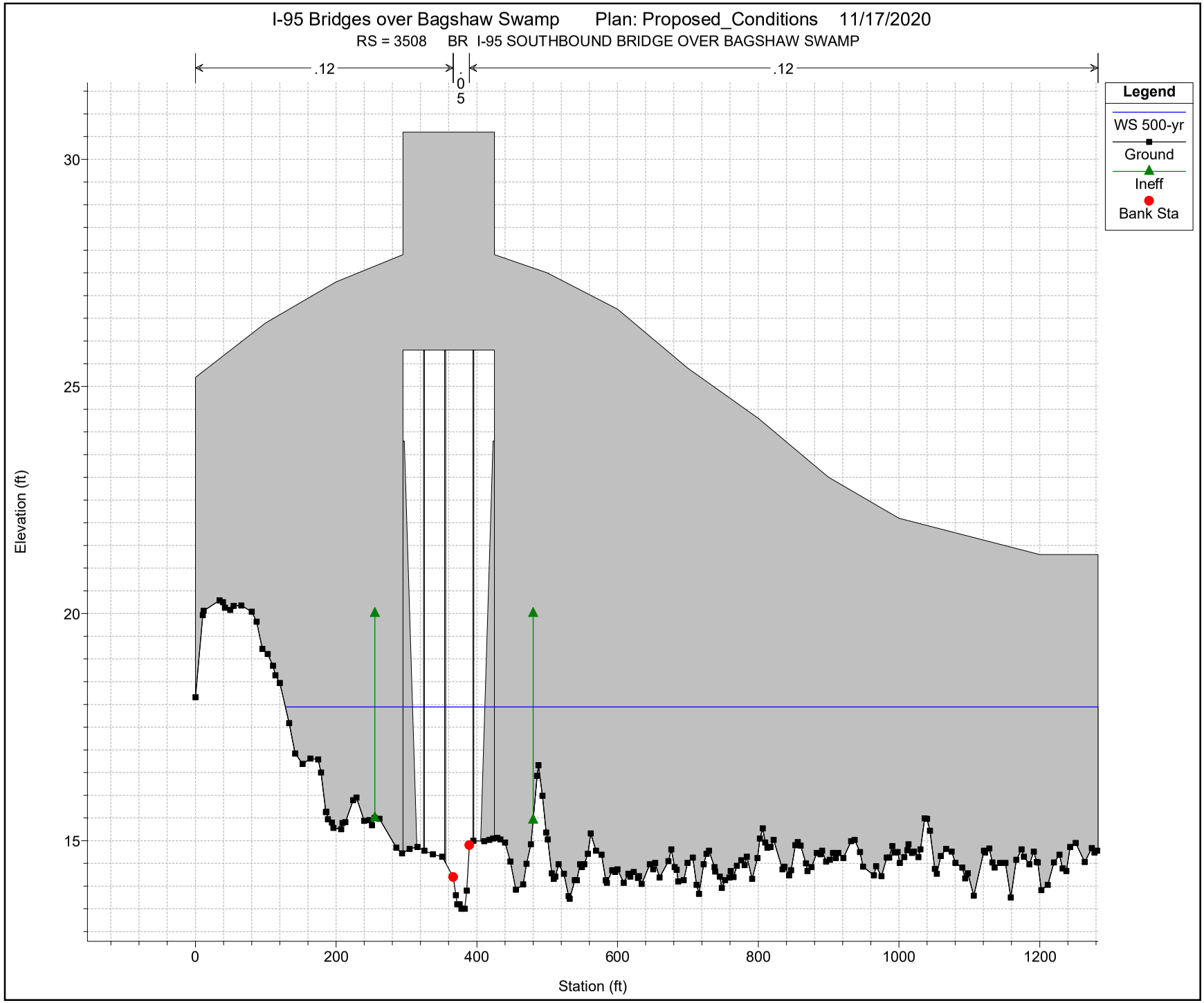
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	1517	2-yr	130.00	12.20	14.90	13.07	14.90	0.000034	0.24	1382.12	1575.94	0.03
Bagshaw Swamp	1517	10-yr	255.00	12.20	15.80	13.37	15.80	0.000018	0.22	3100.11	2258.22	0.02
Bagshaw Swamp	1517	50-yr	330.00	12.20	16.50	13.45	16.50	0.000009	0.18	4905.92	2835.22	0.02
Bagshaw Swamp	1517	100-yr	350.00	12.20	16.90	13.47	16.90	0.000006	0.15	6096.85	3154.95	0.01
Bagshaw Swamp	1517	500-yr	455.00	12.20	17.50	13.54	17.50	0.000005	0.15	8067.26	3443.41	0.01
Bagshaw Swamp	1984	2-yr	130.00	13.09	14.92	13.42	14.92	0.000029	0.19	1532.57	1687.36	0.03
Bagshaw Swamp	1984	10-yr	255.00	13.09	15.81	13.56	15.81	0.000015	0.18	3290.72	2166.79	0.02
Bagshaw Swamp	1984	50-yr	330.00	13.09	16.50	13.62	16.50	0.000008	0.15	4936.19	2621.71	0.01
Bagshaw Swamp	1984	100-yr	350.00	13.09	16.90	13.64	16.90	0.000005	0.13	5986.22	2782.77	0.01
Bagshaw Swamp	1984	500-yr	455.00	13.09	17.50	13.70	17.50	0.000004	0.13	7621.52	2919.60	0.01
Bagshaw Swamp	2394	2-yr	130.00	12.73	14.93	13.55	14.93	0.000038	0.21	1463.87	1693.09	0.03
Bagshaw Swamp	2394	10-yr	255.00	12.73	15.81	13.73	15.81	0.000017	0.19	3141.42	2009.64	0.02
Bagshaw Swamp	2394	50-yr	330.00	12.73	16.51	13.80	16.51	0.000009	0.16	4555.14	2426.71	0.02
Bagshaw Swamp	2394	100-yr	350.00	12.73	16.90	13.84	16.90	0.000006	0.14	5386.15	2474.02	0.01
Bagshaw Swamp	2394	500-yr	455.00	12.73	17.50	13.88	17.50	0.000005	0.15	6640.71	2489.61	0.01
Bagshaw Swamp	2600	2-yr	130.00	13.09	14.94	13.46	14.94	0.000057	0.25	1026.68	1099.50	0.04
Bagshaw Swamp	2600	10-yr	255.00	13.09	15.82	13.61	15.82	0.000033	0.26	1994.91	1506.98	0.03
Bagshaw Swamp	2600	50-yr	330.00	13.09	16.51	13.69	16.51	0.000019	0.23	2975.84	1950.83	0.02
Bagshaw Swamp	2600	100-yr	350.00	13.09	16.91	13.71	16.91	0.000013	0.20	3551.98	2035.65	0.02
Bagshaw Swamp	2600	500-yr	455.00	13.09	17.51	13.74	17.51	0.000011	0.21	4424.12	2039.89	0.02
Bagshaw Swamp	2800	2-yr	130.00	13.40	14.96	13.80	14.96	0.000179	0.40	591.24	654.00	0.06
Bagshaw Swamp	2800	10-yr	255.00	13.40	15.83	13.95	15.83	0.000095	0.40	1256.88	1250.37	0.05
Bagshaw Swamp	2800	50-yr	330.00	13.40	16.52	14.01	16.52	0.000050	0.35	1861.57	1577.67	0.04
Bagshaw Swamp	2800	100-yr	350.00	13.40	16.91	14.02	16.91	0.000034	0.31	2209.81	1653.28	0.03
Bagshaw Swamp	2800	500-yr	455.00	13.40	17.51	14.07	17.51	0.000029	0.33	2738.68	1654.67	0.03
Bagshaw Swamp	2975	2-yr	130.00	13.26	14.98	13.71	14.98	0.000133	0.39	690.13	635.73	0.05
Bagshaw Swamp	2975	10-yr	255.00	13.26	15.84	13.86	15.85	0.000089	0.42	1219.00	1058.03	0.05
Bagshaw Swamp	2975	50-yr	330.00	13.26	16.52	13.90	16.53	0.000057	0.40	1639.97	1264.10	0.04
Bagshaw Swamp	2975	100-yr	350.00	13.26	16.92	13.97	16.92	0.000041	0.36	1883.37	1295.13	0.03
Bagshaw Swamp	2975	500-yr	455.00	13.26	17.51	14.04	17.51	0.000038	0.39	2256.13	1425.88	0.03
Bagshaw Swamp	3100	2-yr	130.00	13.38	15.00	13.87	15.00	0.000286	0.48	507.97	696.50	0.08
Bagshaw Swamp	3100	10-yr	255.00	13.38	15.86	14.12	15.86	0.000162	0.51	909.37	986.88	0.06
Bagshaw Swamp	3100	50-yr	330.00	13.38	16.53	14.16	16.53	0.000101	0.49	1226.97	993.23	0.05
Bagshaw Swamp	3100	100-yr	350.00	13.38	16.92	14.16	16.92	0.000071	0.45	1410.07	996.88	0.04
Bagshaw Swamp	3100	500-yr	455.00	13.38	17.52	14.23	17.52	0.000066	0.48	1690.75	1166.80	0.04
Bagshaw Swamp	3166	2-yr	130.00	12.10	15.02	12.84	15.03	0.000306	0.84	332.73	667.32	0.09
Bagshaw Swamp	3166	10-yr	255.00	12.10	15.87	13.25	15.87	0.000232	0.87	671.20	992.80	0.08
Bagshaw Swamp	3166	50-yr	330.00	12.10	16.54	13.46	16.54	0.000151	0.79	940.09	1006.53	0.07
Bagshaw Swamp	3166	100-yr	350.00	12.10	16.93	13.51	16.93	0.000109	0.71	1095.24	1012.03	0.06
Bagshaw Swamp	3166	500-yr	455.00	12.10	17.52	13.78	17.53	0.000101	0.74	1333.98	1106.44	0.06
Bagshaw Swamp	3214	2-yr	130.00	12.50	15.03	13.37	15.05	0.000597	1.25	210.31	407.65	0.14
Bagshaw Swamp	3214	10-yr	255.00	12.50	15.88	13.90	15.89	0.000507	1.41	394.95	715.70	0.14
Bagshaw Swamp	3214	50-yr	330.00	12.50	16.54	14.22	16.56	0.000343	1.32	566.52	874.45	0.12
Bagshaw Swamp	3214	100-yr	350.00	12.50	16.93	14.29	16.94	0.000247	1.19	672.94	950.03	0.10
Bagshaw Swamp	3214	500-yr	455.00	12.50	17.53	14.62	17.54	0.000227	1.24	848.54	1015.77	0.10
Bagshaw Swamp	3276	2-yr	130.00	11.90	15.07	13.13	15.10	0.000695	1.52	131.23	2246.02	0.16
Bagshaw Swamp	3276	10-yr	255.00	11.90	15.90	13.70	15.95	0.000904	2.07	202.95	2578.59	0.19
Bagshaw Swamp	3276	50-yr	330.00	11.90	16.55	14.11	16.61	0.000770	2.13	263.87	2647.79	0.18
Bagshaw Swamp	3276	100-yr	350.00	11.90	16.93	14.18	16.98	0.000613	2.01	303.62	2698.20	0.16
Bagshaw Swamp	3276	500-yr	455.00	11.90	17.53	14.51	17.58	0.000641	2.23	377.38	2775.99	0.17
Bagshaw Swamp	3370		Bridge									
Bagshaw Swamp	3406	2-yr	130.00	11.00	15.18	12.84	15.20	0.000471	1.27	115.55	268.04	0.13
Bagshaw Swamp	3406	10-yr	255.00	11.00	16.08	13.34	16.12	0.000611	1.74	210.85	1561.15	0.16
Bagshaw Swamp	3406	50-yr	330.00	11.00	16.74	13.60	16.78	0.000524	1.79	283.24	2346.95	0.15
Bagshaw Swamp	3406	100-yr	350.00	11.00	17.10	13.66	17.13	0.000427	1.70	322.48	2499.79	0.14
Bagshaw Swamp	3406	500-yr	455.00	11.00	17.72	13.98	17.76	0.000438	1.87	390.84	2708.74	0.14
Bagshaw Swamp	3417	2-yr	130.00	13.10	15.18	14.00	15.21	0.001156	1.49	107.97	486.53	0.20
Bagshaw Swamp	3417	10-yr	255.00	13.10	16.09	14.36	16.13	0.000883	1.71	220.33	1703.36	0.18
Bagshaw Swamp	3417	50-yr	330.00	13.10	16.75	14.55	16.79	0.000627	1.67	303.00	2362.86	0.16
Bagshaw Swamp	3417	100-yr	350.00	13.10	17.11	14.59	17.14	0.000478	1.56	347.42	2550.20	0.14
Bagshaw Swamp	3417	500-yr	455.00	13.10	17.73	14.80	17.77	0.000448	1.67	425.48	2757.39	0.14
Bagshaw Swamp	3428	2-yr	130.00	11.90	15.19	13.13	15.23	0.000816	1.60	90.66	229.50	0.17
Bagshaw Swamp	3428	10-yr	255.00	11.90	16.09	13.70	16.15	0.000965	2.12	190.23	1315.70	0.20
Bagshaw Swamp	3428	50-yr	330.00	11.90	16.75	14.00	16.81	0.000740	2.07	282.74	2022.94	0.18
Bagshaw Swamp	3428	100-yr	350.00	11.90	17.11	14.08	17.15	0.000574	1.92	332.55	2256.09	0.16
Bagshaw Swamp	3428	500-yr	455.00	11.90	17.73	14.41	17.78	0.000544	2.04	420.01	2598.19	0.16
Bagshaw Swamp	3508		Bridge									
Bagshaw Swamp	3588	2-yr	130.00	11.60	15.83	13.17	15.84	0.000231	0.95	296.22	2580.37	0.09
Bagshaw Swamp	3588	10-yr	255.00	11.60	16.64	13.77	16.66	0.000273	1.20	479.74	2651.37	0.10
Bagshaw Swamp	3588	50-yr	330.00	11.60	17.17	14.12	17.18	0.000250	1.24	598.15	2699.82	0.10
Bagshaw Swamp	3588	100-yr	350.00	11.60	17.44	14.20	17.45	0.000214	1.19	659.22	2703.26	0.10
Bagshaw Swamp	3588	500-yr	455.00	11.60	18.05	14.56	18.06	0.000209	1.27	796.09	2712.09	0.10
Bagshaw Swamp	3700	2-yr	130.00	14.19	15.86	14.33	15.86	0.000169	0.36	545.26	2847.14	0.06
Bagshaw Swamp	3700	10-yr	255.00	14.19	16.68	14.46	16.68	0.000137	0.46	855.98	3018.10	0.06
Bagshaw Swamp	3700	50-yr	330.00	14.19	17.20	14.52	17.20	0.000111	0.49	1054.71	3036.00	0.05

HEC-RAS Plan: PROPOSED River: Bagshaw Swamp Reach: Bagshaw Swamp (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	3700	100-yr	350.00	14.19	17.47	14.54	17.47	0.000091	0.47	1156.19	3037.85	0.05
Bagshaw Swamp	3700	500-yr	455.00	14.19	18.07	14.61	18.08	0.000082	0.51	1387.24	3041.88	0.05
Bagshaw Swamp	3810	2-yr	130.00	11.45	15.86	12.66	15.87	0.000039	0.39	696.08	2766.74	0.04
Bagshaw Swamp	3810	10-yr	255.00	11.45	16.68	13.06	16.68	0.000052	0.52	1016.82	2860.19	0.05
Bagshaw Swamp	3810	50-yr	330.00	11.45	17.20	13.26	17.21	0.000051	0.56	1222.46	2861.47	0.05
Bagshaw Swamp	3810	100-yr	350.00	11.45	17.47	13.30	17.47	0.000044	0.55	1327.63	2862.78	0.04
Bagshaw Swamp	3810	500-yr	455.00	11.45	18.08	13.53	18.08	0.000045	0.60	1569.00	2865.77	0.05
Bagshaw Swamp	3880	2-yr	130.00	12.88	15.87	13.90	15.87	0.000053	0.35	784.55	2649.52	0.04
Bagshaw Swamp	3880	10-yr	255.00	12.88	16.69	14.12	16.69	0.000057	0.46	1166.27	2801.64	0.05
Bagshaw Swamp	3880	50-yr	330.00	12.88	17.21	14.24	17.21	0.000051	0.48	1411.33	2854.16	0.05
Bagshaw Swamp	3880	100-yr	350.00	12.88	17.47	14.33	17.48	0.000044	0.47	1536.40	2855.24	0.04
Bagshaw Swamp	3880	500-yr	455.00	12.88	18.08	14.45	18.08	0.000042	0.51	1823.71	2857.79	0.04
Bagshaw Swamp	3980	2-yr	130.00	13.57	15.89	14.79	15.90	0.000633	0.89	273.36	373.86	0.12
Bagshaw Swamp	3980	10-yr	255.00	13.57	16.71	15.08	16.72	0.000453	0.98	482.98	384.09	0.11
Bagshaw Swamp	3980	50-yr	330.00	13.57	17.23	15.19	17.24	0.000356	0.98	618.37	392.99	0.10
Bagshaw Swamp	3980	100-yr	350.00	13.57	17.49	15.22	17.50	0.000289	0.93	687.61	398.43	0.09
Bagshaw Swamp	3980	500-yr	455.00	13.57	18.10	15.35	18.11	0.000254	0.98	850.17	414.94	0.09
Bagshaw Swamp	4075		Inl Struct									
Bagshaw Swamp	4175	2-yr	130.00	15.08	18.62	14.39	18.62	0.000003	0.10	2260.94	601.49	0.01
Bagshaw Swamp	4175	10-yr	255.00	15.08	19.56	14.51	19.56	0.000006	0.16	2830.79	614.79	0.01
Bagshaw Swamp	4175	50-yr	330.00	15.08	20.38	14.56	20.38	0.000006	0.18	3335.73	625.54	0.01
Bagshaw Swamp	4175	100-yr	350.00	15.08	20.63	14.58	20.63	0.000006	0.18	3493.02	626.68	0.01
Bagshaw Swamp	4175	500-yr	455.00	15.08	21.25	14.65	21.25	0.000007	0.22	3883.97	629.12	0.02
Bagshaw Swamp	4275	2-yr	140.00	15.27	18.63	16.04	18.63	0.000046	0.35	746.74	664.42	0.04
Bagshaw Swamp	4275	10-yr	260.00	15.27	19.56	16.18	19.56	0.000058	0.47	1016.82	672.28	0.04
Bagshaw Swamp	4275	50-yr	330.00	15.27	20.38	16.26	20.38	0.000047	0.47	1257.23	677.30	0.04
Bagshaw Swamp	4275	100-yr	350.00	15.27	20.63	16.29	20.63	0.000043	0.47	1331.90	677.30	0.04
Bagshaw Swamp	4275	500-yr	460.00	15.27	21.25	16.35	21.25	0.000048	0.54	1516.94	677.30	0.04
Bagshaw Swamp	4339	2-yr	140.00	14.94	18.63	15.94	18.63	0.000154	0.69	265.25	984.66	0.07
Bagshaw Swamp	4339	10-yr	260.00	14.94	19.56	16.25	19.57	0.000215	0.96	359.02	1005.04	0.08
Bagshaw Swamp	4339	50-yr	330.00	14.94	20.38	16.41	20.39	0.000177	0.98	453.50	1034.93	0.08
Bagshaw Swamp	4339	100-yr	350.00	14.94	20.63	16.44	20.64	0.000162	0.97	483.62	1034.93	0.07
Bagshaw Swamp	4339	500-yr	460.00	14.94	21.25	16.65	21.26	0.000176	1.09	558.22	1034.93	0.08
Bagshaw Swamp	4408		Bridge									
Bagshaw Swamp	4468	2-yr	140.00	14.40	18.65	14.80	18.65	0.000031	0.35	534.35	1021.97	0.03
Bagshaw Swamp	4468	10-yr	260.00	14.40	19.61	14.98	19.61	0.000053	0.52	672.83	1028.95	0.04
Bagshaw Swamp	4468	50-yr	330.00	14.40	20.45	15.07	20.45	0.000050	0.57	802.88	1037.78	0.04
Bagshaw Swamp	4468	100-yr	350.00	14.40	20.70	15.09	20.71	0.000049	0.57	843.24	1037.78	0.04
Bagshaw Swamp	4468	500-yr	460.00	14.40	21.37	15.23	21.37	0.000059	0.67	948.11	1037.78	0.05
Bagshaw Swamp	4481	2-yr	140.00	13.81	18.65	14.41	18.65	0.000024	0.34	473.90	1020.03	0.03
Bagshaw Swamp	4481	10-yr	260.00	13.81	19.61	14.64	19.61	0.000043	0.51	578.63	1028.62	0.04
Bagshaw Swamp	4481	50-yr	330.00	13.81	20.45	14.76	20.45	0.000043	0.56	671.37	1036.97	0.04
Bagshaw Swamp	4481	100-yr	350.00	13.81	20.70	14.79	20.71	0.000042	0.57	699.51	1036.97	0.04
Bagshaw Swamp	4481	500-yr	460.00	13.81	21.37	14.95	21.38	0.000053	0.68	772.61	1036.97	0.04
Bagshaw Swamp	4540		Bridge									
Bagshaw Swamp	4609	2-yr	140.00	13.81	18.66	14.91	18.67	0.000030	0.35	480.90	1019.12	0.03
Bagshaw Swamp	4609	10-yr	260.00	13.81	19.64	15.12	19.64	0.000051	0.53	598.03	1026.05	0.04
Bagshaw Swamp	4609	50-yr	330.00	13.81	20.50	15.22	20.51	0.000049	0.57	701.53	1031.70	0.04
Bagshaw Swamp	4609	100-yr	350.00	13.81	20.76	15.25	20.77	0.000047	0.58	732.98	1031.70	0.04
Bagshaw Swamp	4609	500-yr	460.00	13.81	21.47	15.40	21.48	0.000057	0.69	817.83	1031.70	0.05
Bagshaw Swamp	4837	2-yr	402.00	14.41	18.68	14.85	18.68	0.000045	0.43	1767.93	1177.05	0.04
Bagshaw Swamp	4837	10-yr	1060.00	14.41	19.67	15.23	19.68	0.000150	0.91	2208.73	1184.84	0.07
Bagshaw Swamp	4837	50-yr	1790.00	14.41	20.55	15.52	20.56	0.000252	1.30	2600.61	1192.83	0.09
Bagshaw Swamp	4837	100-yr	2160.00	14.41	20.82	15.64	20.83	0.000316	1.50	2722.62	1196.72	0.11
Bagshaw Swamp	4837	500-yr	3020.00	14.41	21.55	15.97	21.57	0.000431	1.89	3052.22	1208.87	0.13
Bagshaw Swamp	5134	2-yr	402.00	14.16	18.68	14.73	18.68	0.000017	0.26	2957.39	1304.32	0.02
Bagshaw Swamp	5134	10-yr	1060.00	14.16	19.70	15.10	19.70	0.000054	0.55	3737.95	1524.67	0.04
Bagshaw Swamp	5134	50-yr	1790.00	14.16	20.60	15.36	20.60	0.000088	0.78	4429.40	1530.16	0.06
Bagshaw Swamp	5134	100-yr	2160.00	14.16	20.88	15.47	20.88	0.000109	0.89	4648.18	1532.70	0.06
Bagshaw Swamp	5134	500-yr	3020.00	14.16	21.63	15.71	21.63	0.000145	1.11	5226.92	1542.51	0.07
Bagshaw Swamp	5615	2-yr	402.00	14.59	18.69	15.00	18.69	0.000011	0.21	4230.84	1874.81	0.02
Bagshaw Swamp	5615	10-yr	1060.00	14.59	19.72	15.37	19.72	0.000030	0.40	5609.69	2212.62	0.03
Bagshaw Swamp	5615	50-yr	1790.00	14.59	20.63	15.60	20.63	0.000045	0.55	6830.84	2220.18	0.04
Bagshaw Swamp	5615	100-yr	2160.00	14.59	20.92	15.68	20.92	0.000055	0.63	7222.44	2222.64	0.04
Bagshaw Swamp	5615	500-yr	3020.00	14.59	21.68	15.87	21.68	0.000070	0.76	8248.46	2229.78	0.05
Bagshaw Swamp	6025	2-yr	402.00	14.32	18.70		18.70	0.000016	0.26	4604.78	2503.69	0.02
Bagshaw Swamp	6025	10-yr	1060.00	14.32	19.73		19.73	0.000033	0.43	7357.45	2776.74	0.03
Bagshaw Swamp	6025	50-yr	1790.00	14.32	20.65		20.65	0.000036	0.50	9897.24	2788.42	0.04
Bagshaw Swamp	6025	100-yr	2160.00	14.32	20.94		20.94	0.000040	0.54	10716.68	2791.08	0.04
Bagshaw Swamp	6025	500-yr	3020.00	14.32	21.70		21.70	0.000044	0.61	12851.16	2798.17	0.04
Bagshaw Swamp	6410	2-yr	402.00	14.67	18.70		18.70	0.000021	0.27	4246.09	2937.74	0.02
Bagshaw Swamp	6410	10-yr	1060.00	14.67	19.74		19.75	0.000033	0.40	7526.49	3218.95	0.03
Bagshaw Swamp	6410	50-yr	1790.00	14.67	20.66		20.66	0.000034	0.46	10478.11	3235.23	0.03
Bagshaw Swamp	6410	100-yr	2160.00	14.67	20.95		20.95	0.000037	0.50	11433.67	3238.61	0.04

HEC-RAS Plan: PROPOSED River: Bagshaw Swamp Reach: Bagshaw Swamp (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	6410	500-yr	3020.00	14.67	21.72		21.72	0.000039	0.55	13913.91	3247.62	0.04


I-95 Bridges over Bagshaw Swamp Plan: Proposed_Conditions 11/17/2020
RS = 3508 BR I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP
.12
.05
.12
Legend
WS 500-yr
Ground
Ineff
Bank Sta
Elevation (ft)
30
25
20
15
0
200
400
600
800
1000
1200
Station (ft)

Plan: PROPOSED Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 2-yr

E.G. US. (ft)	15.84	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	15.83	E.G. Elev (ft)	15.80	15.39
Q Total (cfs)	130.00	W.S. Elev (ft)	15.75	15.25
Q Bridge (cfs)	130.00	Crit W.S. (ft)	14.84	14.82
Q Weir (cfs)		Max Chl Dpth (ft)	2.25	1.55
Weir Sta Lft (ft)		Vel Total (ft/s)	1.16	2.84
Weir Sta Rgt (ft)		Flow Area (sq ft)	112.10	45.83
Weir Submerg		Froude # Chl	0.26	0.48
Weir Max Depth (ft)		Specif Force (cu ft)	87.89	39.06
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	1.25	0.94
Min El Prs (ft)	25.80	W.P. Total (ft)	96.43	50.12
Delta EG (ft)	0.61	Conv. Total (cfs)	2898.3	601.9
Delta WS (ft)	0.64	Top Width (ft)	89.83	48.70
BR Open Area (sq ft)	1179.27	Frctn Loss (ft)	0.39	0.11
BR Open Vel (ft/s)	2.84	C & E Loss (ft)	0.03	0.05
BR Sluice Coef		Shear Total (lb/sq ft)	0.15	2.66
BR Sel Method	Energy only	Power Total (lb/ft s)	0.17	7.55

Plan: PROPOSED Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 10-yr

E.G. US. (ft)	16.66	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	16.64	E.G. Elev (ft)	16.61	16.29
Q Total (cfs)	255.00	W.S. Elev (ft)	16.54	16.19
Q Bridge (cfs)	255.00	Crit W.S. (ft)	15.29	15.28
Q Weir (cfs)		Max Chl Dpth (ft)	3.04	2.49
Weir Sta Lft (ft)		Vel Total (ft/s)	1.39	2.23
Weir Sta Rgt (ft)		Flow Area (sq ft)	184.09	114.46
Weir Submerg		Froude # Chl	0.28	0.33
Weir Max Depth (ft)		Specif Force (cu ft)	213.24	117.86
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	1.98	1.25
Min El Prs (ft)	25.80	W.P. Total (ft)	104.67	97.77
Delta EG (ft)	0.50	Conv. Total (cfs)	5657.5	1906.0
Delta WS (ft)	0.55	Top Width (ft)	92.98	91.56
BR Open Area (sq ft)	1179.27	Frctn Loss (ft)	0.32	0.11
BR Open Vel (ft/s)	2.23	C & E Loss (ft)	0.01	0.02
BR Sluice Coef		Shear Total (lb/sq ft)	0.22	1.31
BR Sel Method	Energy only	Power Total (lb/ft s)	0.31	2.91

Plan: PROPOSED Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 50-yr

E.G. US. (ft)	17.18	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	17.17	E.G. Elev (ft)	17.14	16.90
Q Total (cfs)	330.00	W.S. Elev (ft)	17.06	16.83
Q Bridge (cfs)	330.00	Crit W.S. (ft)	15.47	15.50
Q Weir (cfs)		Max Chl Dpth (ft)	3.56	3.13
Weir Sta Lft (ft)		Vel Total (ft/s)	1.41	1.90
Weir Sta Rgt (ft)		Flow Area (sq ft)	233.34	173.70
Weir Submerg		Froude # Chl	0.27	0.25
Weir Max Depth (ft)		Specif Force (cu ft)	327.50	211.34
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	2.45	1.85
Min El Prs (ft)	25.80	W.P. Total (ft)	110.16	104.45
Delta EG (ft)	0.38	Conv. Total (cfs)	7879.9	3374.5
Delta WS (ft)	0.42	Top Width (ft)	95.08	94.12
BR Open Area (sq ft)	1179.27	Frctn Loss (ft)	0.24	0.08
BR Open Vel (ft/s)	1.90	C & E Loss (ft)	0.00	0.01
BR Sluice Coef		Shear Total (lb/sq ft)	0.23	0.99
BR Sel Method	Energy only	Power Total (lb/ft s)	0.33	1.89

Plan: PROPOSED Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 100-yr

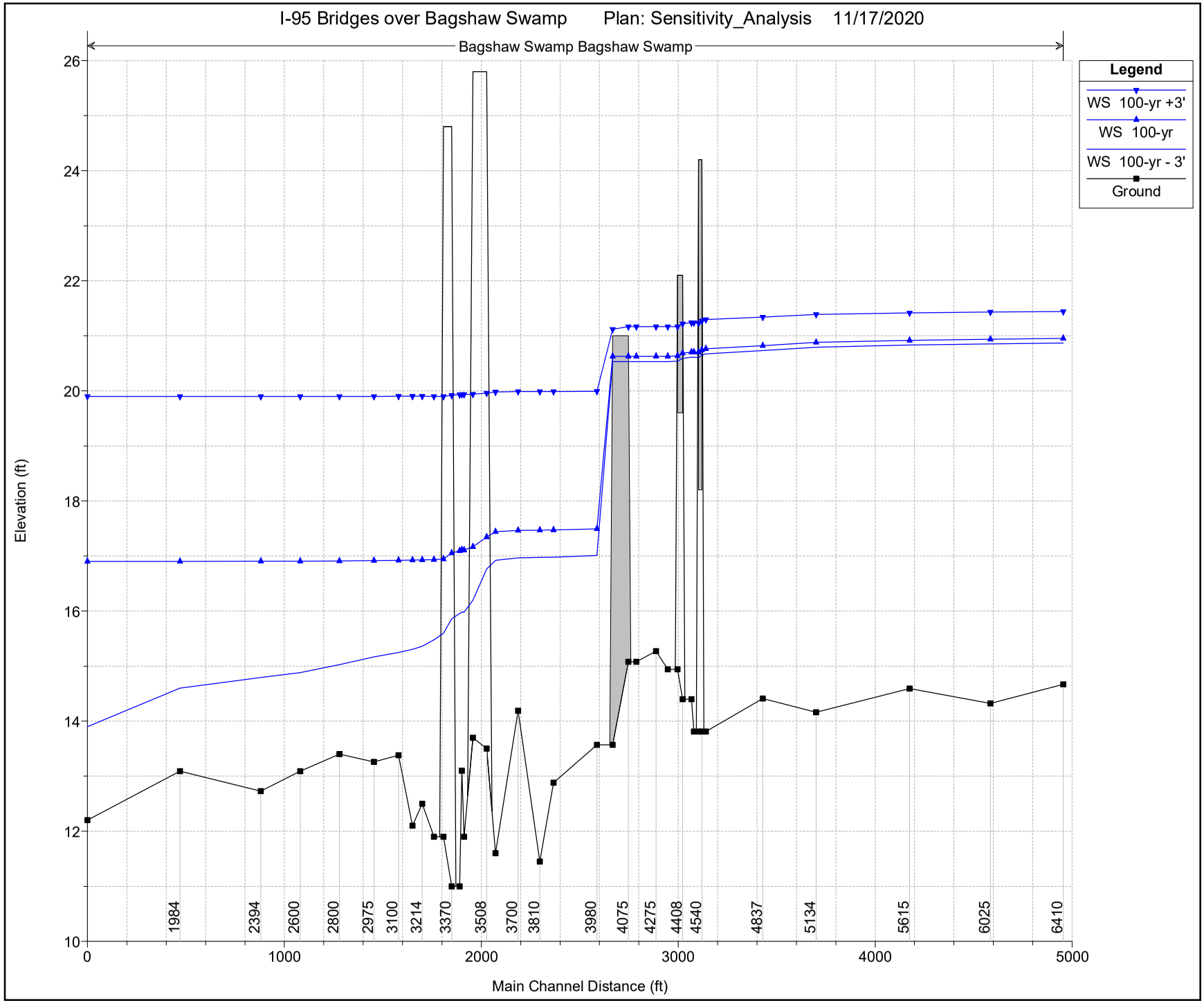
E.G. US. (ft)	17.45	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	17.44	E.G. Elev (ft)	17.42	17.22
Q Total (cfs)	350.00	W.S. Elev (ft)	17.35	17.17
Q Bridge (cfs)	350.00	Crit W.S. (ft)	15.52	15.56
Q Weir (cfs)		Max Chl Dpth (ft)	3.85	3.47
Weir Sta Lft (ft)		Vel Total (ft/s)	1.34	1.70
Weir Sta Rgt (ft)		Flow Area (sq ft)	260.32	205.78
Weir Submerg		Froude # Chl	0.25	0.21
Weir Max Depth (ft)		Specif Force (cu ft)	397.32	274.35
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	2.71	2.16
Min El Prs (ft)	25.80	W.P. Total (ft)	113.11	107.99
Delta EG (ft)	0.30	Conv. Total (cfs)	9193.2	4305.7
Delta WS (ft)	0.33	Top Width (ft)	96.20	95.47
BR Open Area (sq ft)	1179.27	Frctn Loss (ft)	0.19	0.06
BR Open Vel (ft/s)	1.70	C & E Loss (ft)	0.01	0.00
BR Sluice Coef		Shear Total (lb/sq ft)	0.21	0.79
BR Sel Method	Energy only	Power Total (lb/ft s)	0.28	1.34

Plan: PROPOSED Bagshaw Swamp Bagshaw Swamp RS: 3508 Profile: 500-yr

E.G. US. (ft)	18.06	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	18.05	E.G. Elev (ft)	18.02	17.84
Q Total (cfs)	455.00	W.S. Elev (ft)	17.94	17.79
Q Bridge (cfs)	455.00	Crit W.S. (ft)	15.73	15.85
Q Weir (cfs)		Max Chl Dpth (ft)	4.44	4.09
Weir Sta Lft (ft)		Vel Total (ft/s)	1.43	1.71
Weir Sta Rgt (ft)		Flow Area (sq ft)	318.44	265.79
Weir Submerg		Froude # Chl	0.25	0.20
Weir Max Depth (ft)		Specif Force (cu ft)	577.95	426.47
Min El Weir Flow (ft)	21.01	Hydr Depth (ft)	3.23	2.71
Min El Prs (ft)	25.80	W.P. Total (ft)	119.36	114.49
Delta EG (ft)	0.28	Conv. Total (cfs)	12223.9	6254.9
Delta WS (ft)	0.32	Top Width (ft)	98.59	97.95
BR Open Area (sq ft)	1179.27	Frctn Loss (ft)	0.17	0.06
BR Open Vel (ft/s)	1.71	C & E Loss (ft)	0.01	0.00
BR Sluice Coef		Shear Total (lb/sq ft)	0.23	0.77
BR Sel Method	Energy only	Power Total (lb/ft s)	0.33	1.31

APPENDIX K

HEC-RAS SENSITIVITY ANALYSIS RESULTS


I-95 Bridges over Bagshaw Swamp Plan: Sensitivity_Analysis 11/17/2020
Bagshaw Swamp Bagshaw Swamp
Legend
WS 100-yr +3'
WS 100-yr
WS 100-yr - 3'
Ground
Elevation (ft)
Main Channel Distance (ft)
26
24
22
20
18
16
14
12
10
0
1000
2000
3000
4000
5000
1984
2394
2600
2800
2975
3100
3214
3370
3508
3700
3810
3980
4075
4275
4408
4540
4837
5134
5615
6025
6410

HEC-RAS Plan: SENSITIVITY River: Bagshaw Swamp Reach: Bagshaw Swamp

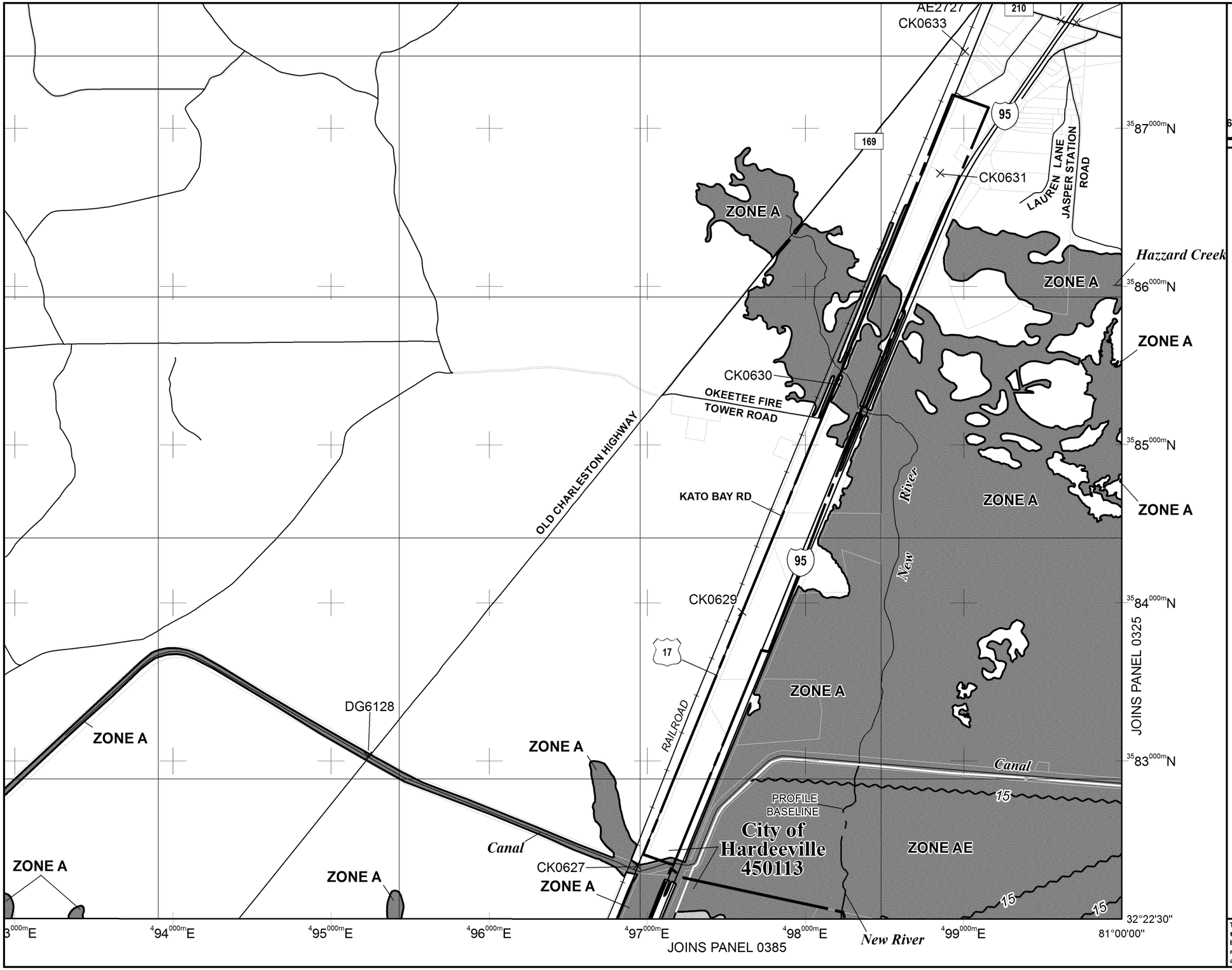
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	1517	100-yr - 3'	350.00	12.20	13.90	13.47	13.93	0.005894	2.05	375.64	677.11	0.34
Bagshaw Swamp	1517	100-yr	350.00	12.20	16.90	13.47	16.90	0.000006	0.15	6096.85	3154.95	0.01
Bagshaw Swamp	1517	100-yr +3'	350.00	12.20	19.90	13.47	19.90	0.000000	0.05	16496.59	3524.23	0.00
Bagshaw Swamp	1984	100-yr - 3'	350.00	13.09	14.60	13.64	14.60	0.000562	0.71	1034.75	1439.69	0.11
Bagshaw Swamp	1984	100-yr	350.00	13.09	16.90	13.64	16.90	0.000005	0.13	5986.22	2782.77	0.01
Bagshaw Swamp	1984	100-yr +3'	350.00	13.09	19.90	13.64	19.90	0.000000	0.05	14316.74	2949.84	0.00
Bagshaw Swamp	2394	100-yr - 3'	350.00	12.73	14.79	13.84	14.79	0.000436	0.68	1238.84	1588.26	0.10
Bagshaw Swamp	2394	100-yr	350.00	12.73	16.90	13.84	16.90	0.000006	0.14	5386.15	2474.02	0.01
Bagshaw Swamp	2394	100-yr +3'	350.00	12.73	19.90	13.84	19.90	0.000000	0.06	11669.66	2494.30	0.00
Bagshaw Swamp	2600	100-yr - 3'	350.00	13.09	14.88	13.71	14.89	0.000486	0.71	974.12	1082.85	0.10
Bagshaw Swamp	2600	100-yr	350.00	13.09	16.91	13.71	16.91	0.000013	0.20	3551.98	2035.65	0.02
Bagshaw Swamp	2600	100-yr +3'	350.00	13.09	19.90	13.71	19.90	0.000001	0.09	7931.73	2049.43	0.01
Bagshaw Swamp	2800	100-yr - 3'	350.00	13.40	15.03	14.02	15.04	0.001065	1.00	637.10	682.24	0.15
Bagshaw Swamp	2800	100-yr	350.00	13.40	16.91	14.02	16.91	0.000034	0.31	2209.81	1653.28	0.03
Bagshaw Swamp	2800	100-yr +3'	350.00	13.40	19.90	14.02	19.90	0.000003	0.14	4876.83	1679.55	0.01
Bagshaw Swamp	2975	100-yr - 3'	350.00	13.26	15.17	13.97	15.17	0.000638	0.91	800.42	773.11	0.12
Bagshaw Swamp	2975	100-yr	350.00	13.26	16.92	13.97	16.92	0.000041	0.36	1883.37	1295.13	0.03
Bagshaw Swamp	2975	100-yr +3'	350.00	13.26	19.90	13.97	19.90	0.000004	0.18	3772.53	1558.51	0.01
Bagshaw Swamp	3100	100-yr - 3'	350.00	13.38	15.25	14.16	15.25	0.001061	1.04	622.89	778.52	0.15
Bagshaw Swamp	3100	100-yr	350.00	13.38	16.92	14.16	16.92	0.000071	0.45	1410.07	996.88	0.04
Bagshaw Swamp	3100	100-yr +3'	350.00	13.38	19.90	14.16	19.90	0.000007	0.22	2810.82	1556.30	0.02
Bagshaw Swamp	3166	100-yr - 3'	350.00	12.10	15.30	13.51	15.34	0.001207	1.78	446.54	859.03	0.18
Bagshaw Swamp	3166	100-yr	350.00	12.10	16.93	13.51	16.93	0.000109	0.71	1095.24	1012.03	0.06
Bagshaw Swamp	3166	100-yr +3'	350.00	12.10	19.90	13.51	19.90	0.000011	0.31	2285.89	1563.39	0.02
Bagshaw Swamp	3214	100-yr - 3'	350.00	12.50	15.36	14.29	15.44	0.002241	2.65	279.70	494.80	0.28
Bagshaw Swamp	3214	100-yr	350.00	12.50	16.93	14.29	16.94	0.000247	1.19	672.94	950.03	0.10
Bagshaw Swamp	3214	100-yr +3'	350.00	12.50	19.90	14.29	19.90	0.000023	0.51	1561.62	1223.49	0.03
Bagshaw Swamp	3276	100-yr - 3'	350.00	11.90	15.48	14.18	15.62	0.002834	3.37	166.40	2482.53	0.33
Bagshaw Swamp	3276	100-yr	350.00	11.90	16.93	14.18	16.98	0.000613	2.01	303.62	2698.20	0.16
Bagshaw Swamp	3276	100-yr +3'	350.00	11.90	19.90	14.18	19.91	0.000069	0.94	792.08	2824.72	0.06
Bagshaw Swamp	3370		Bridge									
Bagshaw Swamp	3406	100-yr - 3'	350.00	11.00	15.96	13.66	16.04	0.001325	2.50	197.05	1417.28	0.23
Bagshaw Swamp	3406	100-yr	350.00	11.00	17.10	13.66	17.13	0.000427	1.70	322.48	2499.79	0.14
Bagshaw Swamp	3406	100-yr +3'	350.00	11.00	19.93	13.66	19.94	0.000066	0.91	634.43	2815.60	0.06
Bagshaw Swamp	3417	100-yr - 3'	350.00	13.10	15.98	14.59	16.06	0.001966	2.48	206.33	1620.01	0.27
Bagshaw Swamp	3417	100-yr	350.00	13.10	17.11	14.59	17.14	0.000478	1.56	347.42	2550.20	0.14
Bagshaw Swamp	3417	100-yr +3'	350.00	13.10	19.93	14.59	19.94	0.000058	0.79	700.55	2828.19	0.05
Bagshaw Swamp	3428	100-yr - 3'	350.00	11.90	15.98	14.08	16.11	0.002102	3.06	174.46	1206.86	0.29
Bagshaw Swamp	3428	100-yr	350.00	11.90	17.11	14.08	17.15	0.000574	1.92	332.55	2256.09	0.16
Bagshaw Swamp	3428	100-yr +3'	350.00	11.90	19.93	14.08	19.94	0.000070	0.92	728.24	2819.73	0.06
Bagshaw Swamp	3508		Bridge									
Bagshaw Swamp	3588	100-yr - 3'	350.00	11.60	16.92	14.20	16.94	0.000370	1.46	542.23	2694.58	0.12
Bagshaw Swamp	3588	100-yr	350.00	11.60	17.44	14.20	17.45	0.000214	1.19	659.22	2703.26	0.10
Bagshaw Swamp	3588	100-yr +3'	350.00	11.60	19.98	14.20	19.98	0.000033	0.62	1230.99	2767.16	0.04
Bagshaw Swamp	3700	100-yr - 3'	350.00	14.19	16.96	14.54	16.97	0.000169	0.56	965.69	3031.40	0.07
Bagshaw Swamp	3700	100-yr	350.00	14.19	17.47	14.54	17.47	0.000091	0.47	1156.19	3037.85	0.05
Bagshaw Swamp	3700	100-yr +3'	350.00	14.19	19.99	14.54	19.99	0.000011	0.26	2113.82	3060.66	0.02
Bagshaw Swamp	3810	100-yr - 3'	350.00	11.45	16.97	13.30	16.98	0.000072	0.64	1131.09	2860.89	0.06
Bagshaw Swamp	3810	100-yr	350.00	11.45	17.47	13.30	17.47	0.000044	0.55	1327.63	2862.78	0.04
Bagshaw Swamp	3810	100-yr +3'	350.00	11.45	19.99	13.30	19.99	0.000008	0.30	2339.05	2876.19	0.02
Bagshaw Swamp	3880	100-yr - 3'	350.00	12.88	16.98	14.33	16.98	0.000075	0.56	1303.34	2835.90	0.05
Bagshaw Swamp	3880	100-yr	350.00	12.88	17.47	14.33	17.48	0.000044	0.47	1536.40	2855.24	0.04
Bagshaw Swamp	3880	100-yr +3'	350.00	12.88	19.99	14.33	19.99	0.000007	0.26	2733.46	2864.00	0.02
Bagshaw Swamp	3980	100-yr - 3'	350.00	13.57	17.01	15.22	17.02	0.000541	1.15	560.84	388.64	0.12
Bagshaw Swamp	3980	100-yr	350.00	13.57	17.49	15.22	17.50	0.000289	0.93	687.61	398.43	0.09
Bagshaw Swamp	3980	100-yr +3'	350.00	13.57	19.99	15.22	19.99	0.000034	0.47	1378.45	454.63	0.03
Bagshaw Swamp	4075		Inl Struct									
Bagshaw Swamp	4175	100-yr - 3'	350.00	15.08	20.53	14.58	20.53	0.000006	0.19	3433.46	626.25	0.01
Bagshaw Swamp	4175	100-yr	350.00	15.08	20.63	14.58	20.63	0.000006	0.18	3493.02	626.68	0.01
Bagshaw Swamp	4175	100-yr +3'	350.00	15.08	21.17	14.58	21.17	0.000004	0.17	3832.69	629.12	0.01
Bagshaw Swamp	4275	100-yr - 3'	350.00	15.27	20.53	16.29	20.53	0.000047	0.48	1303.65	677.30	0.04
Bagshaw Swamp	4275	100-yr	350.00	15.27	20.63	16.29	20.63	0.000043	0.47	1331.90	677.30	0.04
Bagshaw Swamp	4275	100-yr +3'	350.00	15.27	21.17	16.29	21.17	0.000030	0.42	1492.64	677.30	0.03
Bagshaw Swamp	4339	100-yr - 3'	350.00	14.94	20.53	16.44	20.54	0.000175	1.00	472.22	1034.93	0.08
Bagshaw Swamp	4339	100-yr	350.00	14.94	20.63	16.44	20.64	0.000162	0.97	483.62	1034.93	0.07

HEC-RAS Plan: SENSITIVITY River: Bagshaw Swamp Reach: Bagshaw Swamp (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Bagshaw Swamp	4339	100-yr +3'	350.00	14.94	21.17	16.44	21.18	0.000108	0.84	548.45	1034.93	0.06
Bagshaw Swamp	4408		Bridge									
Bagshaw Swamp	4468	100-yr - 3'	350.00	14.40	20.61	15.09	20.61	0.000052	0.58	828.50	1037.78	0.04
Bagshaw Swamp	4468	100-yr	350.00	14.40	20.70	15.09	20.71	0.000049	0.57	843.24	1037.78	0.04
Bagshaw Swamp	4468	100-yr +3'	350.00	14.40	21.24	15.09	21.24	0.000036	0.52	927.46	1037.78	0.04
Bagshaw Swamp	4481	100-yr - 3'	350.00	13.81	20.61	14.79	20.62	0.000044	0.58	689.23	1036.97	0.04
Bagshaw Swamp	4481	100-yr	350.00	13.81	20.70	14.79	20.71	0.000042	0.57	699.51	1036.97	0.04
Bagshaw Swamp	4481	100-yr +3'	350.00	13.81	21.24	14.79	21.24	0.000033	0.53	758.20	1036.97	0.03
Bagshaw Swamp	4540		Bridge									
Bagshaw Swamp	4609	100-yr - 3'	350.00	13.81	20.67	15.25	20.68	0.000050	0.59	721.78	1031.70	0.04
Bagshaw Swamp	4609	100-yr	350.00	13.81	20.76	15.25	20.77	0.000047	0.58	732.98	1031.70	0.04
Bagshaw Swamp	4609	100-yr +3'	350.00	13.81	21.30	15.25	21.30	0.000036	0.54	796.92	1031.70	0.04
Bagshaw Swamp	4837	100-yr - 3'	2160.00	14.41	20.73	15.64	20.74	0.000332	1.53	2681.93	1195.21	0.11
Bagshaw Swamp	4837	100-yr	2160.00	14.41	20.82	15.64	20.83	0.000316	1.50	2722.62	1196.72	0.11
Bagshaw Swamp	4837	100-yr +3'	2160.00	14.41	21.34	15.64	21.35	0.000243	1.39	2957.94	1205.41	0.09
Bagshaw Swamp	5134	100-yr - 3'	2160.00	14.16	20.79	15.47	20.80	0.000114	0.90	4580.42	1531.79	0.06
Bagshaw Swamp	5134	100-yr	2160.00	14.16	20.88	15.47	20.88	0.000109	0.89	4648.18	1532.70	0.06
Bagshaw Swamp	5134	100-yr +3'	2160.00	14.16	21.39	15.47	21.39	0.000084	0.82	5040.09	1539.79	0.06
Bagshaw Swamp	5615	100-yr - 3'	2160.00	14.59	20.83	15.68	20.83	0.000058	0.64	7106.87	2221.91	0.05
Bagshaw Swamp	5615	100-yr	2160.00	14.59	20.92	15.68	20.92	0.000055	0.63	7222.44	2222.64	0.04
Bagshaw Swamp	5615	100-yr +3'	2160.00	14.59	21.42	15.68	21.42	0.000041	0.57	7893.60	2227.17	0.04
Bagshaw Swamp	6025	100-yr - 3'	2160.00	14.32	20.85		20.86	0.000043	0.56	10480.88	2790.38	0.04
Bagshaw Swamp	6025	100-yr	2160.00	14.32	20.94		20.94	0.000040	0.54	10716.68	2791.08	0.04
Bagshaw Swamp	6025	100-yr +3'	2160.00	14.32	21.43		21.43	0.000027	0.47	12090.34	2795.40	0.03
Bagshaw Swamp	6410	100-yr - 3'	2160.00	14.67	20.87		20.87	0.000040	0.51	11163.63	3237.63	0.04
Bagshaw Swamp	6410	100-yr	2160.00	14.67	20.95		20.95	0.000037	0.50	11433.67	3238.61	0.04
Bagshaw Swamp	6410	100-yr +3'	2160.00	14.67	21.44		21.44	0.000025	0.43	13012.37	3244.35	0.03

APPENDIX L

FEMA FIRMETTE



MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

600 0 600 1200 ME

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0300D

FIRM

FLOOD INSURANCE RATE MAP

JASPER COUNTY, SOUTH CAROLINA
AND INCORPORATED AREAS

PANEL 300 OF 575

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HARDEEVILLE, CITY OF	450113	0300	D
JASPER COUNTY	450112	0300	D
RIDGELAND, TOWN OF	450114	0300	D

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

MAP NUMBER
45053C0300D

EFFECTIVE DATE
OCTOBER 18, 2019

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.

APPENDIX M

EXISTING BRIDGE PLANS AND SI&A REPORT

National Bridge Inventory

Bridge Report

Bridge Identification:

Structure Number: 5327

(001) State:	SC	**(009) Location:**	6.5MI N OF HARDEEVILLE
(003) County:	Jasper		
(002) Highway Agency Dist:	6		
(007) Facility Carried:	I-95		
(006) Facility Crossed:	BAGSHAW SWAMP	**(5C) Level of Service:**	Mainline
		(5B) Route Signing Prefix:	Interstate Highway
(016) Latitude:	32º 22' 36"	**(5D) Route Number:**	095
(017) Longitude:	081º 1' 24"	**(5E) Directional Suffix:**	South
(011) Kilometer Point:	12.96	**(13A) LRS Inventory Route:**	00I-000950
(012) Base High. Network:	Route on base highway network	**(13B) Subroute:**	00
(099) Border Br. Struct. No:	N/A	**(98A) Neighbor State Code:**	N/A
		(98B) % Responsibility	N/A

Classification:

(112) NBIS Bridge Length:	Yes	**(105) Federal Lands Hwy:**	N/A
(104)Hwy Sys of Inv Rte:	N/A	**(110) Desig National Netw:**	Part of national network for trucks
(026) Functional Class:	Rural - Principal Arterial - Interstate	**(020) Toll:**	On free road
(100) STRAHNET Desig:	On Interstate STRAHNET route	**(021) Maintenance Respon:**	State Highway Agency
(101) Parallel Desig:	Left Bridge	**(022) Owner:**	State Highway Agency
(102) Direction of Traffic:	1-way traffic	**(037) Historical Value:**	Not eligible for National Register
(103) Temp Struc Desig:	N/A		

Age and Service:

(027) Year Built:	1968
(106) Year Recon:	N/A
(42A) Type Serv on Bridge:	Highway
(42B) Type Serv under Br:	Waterway
(28A) #Lanes on Struct:	2
(28B) #Lanes under Struct:	0
(029) ADT & (030) Year:	21650 2011
(109) Truck ADT	18 %
(019) Bypass Det. Length:	2 km

Structure Type and Material:

(045) # Main Spans:	4
(43A) Main Struct Material:	Concrete
(43B) Main Struct Type:	Tee Beam
(046) # Appr Spans:	0
(44A) Appr Struct Material:	N/A
(44B) Appr Struct Type:	N/A
(107) Deck Struct Type:	Concrete Cast-In-Place
(108A) Type Wearing Sur:	Monolithic Concrete
(108B) Type Membrane:	Unknown
(108C) Deck Protection:	Unknown

Geometric Data:

(048) Max Span Length:	9.1 m
(049) Struct Length:	36.6 m
(50B) Sidewalk Right:	0 m
(50A) Sidewalk Left:	0.5 m
(051) Curb to Curb:	11.3 m
(052) Deck Out to Out:	12 m
(010) Min Vert. Clearance:	N/A
(032) Appr Rdway Width:	11.6 m
(033) Bridge Median:	No Median
(034) Skew:	0 º
(035) Flared:	No Flare
(36A) Railings:	Feature does not meet standards
(36B) Transitions:	Feature meets standards
(36C) Appr Guard:	Feature meets standards
(36D) Appr Guard End:	Feature meets standards
(053) Vert Clearance:	N/A
(54A) Vert Clear Ref:	Feature not a highway or railroad
(54B) Min Vert Underclear:	0 m
(55A) Lat Clear Ref:	Feature not a highway or railroad
(55B) Lat Clear Right:	0 m
(056) Lat Clear Left:	0.6 m
(047) Horiz Clear	0 m

Navigation Data:

(038) Navigation Cont:	No navigation control on waterway
(039) Nav Vert Clear:	0 m
(040) Nav Horz Clear:	0 m
(111) Nav Pier Prot:	N/A

Proposed Improvements:

(75A) Type Work Prop:	35 SEE CODING GUIDE FOR EXP
(75B) Done By:	Work done by contract
(076) Length Improv:	45.4 m
(094) Bridge Impr Cost:	$250,000
(095) Road Impr Cost:	$13,000
(096) Total Cost:	$275,000
(097) Year Cost Estimate:	2013
(114) Fut. ADT & (115) Year:	37888 2031

Load and Posting:

(031) Design Load:	HS 20
(041) Traffic Status:	Open, no restriction

Condition Ratings:

(SR) Sufficiency Rating:	67	**(058) Deck:**	6-Satisfactory
(063) Oper Rating Method:	Load Factor (LF)	**(059) Superstructure:**	6-Satisfactory
(064) Operation Rating:	68.4 metric tons	**(060) Substructure:**	4-Poor *Structurally Deficient*
(065) Inv Rating Method:	Load Factor (LF)	**(061) Channel:**	7-Good
(066) Inventory Rating:	41.4 metric tons	**(062) Culvert:**	N/A

Critical Inspection Data

(090) Inspection Date:	112 (mmyy)
(091) Inspec Frequency:	24 months
(113) Scour Critical:	
(93A) Fracture:	N/A
(93B) Underwater:	N/A
(93C) Special:	N/A

Appraisal Ratings*:

(067) Structure:	4
(068) Deck Geom:	6
(069) Underclear:	N
(070) Bridge Post:	5
(071) Water Adeq:	6
(072) Appr Rdway:	8

***SEE CODING GUIDE FOR EXPLANATION**

FED. ROAD DIV. NO.	STATE	COUNTY	FILE NO.	F. A. PROJ. NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	JASPER	27.314.4	I-95-1(6)	I-95	1	14

INDEX OF SHEETS

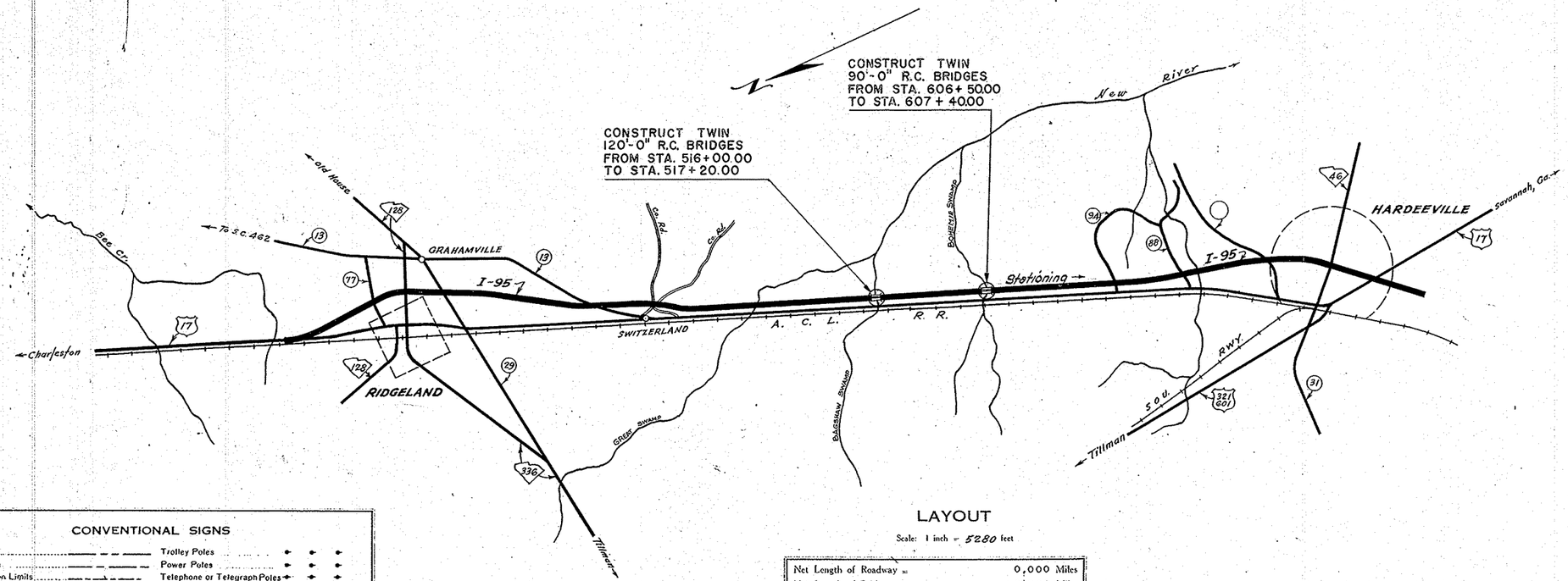
SHEET NO. 1. TITLE SHEET
2. (BLANK)
3. FLARED CURB AND GUTTER
4. 8" PIPE SLOPE DRAINS
5. STANDARD NOTES
6. STANDARD DETAILS
7 & 8. ROAD PLAN AND PROFILE
9. BRIDGE PLAN AND PROFILE - BOHEMIE SWAMP
10. BRIDGE PLAN AND PROFILE - BAGSHAW SWAMP
11. END BENTS
12. INTERIOR BENTS
13. 16" SQ. PRESTRESSED CONCRETE PILE DETAILS
14. SPAN SUPERSTRUCTURES

SOUTH CAROLINA
STATE HIGHWAY DEPARTMENT
COLUMBIA

PLAN AND PROFILE OF PROPOSED STATE HIGHWAY

F.A. PROJ. NO. I-95-1(6)
JASPER COUNTY
FILE NO. 27.314.4
TWIN BRIDGES OVER BOHEMIE SWAMP

TWIN BRIDGES OVER BAGSHAW SWAMP
ROUTE NO. I-95



LAYOUT

Scale: 1 inch = 5280 feet

Net Length of Roadway	0.000 Miles
Net Length of Bridges	0.040 Miles
Net Length of Project	0.040 Miles
Length of Exceptions	0.000 Miles
Gross Length of Project	0.040 Miles

Equalities in Stationing

SUMMARY OF ESTIMATED QUANTITIES

CLASS "A" CONCRETE	919.0	C.Y.
REINFORCING STEEL	262,698	LBS.
CREOSOTED TIMBER PILES	1,920	L.F.
16" SQ. PRESTRESSED CONCRETE PILING ①	1,800	L.F.
8" PIPE SLOPE DRAINS ①	624	L.F.
INTAKE SPILLWAY ASSEMBLIES ①	12	EA.

① SEE "SPECIAL PROVISIONS" FOR DEDUCTIONS TO BE MADE FOR MATERIALS THAT HAVE BEEN PURCHASED OR CONTRACTED FOR BY THE DEPARTMENT.

CONVENTIONAL SIGNS

State Line		Trolley Poles	
County Line		Power Poles	
City or Town Limits		Telephone or Telegraph Poles	
Property Line		Marsh	
Fence		Trees	
Retaining Wall		Brush	
Existing Road		Stumps	
℄ and R.O.W. Lines of		Buildings	
Proposed Road		Bridge	
Railroad		Concrete Box Culvert	
Levee or Embankment		Pipe Culvert	
Guard Rail		Drop Inlet and Culvert	
Point of Intersection (P.I.)	△	Hub on Center Line	

LEGEND

PROPOSED PROJECT — PAV. — ER.
OTHER ROADS

Note: All workmanship and material on this project to conform with South Carolina State Highway Department Standard Specifications for Highway Construction, Edition of 1964

APPROVED:
STATE HIGHWAY ENGINEER — DATE 6/26/64

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
APPROVED:
DISTRICT ENGINEER — DATE

R. K. HUGHES CO., FGH, PA. REGION A-3203

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	JASPER	27.3.14.1	I-95-1(6)	I-95	7	14

PLAN — SURVEYED BY JEC DATE 1/62; PLOTTED; CHECKED; QUANTITIES CHECKED; RT. OF WAY CHECKED; NOTE BOOK; NO.

PROFILE — SURVEYED; PLOTTED; GRADES CHECKED; JR. M.'s NOTED; STRUCTURE NOTATIONS CHECKED; NOTE BOOK; NO.

(2)
UNION BAG-CAMP PAPER CORP.
C.11.27.62

3" Oak
0.75'
POT @ 601+11.4
10.22'
3" Oak

12" Gum
10.50'
POT. 12.40' 12" Gum
601+27.5

200' R/W
Controlled Access Line
595
600
605
610
200' R/W
Controlled Access Line

BOHEMIA SWAMP
DEAD SWAMP
150'
85°
72'
72'
120' Median
S22°-59'W

Twin 90' Bridges to be Constructed
Sta. 606+50. to Sta. 607+40
By Others

Controlled Access Line
200' R/W
(2)
UNION BAG-CAMP PAPER, CORP.
C.11.27.62
Controlled Access Line
200' R/W

B.M. No. 58 Nail in 12" pine
100' ℓ Sta. 603+00 Elev. 15.22

Elev. 25.0 Coin Rates
Bar Hill 20% 15.042
Elev. 25.0 N. Sta. 24.67
Top 19.0 Dirt 15.018
Overhead 34.4 kv. exists.

Finished Grade
2.00%
Pl. = 599+50
El. = 20.92
4.00% V.C.
Swale Ditch Elevations
Swale Ditch
0.50%
±0.30%
Place from Toes of Rip Rap at Slopes of cliff at ends of bridges on fill in lieu
Pl. 606+50
El. = 29.02
-0.30%
500' V.C.
+0.06%
Swale Ditch

Note: Complete Channel Change around toe of fill for Bridge ends.

PLATE 1 PLAN-PROFILE O.P.R.S.C. STANDARD

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	JASPER	27.314	I-95-1(6)	I-95	8	14

Sketch Showing Crossing of Rightof-Ways of Bee... Line R.R. ... Low Water Canal and Interstate Highway No. 95, Jasper County, S.C.
Scale: 1" = 50'
B.P. Barber and Associates, Inc. Engineers
Columbia, S.C.

(77) OKEETEE CLUB C.12.30.63

P.O.T. = 512+29± 14.59' 6.55' 4" Gum 3" Oak

Begin Frontage Rd. Lt. Sta. 512+81±

Erect One Sided Exempt Highway Construction Sign (Ref. No. 5A) on Route 17 Approach to Sta. 516+00

4" Gum 9.25 P.O.T. = 516+97± (±) 4.60' 6" Gum

HORACE W. PHILLIPS O-ON DKT. 27.301 C.11.27.62 200' R/W

200' R/W Controlled Access Line

125' R/W

Ben. Fort Co. Water Assn. Inc.

Road Canal

Low Water Canal

DRAIN

505 510 515 520

522°-59'W

16' Frontage Rd.

50R

165'

TIE EQUALITY: STA. 516+42, I-95 = STA. 517+82±, Frontage Rd. Lt. Ref.

516+97±

517+04

BRANCH BAGSHAW SWAMP

Twin 120' Bridges to be Constructed Sta. 516+00.0 To Sta. 517+20.0 By Others

Begin Frontage Rd. Rt. Sta. 513+90±

Survey Sta. 516+87± Eng. Final No. I-95-1(6), Dkt. No. 27.300 Rte. No. I-95

Controlled Access Line 200' R/W

O-ON DKT. 27.301

HORACE W. PHILLIPS C. 11.27.62

(77) OKEETEE CLUB C.12.30.65

B.M. No. 49 Nail in 8" Oak 160' Lt. Sta. 509+03 Elev. 15.92

B.M. No. 50 Nail in Twin Oak 185' Lt. Sta. 519+99 Elev. 15.94

No Treatment 8'-0" 8'-0" 24' 34'

4" Uniform Earth Tape Base Course

Use This Section Frontage Rd. Lt. Sta. 512+80 - Sta. 517+82 Rt. Rt. Sta. 513+70 - Sta. 517+82

Tie Equality: Sta. 516+42, I-95 = Sta. 517+82±, Rt. Lt. Ref.

Frontage Road Left

Frontage Road Right

500' V.C.

0.00%

-1.22%

Swale Ditch Lt. & Rt.

-0.05%

Rte. 307+97 Bk. 22.76

P.I. = 513+25 El. = 16.00

P.I. = 516+60 El. = 30.85

600' V.C.

+1.22%

Swale Ditch Elev.

Rte. 312 To Rest Of Ramp Slopes of Inner Ends of Bridges

End Swale Ditch Lt. Sta. 517+20.0 Rt. Sta. 517+25

F.H.W.A. T-2 1943 W.L. Reynolds

H.W. = 17.0 H.W. = 18.7 Swale Ditch =

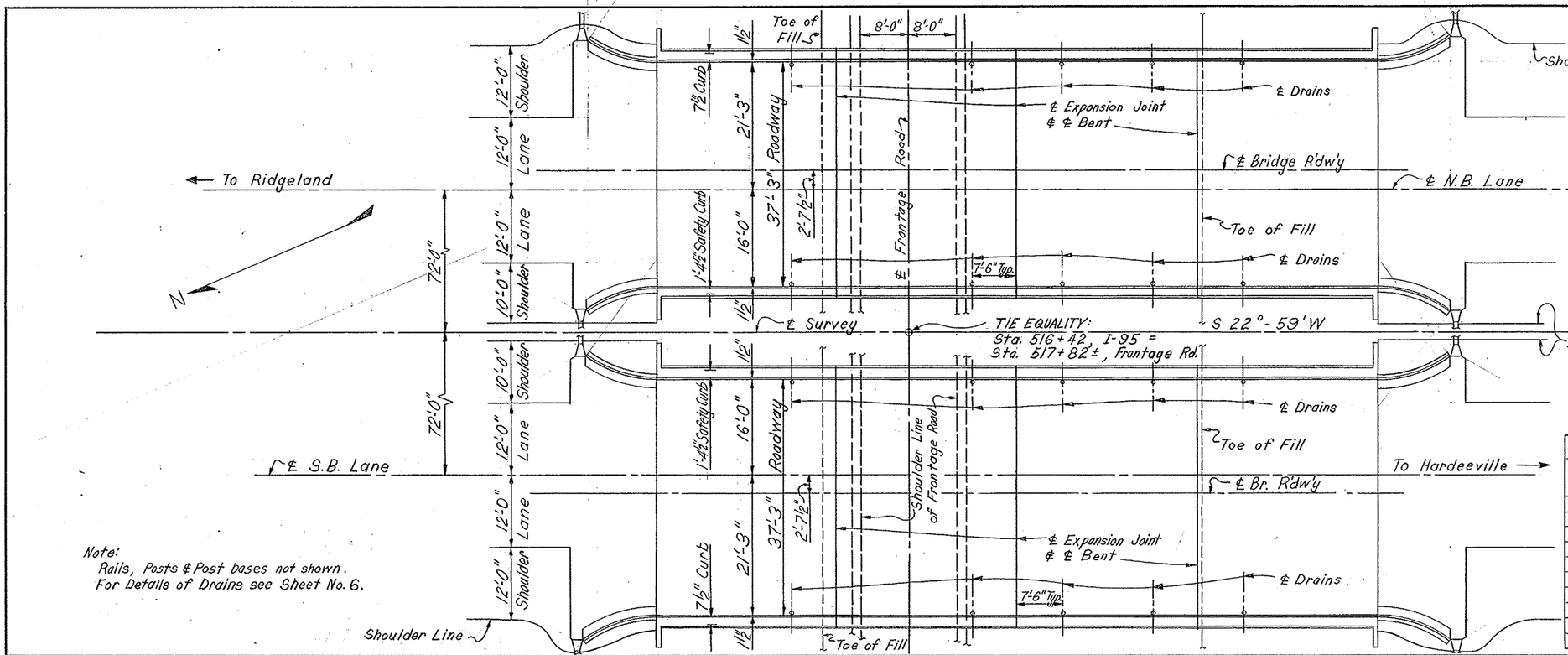
By Letter Rte. 17 H.W. = 20.4± 1929 H.W. = 17.0 1947

PLAN: SURVEYED, PLOTTED, NOTE BOOK, NO., ALIGNMENT CHECKED, R/W CHECKED, BY, DATE

PROFILE: SURVEYED, PLOTTED, GRADES CHECKED, NOTE BOOK, NO., ST. SURFACE & DRAINAGE CHKD.

PLATE 1 - PLAN - PROFILE - U.S. & S.C. STANDARD

FED. RD. DIV. NO.	STATE	COUNTY	FILE NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	JASPER	27314.4	I-95	10	14



Note:
Rails, Posts & Post bases not shown.
For Details of Drains see Sheet No. 6.

Test on Samples From Foundation Material		
Location of Boring	℄ S.B.L.	℄ S.B.L.
Station	515+87	515+87
Sample Elevation	-0.7	-15.0
% Pass #10 Ret. #60	79	1
% Pass #60 Ret. #200	19	55
% Silt	1	18
% Clay	1	26
AASHO Class	A-3	A-7-6(10)
Type Soil	Fine Sand	Clayey
Chemical Analysis		
Rock		
Maximum Load		

*Includes quantities for 2 pavement rests.

SUMMARY OF ESTIMATED QUANTITIES

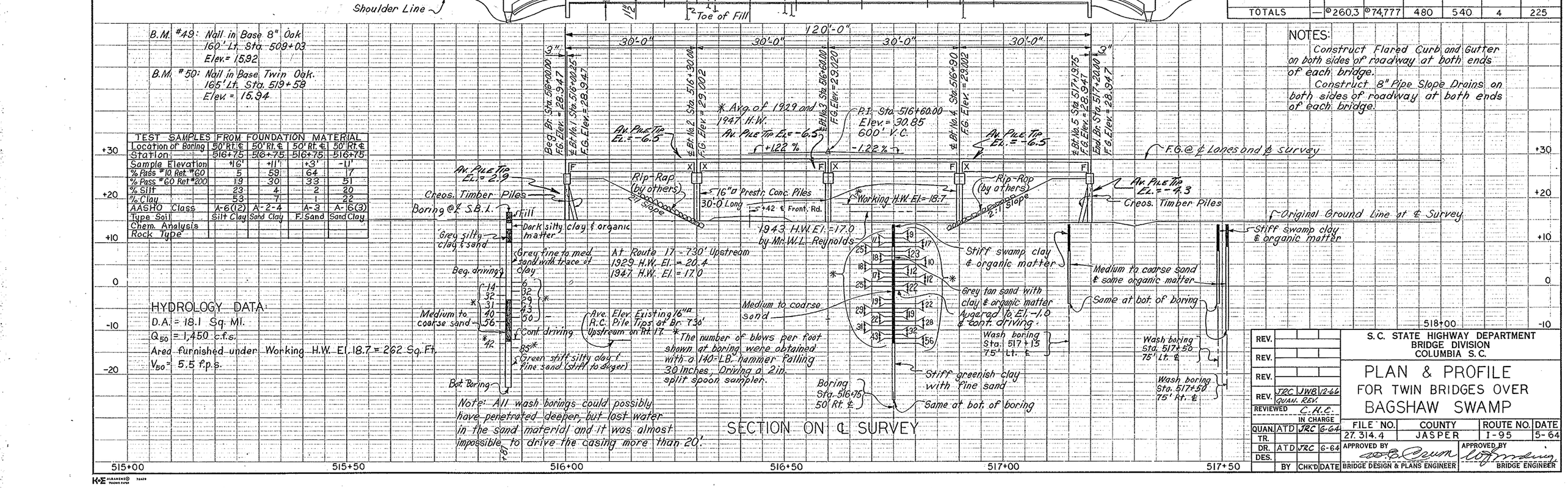
ONE BRIDGE	NO.	CLASS "A" CONCRETE	REINF. STEEL	CREOS. TIMBER PILING	16" SQ. PRE-STR. CONC. PILING	INTAKE SPILLWAY ASSEMB.	8" PIPE SLOPE DRAINS
	—	C.Y.	LBS.	L.F.	L.F.	EACH	L.F.
END BENTS 1 & 5	2	16.8	2,518	480	——	——	——
INT. BENTS 2-4	3	26.1	3,379	——	540	——	——
30' END SPAN	2	*110.2	*34,580	——	——	——	——
30' INT. SPAN	2	*104.8	*34,142	——	——	——	——
CURB & GUTTER	2	2.4	158	——	——	4	225
TOTALS	—	*260.3	*74,777	480	540	4	225

B.M. #49: Nail in Base 8" Oak
160' Lt. Sta. 509+03
Elev. = 15.92

B.M. #50: Nail in Base Twin Oak.
165' Lt. Sta. 519+58
Elev. = 15.94

TEST SAMPLES FROM FOUNDATION MATERIAL								
Location of Boring	50' Rt. ℄		50' Rt. ℄		50' Rt. ℄		50' Rt. ℄	
Station	516+75		516+75		516+75		516+75	
Sample Elevation	+16'		+11'		+3'		-11'	
% Pass #10 Ret. #60	5		59		64		17	
% Pass #60 Ret #200	19		30		33		51	
% Silt	23		4		2		20	
% Clay	53		7		1		22	
AASHO Class	A-6(12)		A-2-4		A-3		A-6(3)	
Type Soil	Silt Clay		Sand Clay		F. Sand		Sand Clay	
Chem. Analysis								
Rock Type								

HYDROLOGY DATA:
D.A. = 18.1 Sq. Mi.
Q_{50} = 1,450 c.f.s.
Area furnished under Working H.W. El. 18.7 = 262 Sq. Ft.
V_{50} = 5.5 f.p.s.



The number of blows per foot shown at boring were obtained with a 140-LB. hammer falling 30 inches, Driving a 2in split spoon sampler.

Note: All wash borings could possibly have penetrated deeper, but lost water in the sand materia and it was almost impossible to drive the casing more than 20'

SECTION ON ℄ SURVEY

NOTES:
Construct Flared Curb and Gutter on both sides of roadway at both ends of each bridge.
Construct 8" Pipe Slope Drains on both sides of roadway at both ends of each bridge.

REV.			
REV.			
REV.			
REV.	JRC	JWB	12-64
	QUAN. REV.		
REVIEWED	C.H.C.		
IN CHARGE			

S. C. STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION
COLUMBIA S. C.

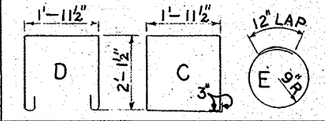
PLAN & PROFILE FOR TWIN BRIDGES OVER BAGSHAW SWAMP

	FILE NO.	COUNTY	ROUTE NO.	DATE
QUAN. ATD JRC 6-64	27.314.4	JASPER	I-95	5-64
TR.				
DR. ATD JRC 6-64	APPROVED BY		APPROVED BY	
DES.				
BY CHK'D DATE	BRIDGE DESIGN & PLANS ENGINEER		BRIDGE ENGINEER	

FED. RD. DIV. NO.	STATE	COUNTY	FILE NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	JASPER	27.314.4	I-95	11	14

REINFORCING STEEL ONE BENT, EITHER LANE

MK.	SIZE	D	NO.	LENGTH
A	8	S	8	39'-6"
B	4	S	2	39'-6"
C	4	B	46	8'-8"
D	4	B	8	7'-3"
E	3	B	16	5'-9"
DOW.	6	S	12	1'-3"

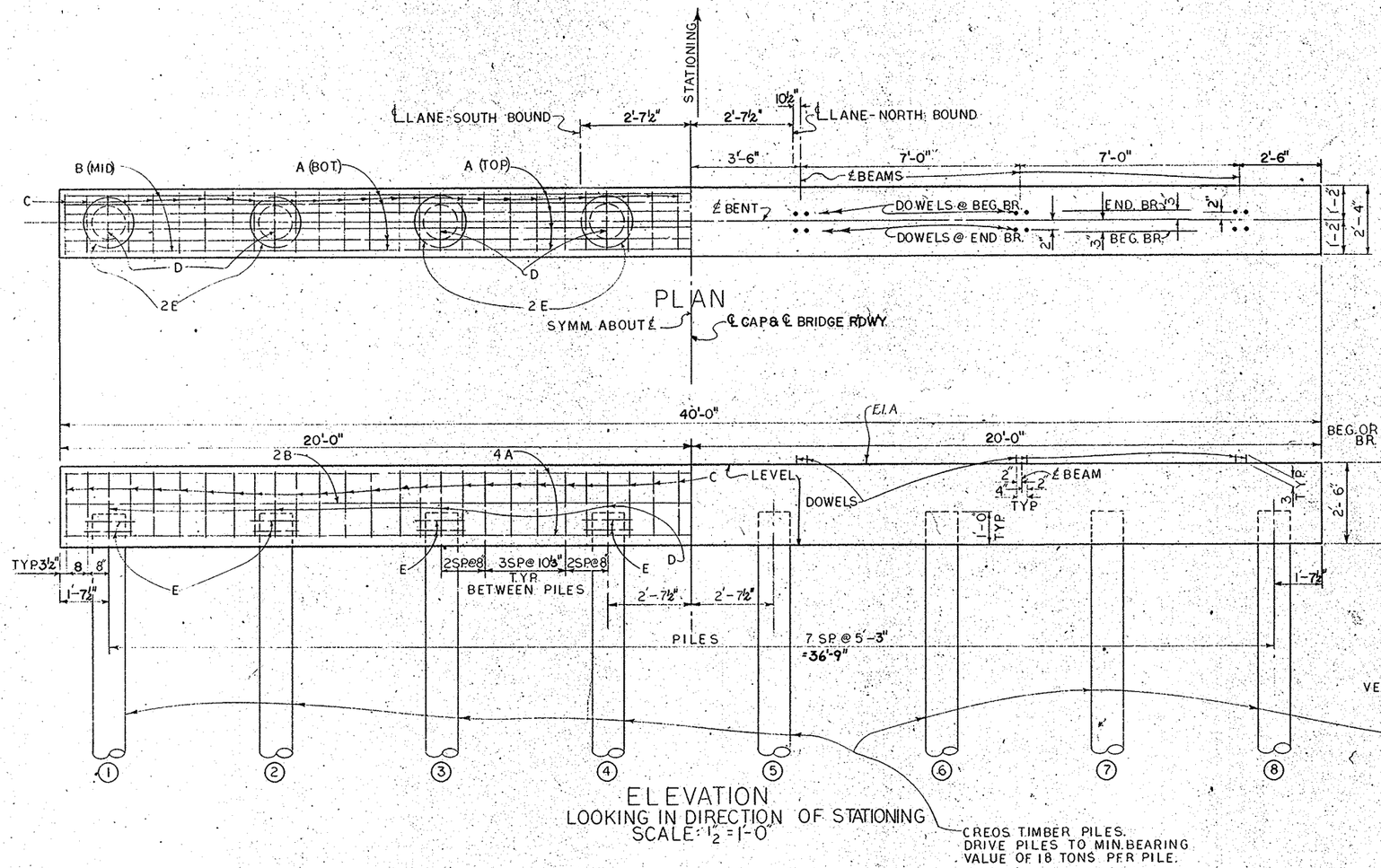


QUANTITIES ONE BENT, EITHER LANE

CONCRETE, CLASS 'A'	8.4	C.Y.
REINFORCING STEEL	* 1,259	LBS.
CREOSOTED TIMBER PILING - SEE SUMMARY ON SH. NO. 9, 10		L.F.

*INCLUDES 23 LBS. FOR DOWELS.

NOTES:
FOR STANDARD NOTES SEE SH. NO. 5.
FOR STANDARD DETAILS, INCLUDING HOOK & DOWEL DETAILS, SEE SH. NO. 6.



ELEVATION "A"		
	BOH. SW.	BAG. SW.
Bent 1	19.468 ✓	25.770 ✓
Bent 4	19.419 ✓	———
Bent 5	———	25.770 ✓

REV.			
REV.			
REV.	REK	ATD	6-64
	For Dkt. 27.314.4		
REV.	REK	CHE	5-64
	From Dkt. 40.582		
REVIEWED	C.H.E.	IN CHARGE.	
QUAN.	REK	ATD	6-64
TR.			
DR.	JAD	JRC	2-64
DES.	CHE	JRC	2-64
	BY	CHK'D	DATE

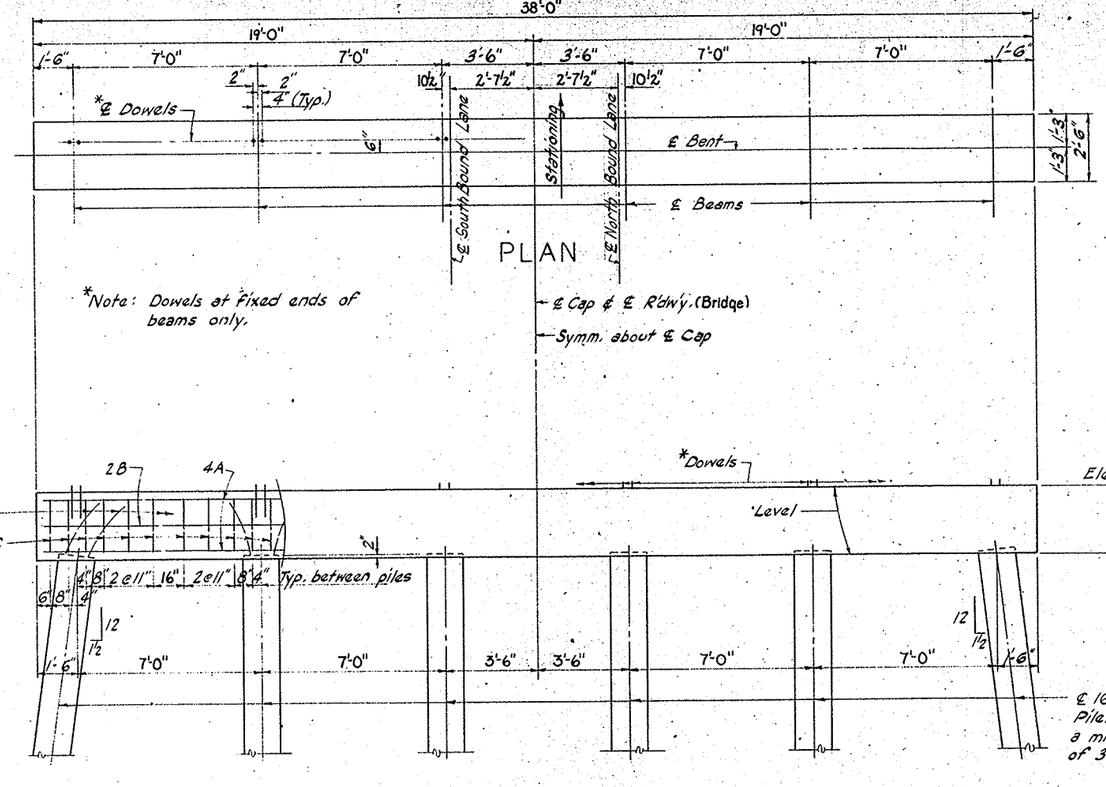
S.C. STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION
COLUMBIA S.C.

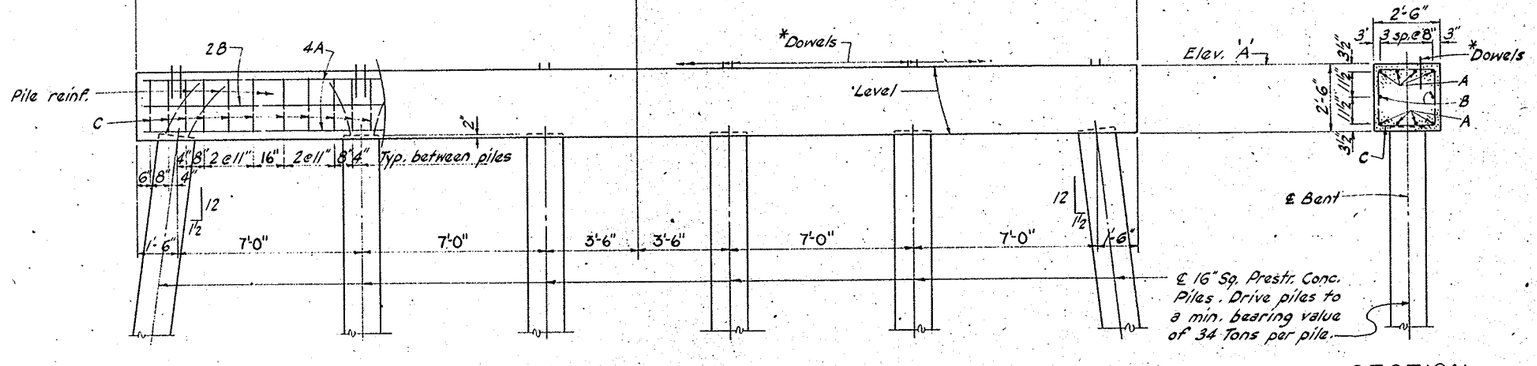
END BENTS
FOR TWIN BRIDGES OVER
BOHEMIE SWAMP
BAGSHAW SWAMP

FILE NO.	COUNTY	ROUTE NO.	DATE
27.314.4	JASPER	I-95	6-64

APPROVED BY: W. E. Gum — BRIDGE DESIGN & PLANS ENGINEER
APPROVED BY: W. Armstrong — BRIDGE ENGINEER

FED. RD. DIV. NO.	STATE	COUNTY	FILE NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	JASPER	27.314.4	I-95	12	14





ELEVATION

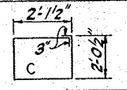
SECTION
THRU CAP

ELEVATION "A"		
	BOH. SW.	BAG. SW.
Bent # 2	19463	25825
" 3	19446	25843
" 4	——	25825
"		
"		

REINFORCING STEEL

ONE INT. BENT				
MK.	SIZE	D	NO.	LENGTH
A	6	5	8	37'-6"
B	4	5	2	37'-6"
C	4	B	44	8'-10"
* Dow.	6	5½		1'-3"

BENDING DETAILS



QUANTITIES

ONE INTERIOR BENT		
Class 'A' Concrete	8.7	C.Y.
Reinforcing Steel	@ 1134	Lbs.
16" Sq. Prestr. Conc. Piling - See Summ.		L.F.

@ Includes 23 lbs. for dowels. Omit dowels on Bohemie Swamp, Bent No. 3 and on Bagshaw Swamp, Bent No. 2 where ends of both spans are expan. ends.

Notes:
For Std. Notes see Sh. No. 5.
For Dowel Detail see Sh. No. 6.
For Pile Details see Sh. No. 13.

REV.			
REV.			
REV.	RFK	ATD	6-64
	For Dkt. 27.314.4		
REV.	REK	CHE	4-64
	From Dkt. 40.582		
REVIEWED	C.H.E.		
	IN CHARGE		
QUAN.	REK	ATD	6-64
TR.			
DR.	JRC	CHE	2-64
DES.	CHE	JRC	2-64
	BY	CHK'D	DATE

S. C. STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION
COLUMBIA S. C.

INT. BENTS

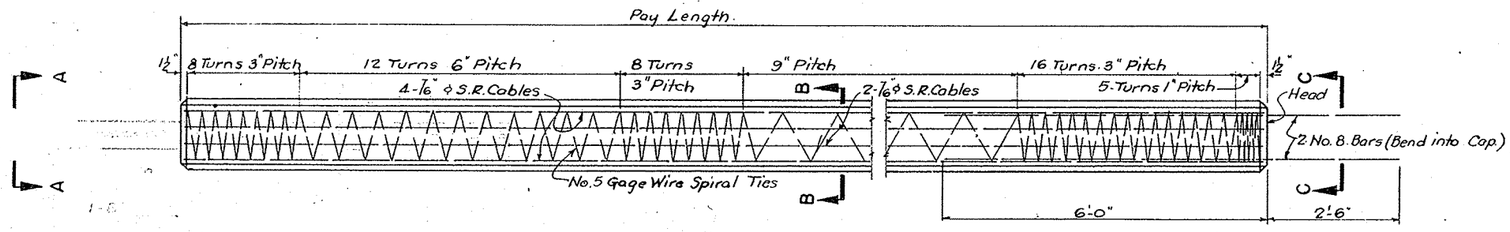
FOR TWIN BRIDGES OVER
BOHEMIE & BAGSHAW SWAMPS

FILE NO.	COUNTY	ROUTE NO.	DATE
27.314.4	JASPER	I-95	6-64

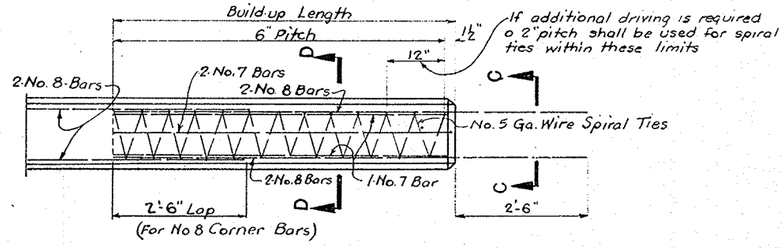
APPROVED BY W. E. Clyburn
BRIDGE DESIGN & PLANS ENGINEER

APPROVED BY L. D. Bradley
BRIDGE ENGINEER

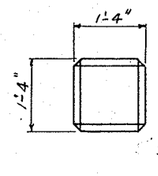
FED. RD. DIV. NO.	STATE	COUNTY	FILE NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	JASPER	27.314.4	I-95	13	14



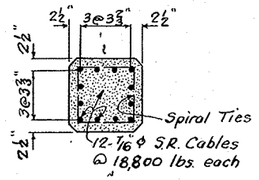
16" SQUARE PRESTRESSED PILE



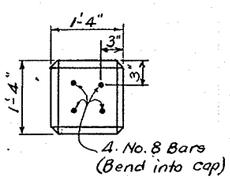
BUILD-UP



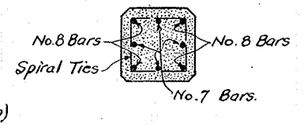
ELEVATION A-A



SECTION B-B

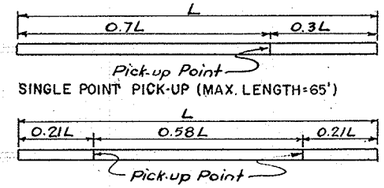


SECTION C-C



SECTION D-D

Concrete Quantity per pile = 0.0658 C.Y./L.F.



SINGLE POINT PICK-UP (MAX. LENGTH=65')

DOUBLE POINT PICK-UP (MAX. LENGTH=80')

Note:
Piles shall be marked at Pick-up Points to indicate proper points for attaching handling lines.

NOTES:

Spiral ties shall be tied to all corner cables and reinf. bars.

All dimensions relative to reinforcing steel are to centers of bars.

Chamfer all exposed edges ¾" unless otherwise noted.

All concrete shall be Class "X" See Special Provisions.

Prestressed piles shall not be transported to the bridge site or driven until the concrete has cured for at least 6 days.

In case it is necessary to cut off a prestressed concrete pile and the remaining embedment of the reinforcing bars projecting from the pile head is 20" or less, the point of cutting prestressing strands shall be 24" above the cut-off so that the prestressing strands may be embedded in the pile cap for 24".

f'c = 5,000 psi
fci = 4,000 psi
fc = 2,400 psi
fs = 24,000 psi
fsi = 175,000 psi

REV			
REV			
REV	REK	CHE	6-64
	For DH-27.314.4		
REV	J.R.C.	C.H.E.	5-60
	Remove P.I. Point		
REVIEWED	CHE		
IN CHARGE			
QUAN.			
TR.	WEB	WEB	10-56
DR.	CGW	EHS	8-56
DES.			
	BY	CHK'D	DATE

S.C. STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION
COLUMBIA, S.C.

16" SQ. PRESTRESSED CONCRETE PILES

FILE NO.	COUNTY	ROUTE NO.	DATE
27.314.4	JASPER	I-95	6-64

APPROVED BY: W. E. Quinn — BRIDGE DESIGN & PLANS ENG.
APPROVED BY: [illegible] — BRIDGE ENG.

FED. RD. DIV. NO.	STATE	COUNTY	FILE NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	JASPER	27.314.4	I-95	14	14

Design Data: LL HS20 - 44 Loading
2 axles 4' apart with each axle weighing 16 kips
Loading: f_s = 20,000 psi; f_c = 1200 psi; E_c = 3000 psi; n = 10
A.A.S.H.O. Specifications - 1961 with revisions thru 1964

NOTE
END ELEVATION
LOOKING IN DIRECTION OF STATIONING-SOUTH BOUND LANE
LOOKING IN OPPOSITE DIRECTION OF STATIONING-NORTH BOUND LANE

NOTE:
Pavement Rest not Shown.
Construct Pavement Rest at Beg. & End of Bridge.
See Sheet No. 6 for Details.

Placed year of completion on inside face of rail on right of Beg. of Bridge and on left of End of Bridge.

PLAN-END SPAN | HALF PLAN-INT. SPAN

NOTE: Rails and Posts not shown in "PLAN VIEW."

NOTE: Drains not shown. For location see Sh. No. 9 & 10. For Details see Sheet No. 6.

For "SECTION G-G" See Sheet No. 6.

NOTE: Rail and Posts shown are typical for both sides.

SIDE ELEVATION

SECTION B-B

SECTION C-C

SECTION D-D
(SHOWING RAIL, POST, POST BASE & SAFETY CURB STEEL)

SECTION E-E
(SHOWING RAIL, POST, POST BASE & CURB STEEL)

SECTION A-A

BEAM SECTION

BEAM DETAIL
(EXT. & INT. BEAM)

SECTION F-F
(LOOKING IN DIRECTION OF STATIONING-SOUTH BOUND LANE
LOOKING IN OPPOSITE DIRECTION OF STATIONING-NORTH BOUND LANE)

* At ends of Bridge and ℄ Int. Bents only.

* See "END ELEVATION" for location of U1, U2 & U3 bars.

NOTE: See "SECTION D-D" for reinf. Steel in Rail, Post, Post Bases and Safety Curb.

NOTE: See "SECTION E-E" for reinf. steel in Rail, Post, Post Bases and Curb.

Round to 1" Radius (Typ)

Int. Span Symm. about ℄

Constr. Joint

Level

Fin. Grade

Porabolic Crown

℄ Lane

℄ Rdwy (Bridge)

Const. Jt.

4" Drip Groove (Entire length of span. Typ.)

2" Typ.

3" Typ.

Bend around 4" ϕ Pin

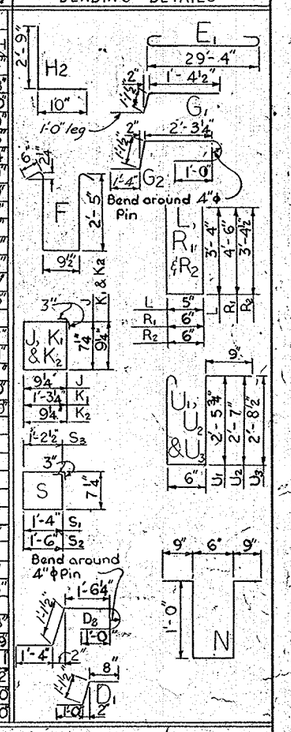
L (Open end up)

Symm. about ℄ Span

REINFORCING STEEL SCHEDULE

MARK	SIZE	D	30' END SPAN NO REQ'D	30' END SPAN LENGTH	30' INT. SPAN NO REQ'D	30' INT. SPAN LENGTH
A	5	S	124	40'-4"	126	40'-4"
B	5	S	84	29'-8"	84	29'-8"
C	5	S	30	0'-10"	30	0'-10"
D_1	4	B	24	2'-10"	24	2'-10"
D_2	7	B	20	5'-8"	20	5'-8"
E_1	11	B	18	31'-4"	18	31'-4"
E_2	10	S	12	25'-0"	12	25'-0"
E_3	10	S	6	19'-0"	6	19'-0"
F	4	B	222	6'-8"	222	6'-8"
G_1	4	B	24	3'-6"	24	3'-6"
G_2	7	B	20	6'-5"	20	6'-5"
H_1	7	S	22	2'-6"	20	2'-6"
I	6	S	12	29'-7"	12	29'-7"
J	3	B	96	3'-3"	96	3'-3"
K_1	3	B	10	4'-7"	—	—
K_2	3	B	40	3'-7"	50	3'-7"
L	6	B	24	7'-1"	24	7'-1"
M	8	S	2	35'-8"	2	35'-8"
N	4	B	30	4'-0"	30	4'-0"
P	4	S	2	35'-0"	2	35'-0"
Q_1	4	S	5	48'-2"	—	—
Q_2	4	S	4	5'-2"	—	—
Q_3	4	S	4	3'-11"	—	—
R_1	4	B	8	9'-6"	—	—
R_2	4	B	2	7'-3"	—	—
S_1	4	B	24	4'-5"	24	4'-5"
H_2	7	B	22	3'-7"	20	3'-7"
S_2	4	B	8	4'-9"	—	—
S_3	4	B	8	4'-2"	16	4'-2"
W	4	S	19	29'-8"	19	29'-8"
T	4	S	4	35'-8"	8	35'-8"
U_1	4	B	13	6'-9"	12	6'-9"
U_2	4	B	25	6'-11"	24	6'-11"
U_3	4	B	24	7'-2"	24	7'-2"
BB	1" HT.	—	REQD	445'-0"	REQD	445'-0"
BBU	1½" HT.	—	REQD	445'-0"	REQD	445'-0"

BENDING DETAILS



QUANTITIES

ITEM		1-30' END SPAN	1-30' INT. SPAN
CONCRETE, CLASS "A"	C.Y.	③ 55.1	52.4
REINFORCING STEEL ①	LBS.	③ 17,290	17,071

① Includes 281 Lbs. For Bolsters.
② Includes 1.1 C.Y. for Pavement Rest.
③ Includes 112 lbs. for Pavement Rest. See Sh. No. 6 for Details of Pav't Rest.

NOTES:
For Standard Notes see Sheet No. 5.
For Standard Details, including bolster details, hook details, drain details, beam build-down details, and expansion joint details, see Sheet No. 6.
Diaphragms and Wings shall be cast monolithic with slab and beams.
No sidewalk concrete shall be cast until beam falsework has been struck.

REV.			
REV.	JRC		12-66
REV.	For 27.314.4 F.S.W.	JRC	12-64
REV.	For New Monorail CHE.	JRC	4-64
REV.	From Dkt 40.582		
REVIEWED		IN CHARGE	
QUAN.	JRC	JWB	12-66
TR.			
DR.	CHE	JRC	2-64
DES.	CHE	JRC	2-63
✓	BY	CK'D	DATE

S. C. STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION
COLUMBIA S. C.

30 FT. END & INT. SPAN FOR TWIN BRIDGES OVER BOHEMIE SWAMP & BAGSHAW SWAMP

FILE NO.	COUNTY	ROUTE NO.	DATE
27.314.4	JASPER	I-95	12-66

APPROVED BY: S. E. Queen — BRIDGE DESIGN & PLANS ENGINEER
APPROVED BY: W. H. Armstrong — BRIDGE ENGINEER

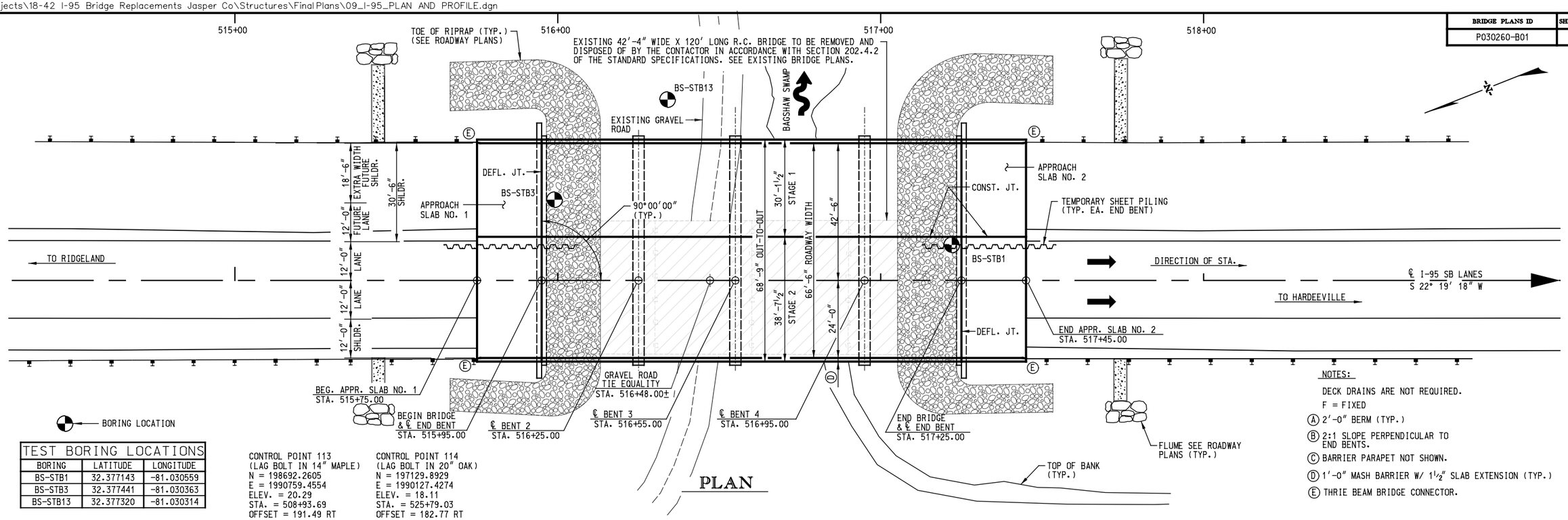
I-95

APPENDIX N

PROPOSED BRIDGE PLAN AND PROFILE

R:\Projects\18-42 I-95 Bridge Replacements Jasper Co\Structures\Final Plans\09_I-95_PLAN AND PROFILE.dgn

BRIDGE PLANS ID	SHEET NO.
P030260-B01	9



NOTES:

DECK DRAINS ARE NOT REQUIRED.

F = FIXED

(A) 2′-0″ BERM (TYP.)

(B) 2:1 SLOPE PERPENDICULAR TO END BENTS.

(C) BARRIER PARAPET NOT SHOWN.

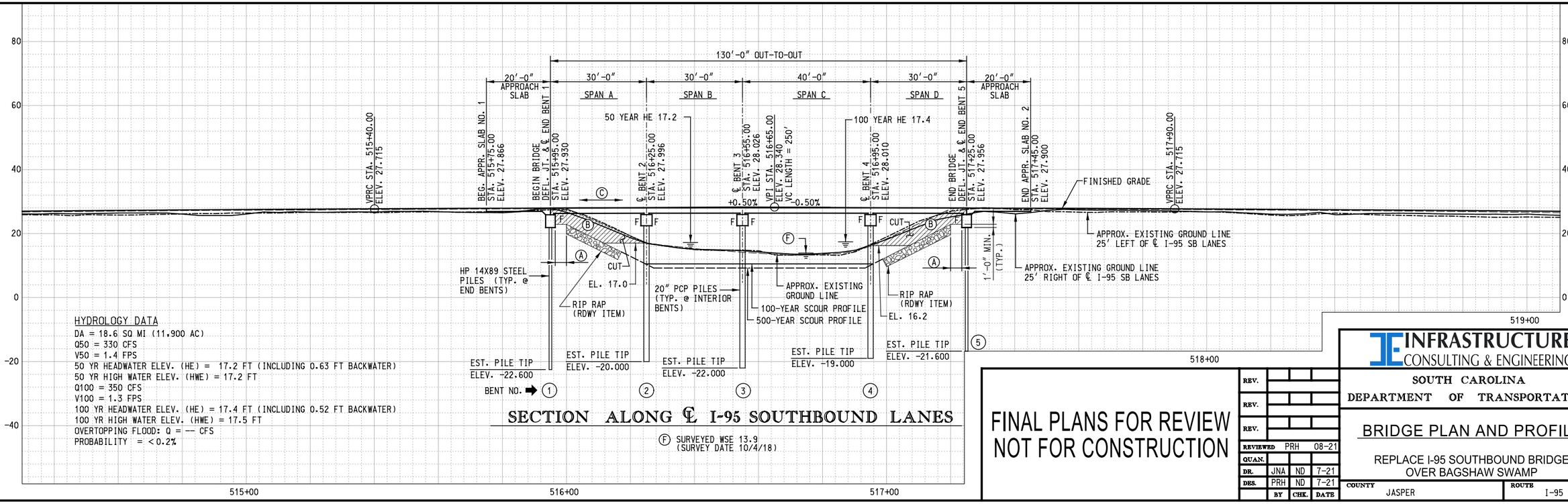
(D) 1′-0″ MASH BARRIER W/ 1½″ SLAB EXTENSION (TYP.)

(E) THRIE BEAM BRIDGE CONNECTOR.

TEST BORING LOCATIONS		
BORING	LATITUDE	LONGITUDE
BS-STB1	32.377143	-81.030559
BS-STB3	32.377441	-81.030363
BS-STB13	32.377320	-81.030314

CONTROL POINT 113
(LAG BOLT IN 14″ MAPLE)
N = 198692.2605
E = 1990759.4554
ELEV. = 20.29
STA. = 508+93.69
OFFSET = 191.49 RT

CONTROL POINT 114
(LAG BOLT IN 20″ OAK)
N = 197129.8929
E = 1990127.4274
ELEV. = 18.11
STA. = 525+79.03
OFFSET = 182.77 RT



HYDROLOGY DATA

DA = 18.6 SQ MI (11,900 AC)
Q50 = 330 CFS
V50 = 1.4 FPS
50 YR HEADWATER ELEV. (HE) = 17.2 FT (INCLUDING 0.63 FT BACKWATER)
50 YR HIGH WATER ELEV. (HWE) = 17.2 FT
Q100 = 350 CFS
V100 = 1.3 FPS
100 YR HEADWATER ELEV. (HE) = 17.4 FT (INCLUDING 0.52 FT BACKWATER)
100 YR HIGH WATER ELEV. (HWE) = 17.5 FT
OVERTOPPING FLOOD: Q = -- CFS
PROBABILITY = < 0.2%

SECTION ALONG ℄ I-95 SOUTHBOUND LANES

(F) SURVEYED WSE 13.9 (SURVEY DATE 10/4/18)

FINAL PLANS FOR REVIEW NOT FOR CONSTRUCTION

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

BRIDGE PLAN AND PROFILE

REPLACE I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP

	BY	CHK.	DATE
REV.			
REV.			
REV.			
REVIEWED	PRH		08-21
QUAN.			
DR.	JNA	ND	7-21
DES.	PRH	ND	7-21

COUNTY: JASPER

ROUTE: I-95 SB

4:15:47 PM
8/3/2021
User: brandon.mantei

APPENDIX O

SCOUR ANALYSIS

BRIDGE PLANS ID	SHEET NO.
P030260-B01	9

515+00 516+00 517+00 518+00

TOE OF RIPRAP (TYP.) (SEE ROADWAY PLANS)

EXISTING 42'-4" WIDE X 120' LONG R.C. BRIDGE TO BE REMOVED AND DISPOSED OF BY THE CONTACTOR IN ACCORDANCE WITH SECTION 202.4.2 OF THE STANDARD SPECIFICATIONS. SEE EXISTING BRIDGE PLANS.

BS-STB13

EXISTING GRAVEL ROAD

BAGSHAW SWAMP

N

18'-6" EXTRA WIDTH FUTURE SHLDR.
12'-0" FUTURE LANE
12'-0" LANE
12'-0" LANE
12'-0" SHLDR.
30'-6" SHLDR.

DEFL. JT.

BS-STB3

APPROACH SLAB NO. 1

90°00'00" (TYP.)

30'-1½" STAGE 1
68'-9" OUT-TO-OUT
38'-7½" STAGE 2
66'-6" ROADWAY WIDTH
42'-6"
24'-0"

APPROACH SLAB NO. 2

CONST. JT.

TEMPORARY SHEET PILING (TYP. EA. END BENT)

BS-STB1

DEFL. JT.

TO RIDGELAND

DIRECTION OF STA.

℄ I-95 SB LANES
S 22° 19' 18" W

TO HARDEEVILLE

END APPR. SLAB NO. 2
STA. 517+45.00

BEG. APPR. SLAB NO. 1
STA. 515+75.00

BEGIN BRIDGE & ℄ END BENT
STA. 515+95.00

℄ BENT 2
STA. 516+25.00

GRAVEL ROAD TIE EQUALITY
STA. 516+48.00±

℄ BENT 3
STA. 516+55.00

℄ BENT 4
STA. 516+95.00

END BRIDGE & ℄ END BENT
STA. 517+25.00

FLUME SEE ROADWAY PLANS (TYP.)

TOP OF BANK (TYP.)

BORING LOCATION

TEST BORING LOCATIONS		
BORING	LATITUDE	LONGITUDE
BS-STB1	32.377143	-81.030559
BS-STB3	32.377441	-81.030363
BS-STB13	32.377320	-81.030314

CONTROL POINT 113
(LAG BOLT IN 14" MAPLE)
N = 198692.2605
E = 1990759.4554
ELEV. = 20.29
STA. = 508+93.69
OFFSET = 191.49 RT

CONTROL POINT 114
(LAG BOLT IN 20" OAK)
N = 197129.8929
E = 1990127.4274
ELEV. = 18.11
STA. = 525+79.03
OFFSET = 182.77 RT

PLAN

NOTES:

DECK DRAINS ARE NOT REQUIRED.
F = FIXED
(A) 2'-0" BERM (TYP.)
(B) 2:1 SLOPE PERPENDICULAR TO END BENTS.
(C) BARRIER PARAPET NOT SHOWN.
(D) 1'-0" MASH BARRIER W/ 1½" SLAB EXTENSION (TYP.)
(E) THRIE BEAM BRIDGE CONNECTOR.

130'-0" OUT-TO-OUT

20'-0" APPROACH SLAB | 30'-0" SPAN A | 30'-0" SPAN B | 40'-0" SPAN C | 30'-0" SPAN D | 20'-0" APPROACH SLAB

VPRC STA. 515+40.00 ELEV. 21.715
BEG. APPR. SLAB NO. 1 STA. 515+75.00 ELEV. 27.866
BEGIN BRIDGE DEFL. JT. & ℄ END BENT 1 STA. 515+95.00 ELEV. 27.930
℄ BENT 2 STA. 516+25.00 ELEV. 27.996
℄ BENT 3 STA. 516+55.00 ELEV. 28.026
VPI STA. 516+65.00 ELEV. 28.340 VC LENGTH = 250'
℄ BENT 4 STA. 516+95.00 ELEV. 28.010
END BRIDGE DEFL. JT. & ℄ END BENT 5 STA. 517+25.00 ELEV. 27.956
END APPR. SLAB NO. 2 STA. 517+45.00 ELEV. 27.900
VPRC STA. 517+90.00 ELEV. 21.715

50 YEAR HE 17.2
100 YEAR HE 17.4
+0.50%
-0.50%

FINISHED GRADE
APPROX. EXISTING GROUND LINE 25' LEFT OF ℄ I-95 SB LANES
APPROX. EXISTING GROUND LINE 25' RIGHT OF ℄ I-95 SB LANES
1'-0" MIN. (TYP.)

HP 14X89 STEEL PILES (TYP. @ END BENTS)
RIP RAP (RDWY ITEM)
CUT
EL. 17.0
20" PCP PILES (TYP. @ INTERIOR BENTS)
APPROX. EXISTING GROUND LINE
100-YEAR SCOUR PROFILE
500-YEAR SCOUR PROFILE
RIP RAP (RDWY ITEM)
EL. 16.2

EST. PILE TIP ELEV. -22.600
EST. PILE TIP ELEV. -20.000
EST. PILE TIP ELEV. -22.000
EST. PILE TIP ELEV. -19.000
EST. PILE TIP ELEV. -21.600

BENT NO. ➡ 1 2 3 4 5

SECTION ALONG ℄ I-95 SOUTHBOUND LANES

(F) SURVEYED WSE 13.9
(SURVEY DATE 10/4/18)

80 60 40 20 0 -20 -40

515+00 516+00 517+00 518+00 519+00

HYDROLOGY DATA
DA = 18.6 SQ MI (11,900 AC)
Q50 = 330 CFS
V50 = 1.4 FPS
50 YR HEADWATER ELEV. (HE) = 17.2 FT (INCLUDING 0.63 FT BACKWATER)
50 YR HIGH WATER ELEV. (HWE) = 17.2 FT
Q100 = 350 CFS
V100 = 1.3 FPS
100 YR HEADWATER ELEV. (HE) = 17.4 FT (INCLUDING 0.52 FT BACKWATER)
100 YR HIGH WATER ELEV. (HWE) = 17.5 FT
OVERTOPPING FLOOD: Q = -- CFS
PROBABILITY = <0.2%

FINAL PLANS FOR REVIEW
NOT FOR CONSTRUCTION

REV.				
REV.				
REV.				
REVIEWED	PRH		08-21	
QUAN.				
DR.	JNA	ND	7-21	
DES.	PRH	ND	7-21	
	BY	CHK.	DATE	

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

BRIDGE PLAN AND PROFILE

REPLACE I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP

COUNTY: JASPER

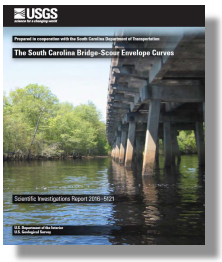
ROUTE: I-95 SB

The South Carolina
Bridge-Scour Envelope Curve Template
2016

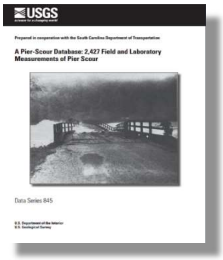
The South Carolina Bridge-Scour Envelope Curve Template was designed to provide a consistent procedure to apply the South Carolina bridge-scour envelope curves. The template was tested with a limited number of bridges and corrections were made as necessary.

The development of the South Carolina bridge-scour envelope curves is documented in a series of five reports published over a period from 2003 to 2014 (reports listed below with website links). Benedict and others (2016; website link below) provides a summary of those five previous reports and the 2016 report should be used as the primary source for guidance in applying the envelope curves and understanding their limitations. However, the earlier five reports provide important background information, and users of this template should be familiar with their content. The South Carolina bridge-scour envelope curves are useful supplementary tools for assessing scour potential at bridges in South Carolina. However, there are limitations associated with these empirical methods that must be considered in their application. The reports listed below (with website links) describe these limitations, and users of this template should be familiar with their content.

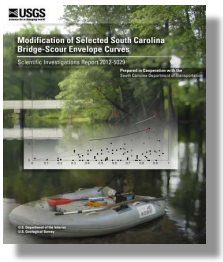
Although much effort was expended in the development and review of this template, no warranty, expressed or implied, is made by the U.S. Geological Survey as to the accuracy and functioning of the template and related template materials.



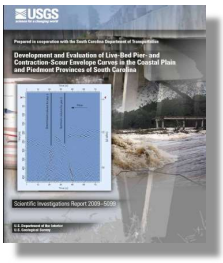
Benedict, S.T., Feaster, T.D., and Caldwell, A.W., 2016, The South Carolina bridge-scour envelope curves: U.S. Geological Survey Scientific Investigations Report 2016-5121, 96 p.
https://pubs.er.usgs.gov/publication/sir20165121



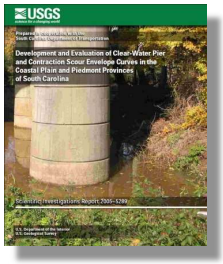
Benedict, S.T., and Caldwell, A.W., 2014, A pier-scour database—2,427 field and laboratory measurements of pier scour: U.S. Geological Survey Data Series 845, 22 p.
http://pubs.usgs.gov/ds/0845/



Benedict, S.T., and Caldwell, A.W., 2012, Modification of selected South Carolina bridge-scour envelope curves:U.S. Geological Survey Scientific Investigations Report 2012-5029, 37 p.
http://pubs.usgs.gov/sir/2012/5029/



Benedict, S.T., and Caldwell, A.W., 2009, Development and evaluation of live-bed pier and contraction scour envelope curves in the Coastal Plain and Piedmont Provinces of South Carolina, U.S. Geological Survey Scientific Investigations Report 2009–5099, 108 p.
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http://pubs.usgs.gov/sir/2005/5289/



Benedict, S.T., 2003, Clear-water abutment and contraction scour in the Coastal Plain and Piedmont Provinces of South Carolina, 1996–99: U.S. Geological Survey Water-Resources Investigations Report 03–4064, 137 p.



http://pubs.usgs.gov/wri/wri034064/

A Note to Template Users:

Throughout this workbook there are several locations where users are asked to fill in bridge-site information and where users have the option to select their preferred bridge-scour envelope curve. The authors recommend that a blank template be used when starting a new bridge-scour assessment to avoid mistakes possible when back-tracking through a previously populated template.

Abbreviations Used in the Template

#	number
CH	channel
D/S	downstream
DA	drainage area
DMS	degrees-minutes-seconds
FEMA	Federal Emergency Management Agency
ft	feet
HEC-18	Hydraulic Engineering Circular No. 18 (Arneson and others, 2012)
HWM	high water mark
LABUT	left abutment
LEW	left edge of water
LTB	left top bank
LOB	left overbank
m	geometric-contraction ratio
N/A	not applicable
RABUT	right abutment
REW	right edge of water
ROB	right overbank
RTB	right top bank
SCDOT	South Carolina Department of Transportation
sq mi	square mile
topo	topographic
USGS	U.S. Geological Survey
WSEL	water-surface elevation

References Used in the Template

Arneson, L.A., Zevenbergen, L.W., Lagasse, P.F., and Clopper, P.E., 2012, Evaluating scour at bridges (5th ed.): Federal Highway Administration Hydraulic Engineering Circular No. 18, Publication No. FHWA-HIF-12-003, 340 p.

Benedict, S.T., 2003, Clear-water abutment and contraction scour in the Coastal Plain and Piedmont Provinces of South Carolina, 1996–99: U.S. Geological Survey Water-Resources Investigations Report 03–4064, 137 p.

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Benedict, S.T., Feaster, T.D., and Caldwell, A.W., 2016, The South Carolina bridge-scour envelope curves: U.S. Geological Survey Scientific Investigations Report 2016-5121, 96 p.

Site Information

Use a blank template when starting new assessments
(Fill in gray shaded cells; leave blank if data not available.)

Bridge Number:	2710009530800	**Stream:**	Bagshaw Swamp	**Date of Analysis:**	8/2/21
County:	Jasper	**Road:**	I-95 Southbound		
Physiographic Region (for scour):	Coastal Plain	**Multiple Bridge?**	No	**Bridge Length:**	130 ft
		Relief Bridge?	No		
Latitude:	32°22'38" DMS	**Swampy, Poorly Defined Channel?**	Yes	**Drainage Area:**	18.6 sq mi
Longitude:	81°1'50" DMS				

Hydraulic Model Data (Stations for bridge cross section are based on unconstricted approach section station with bridge projected on to approach)

Data Available?	Yes
Quality of Model Data:	Good

LEW station at unconstricted approach cross section; OR left stagnation point for multiple bridge (if no data, leave cell empty):	0	ft
REW station at unconstricted approach cross section; OR right stagnation point for multiple bridge (if no data, leave cell empty):	485	ft
Unconstricted cross-section topwidth from model data (approach before cross-section):	485	ft

CHECK (Single bridge data):

Do embankment lengths and toe-to-toe distance equal unconstricted cross-section topwidth? (approach before cross-section)	**Yes**

LEW station at bridge (based on approach):	121	ft
REW station at bridge (based on approach):	236	ft
Left abutment toe station (based on approach):	123	ft
Right abutment toe station (based on approach):	234	ft
LTB station at bridge (if relief bridge or swampy, poorly defined channel, leave cell empty):	186	ft
RTB station at bridge (if relief bridge or swampy, poorly defined channel, leave cell empty):	221	ft
Channel topwidth (model):	0	ft
Distance from toe to toe (model):	111	ft
Left embankment length (model):	123	ft
Right embankment length (model):	251	ft
m (model):	0.76	

SCDOT Plan Data (Be sure to check for tie equalities)

Data Available?	No
Quality of Plan Data:	Not Usable

SCDOT Road Plan number:		
Use HWM or average flood-plain flow depth for WSEL?**		
WSEL on SCDOT datum:		ft
LEW station at unconstricted cross section from plans (if no data, leave cell empty):		ft
REW station at unconstricted cross section from plans (if no data, leave cell empty):		ft
Unconstricted cross-section topwidth from plans:	No Data	ft

CHECK (Single bridge data):

Do embankment lengths and toe-to-toe distance equal unconstricted cross-section topwidth?	**No**

LEW station at bridge:		ft
REW station at bridge:		ft
Left abutment toe station:		ft
Right abutment toe station:		ft
LTB station at bridge (if relief bridge or swampy, poorly defined channel, leave cell empty):		ft
RTB station at bridge (if relief bridge or swampy, poorly defined channel, leave cell empty):		ft
Channel topwidth (plans):	0	ft
Distance from toe to toe (plans):	No Data	ft
Left embankment length (plans):	No Data	ft
Right embankment length (plans):	No Data	ft
m (plans):	No Data	

****NOTE:** Average flood-plain flow depth in Coastal Plain and Piedmont is approximately 7 ft.

Topographic Map Data

Data Available?	Yes
Quality of Map Data:	Good

Does topo indicate wide, flat floodplain?	Yes	
Does topo indicate severe meander just upstream?	No	
Bridge length as provided by SCDOT (verify with topo map if possible):	130	ft
Approach flood-plain topwidth (topo map):**	485	ft
Left embankment length (topo map):	120	ft
Right embankment length (topo map):	235	ft

CHECK (Single bridge data):

Does sum of embankment and bridge lengths equal approach flood-plain topwidth?	**Yes**

m (topo map):	0.73

****NOTE:** The approach cross section should represent the unconstricted natural cross section located approximately one bridge-width upstream of the bridge of interest.
****NOTE:** The HWM from the SCDOT plans, HWM from flood documentation, or the average flood-plain flow depth should be used to approximate the flood-plain topwidth.

FEMA/Other Map Data

Data Available?	Yes
Quality of Map Data:	Not Usable
If "Other Map," describe:	

Bridge length as provided by SCDOT (verify with FEMA/Other map if possible):		**ft**
Approach flood-plain topwidth (FEMA/Other map):**		**ft**
Left embankment length (FEMA/Other map):		**ft**
Right embankment length (FEMA/Other map):		**ft**
m (FEMA/Other map):	No Data	

CHECK (Single bridge data):

Does sum of embankment and bridge lengths equal approach flood-plain topwidth?	**No**

****NOTE:** The approach cross section should represent the unconstricted natural cross section located approximately one bridge-length upstream of the bridge of interest.
****NOTE:** The inundated areas on the FEMA/Other map should be used to approximate the flood-plain topwidth.

Comparison of Geometric-Contraction Ratios [m]

Select Source for m: Source Used: Hydraulic Model

	m Value	Quality of Source Data
m from model:	0.76	Good
m from road plans:	No Data	No Data
m from topographic map:	0.73	Good
m from FEMA/Other map:	No Data	Not Usable
USE m:	0.76	

****NOTE: The "USE m" value is automatically selected, but can be overridden by typing in another value. If the originally selected value of m is overridden, justification should be provided in the comments below.**

**NOTE: In most cases, the model data should provide a reasonable estimate of m and should be given strong consideration in the selection of the final m. The other sources of data (road plans and maps) should be used to confirm the m estimate based on the model data. The road plans are based on an actual survey, likely providing a better data source for confirming the m determined from the model data. The details associated with the topographic and FEMA/Other maps will often be limited, causing discrepancies in the estimate of m. When significant discrepancies in the estimate of m exist between the four data sources, the user should determine the reason for the discrepancy and then select a reasonable, but conservative estimate of m. As a general rule, the selected m and embankment lengths should come from the same data source.

Comparison of Embankment Lengths

Select Source for Embankment Length: Source Used: Topo Map

	Left		Right	
	Embankment Length (ft)	Quality of Source Data	Embankment Length (ft)	Quality of Source Data
Embankment length from model:	123	Good	251	Good
Embankment length from road plans:	No Data	No Data	No Data	No Data
Embankment length from topographic map:	120	Good	235	Good
Embankment length from FEMA/Other map:	No Data	Not Usable	No Data	Not Usable
USE embankment length:	235 ft		235 ft	

CHECK:

Is this a relief or swampy bridge with a poorly defined channel and a bridge length less than or equal to 240 ft? If so, use the maximum embankment length from the selected "Source Used" for left and right embankment length.	**Yes**

****NOTE:** The "USE embankment length" value is automatically selected, but can be overridden by typing in another value. If the originally selected value of embankment length is overridden, justification should be provided in the comments below.

**NOTE: In most cases, the model data should provide a reasonable estimate of embankment lengths and should be given strong consideration in the selection of the final embankment lengths. The other sources of data (road plans and maps) should be used to confirm the embankment length estimates baed on the model data. The road plans are based on an actual survey, likely providing a better data source for confirming the embankment lengths determined from the model data. The details associated with the topographic and FEMA/Other maps will often be limited, causing discrepancies in the estimate of embankment length. When significant discrepancies in the estimate of embankmnent lengths exist between the four data sources, the user should determine the reason for the discrepancy and then select a reasonable, but conservative estimate of embankment length. As a general rule, the selected m and embankment lengths should come from the same data source.

Comparison of Overbank Widths underneath Bridge

Select Source for Overbank Width: Source Used: Hydraulic Model

	Left Overbank Width (Left abutment toe to left top of bank)**	Right Overbank Width (Right top of bank to right abutment toe)**
Overbank width (Old SCDOT plans if available):	No Data ft	No Data ft
Overbank width (Hydraulic Model):	55.5 ft	55.5 ft
USE overbank width:	27 ft	0 ft
CHECK: **Is overbank width greater than or equal to 10 feet?**++**	Yes	No

****NOTE:** The overbank width information is compared with the topwidth of the abutment-scour hole to determine how much of the overbank width will be covered by the abutment-scour hole and how much will remain for overbank scour.

****NOTE:** If the site is a relief bridge or has a swampy, poorly defined channel, then the overbank width will be determined by splitting the toe-to-toe width between the left and right overbanks.

++**NOTE:** The SCDOT Requirements Manual recommends for new and replacement bridges that there be a minimum 10 foot setback distance from the top of bank to the abutment toe (written commun., S.T. Benedict, South Carolina Department of Transportation, September 12, 2016).

3

Comments:

1	These and other limitations should be kept in mind when using the envelope curves to assess scour potential. The envelope curves are empirical methods that are based on limited field samples; it is possible that scour could exceed the envelope curves; therefore, application of a safety factor may be prudent. Application of the envelope curves is constrained to the range of data and site characteristics used to develop the envelope curves. The uncertainty associated with the envelope curves increases near the limits of the data range. The live-bed scour data have the largest uncertainty.
2	The envelope curves do not account for unusual site conditions such as: debris; channel bank failures; pressure flow; unusual flow patterns created by unique site conditions; unusual pier geometries; and washout of approach road embankments.
3	The field data generally represent scour associated with flows approaching the 100-year flow magnitude but should not be considered a definitive estimate of the scour depth associated with the 100-year flow. Similarly, the 500-year flow adjustment coefficients can be used to provide perspective on the relative increase in theoretical scour associated with the 100- to 500-year flow condition, but should not be considered a definitive estimate of the scour depth associated with the 500-year flow.
4	Subsurface soils can impede or promote scour. Therefore, assessing the potential effect of subsurface soils on scour is important.
5	
6	

Clear-Water Abutment-Scour Estimate

(occurs in the abutment region)

(Option to fill in/modify gray shaded cells. Other cells are selected/calculated automatically.)

Bridge Number:	2710009530800	**Stream:**	Bagshaw Swamp	**Date of Analysis:**	8/2/21
County:	Jasper	**Road:**	I-95 Southbound		
Physiographic Region:	Coastal Plain	**Multiple Bridge?**	No	**Bridge Length:**	130 ft
		Relief Bridge?	No		
Latitude:	32°22'38" DMS	**Swampy, Poorly Defined Channel?**	Yes	**Drainage Area:**	18.6 sq mi
Longitude:	81°1'50" DMS				

Drainage Area Check -- Original Curve (Benedict and others, 2016; Benedict, 2003): **DA IN RANGE**

Drainage Area Check -- Modified Curve (Benedict and others, 2016; Benedict and Caldwell, 2012): **DA IN RANGE**

Comparison of Geometric-Contraction Ratios [m]

	m Value	Quality of Source
m from model:	0.76	Good
m from road plans:	No Data	No Data
m from topographic map:	0.73	Good
m from FEMA/Other map:	No Data	Not Usable
USE m: (from "Site Info" Sheet)	0.76	

m range check -- Original Curve (Benedict and others, 2016; Benedict, 2003): **OK**

m range check -- Modified Curve (Benedict and others, 2016; Benedict and Caldwell, 2012): **OK**

****NOTE: The "USE m" value is automatically pulled from the Site Info Sheet.**

Guidance:

Original Clear-Water Abutment-Scour Curves
(Benedict and others, 2016; Benedict, 2003)

Limits:
1) For Piedmont sites the maximum m =0.82, but 0.86 could be justified with caution.
2) For Coastal Plain sites the maximum m =0.98, but use caution when greater than 0.9.
3) Drainage area should fall within range of measured data and caution should be used as drainage area approaches limits of data.

Modified Clear-Water Abutment-Scour Curve
(Benedict and others, 2016; Benedict and Caldwell, 2012)

Limits:
1) For Piedmont sites the maximum m =0.85.
2) For Coastal Plain sites the maximum m =0.9.
3) Drainage area should fall within the range of measured data and caution should be used as drainage area approaches limits of data.

Comparison of Embankment Lengths

	Left		Right	
	Embankment Length (ft)	Quality of Source Data	Embankment Length (ft)	Quality of Source Data
Embankment length from model:	123	Good	251	Good
Embankment length from road plans:	No Data	No Data	No Data	No Data
Embankment length from topographic map:	120	Good	235	Good
Embankment length from FEMA/Other map:	No Data	Not Usable	No Data	Not Usable
USE embankment length (*from Site Info Sheet*)**:**	**235**		**235**	
Embankment length range check -- Original Curve (Benedict and others, 2016; Benedict, 2003): (*from "EQUATIONS" Sheet*)	**OK**		**OK**	
Embankment length range check -- Modified Curve (Benedict and others, 2016; Benedict and Caldwell, 2012): (*from "EQUATIONS" Sheet*)	**OK**		**OK**	

****NOTE:** The "USE embankment length" value is automatically pulled from the Site Info Sheet.

CHECK:

Is this a relief or swampy bridge with a length less than or equal to 240 ft?	**Yes**
If so, use the maximum embankment length from the selected "Source Used" (see "Site Info" Sheet) for left and right embankment lengths.	

Guidance:

Original Clear-Water Abutment-Scour Curves
(Benedict and others, 2016; Benedict, 2003)

Limits:
1) If the bridge is a relief or swampy bridge with a length of 240 ft or less, the longest embankment length for the left or right embankments should be used at both abutments.
2) For Piedmont sites the maximum embankment length = 950 ft.
3) For Coastal Plain sites the maximum embankment length = 7,440 ft, but most of the data is for lengths of about 2,000 ft or less. Caution must be used when values exceed 2,000 ft.
4) Drainage area should fall within the range of measured data and caution should be used as drainage area approaches limits of data.

Modified Clear-Water Abutment-Scour Curve
(Benedict and others, 2016; Benedict and Caldwell, 2012)

Limits:
1) If the bridge is a relief or swampy bridge with a length of 240 ft or less, the longest embankment length for the left or right embankments should be used at both abutments.
2) For Piedmont and Coastal Plain sites, the maximum embankment length = 500 ft.
3) Drainage area should fall within the range of measured data and caution should be used as drainage area approaches limits of data.

Clear-Water Abutment-Scour Depth from Envelope Curves

	Left Abutment		Right Abutment	
Original Clear-Water Abutment-Scour Curves (Benedict and others, 2016; Benedict, 2003):				
Abutment-scour depth by embankment length:	7.9	ft	7.9	ft
Abutment-scour depth by geometric-contraction ratio m:	11.5	ft	11.5	ft
Original abutment-scour curve selection:	**Embankment Length**		**Embankment Length**	
Selected original abutment-scour depth:	**7.9**	ft	**7.9**	ft
Modified Clear-Water Abutment-Scour Curve (Benedict and others, 2016; Benedict and Caldwell, 2012):				
Abutment-scour depth by embankment-length category:	8.4	ft	8.4	ft
Abutment-scour depth by interpolation:	6.5	ft	6.5	ft
Modified abutment-scour curve selection:	**Interpolation**		**Interpolation**	
Selected modified abutment-scour depth:	**6.5**	ft	**6.5**	ft
Final Selected Clear-Water Abutment-Scour Depth:				
Final abutment-scour curve selection:	**Automatic Selection**		**Automatic Selection**	
Final selected clear water abutment-scour depth:	**6.5**	ft	**6.5**	ft
Relative Increase in Theoretical Clear-Water Abutment-Scour from the 100- to 500-Year Flows (Benedict and others, 2016):				
500-yr flow coefficient:	1.21		1.21	
Abutment-scour by 500-year flow coefficient:	**7.8**	ft	**7.8**	ft

Guidance:

Original Clear-Water Abutment-Scour Curves
(Benedict and others, 2016; Benedict, 2003)

1) If the bridge is a relief or swampy bridge with a length of 240 ft or less, the scour depth determined by embankment length for the left and right abutments should be based on the longest embankment length. NOTE: The "Use embankment length" from above should reflect the maximum embankment length from the left or right embankment if the bridge meets the criteria in item 1. Check to verify.
2) For single bridge, the spreadsheet will use the embankment-length envelope curves. However, there are cases when it may be appropriate to use the geometric-contraction ratio envelope curve if a more conservative estimate is deemed appropriate. Refer to Benedict and others (2016) for additional discussion.
3) For multiple bridge in Piedmont, use m envelope curve.
4) For multiple bridge in Coastal Plain, for embankment length < 426 ft use m envelope curve.
5) For multiple bridge in Coastal Plain: for embankment length >= 426 ft, the spreadsheet will use the embankment-length envelope curves. However, there are cases when it may be appropriate to use the geometric-contraction ratio envelope curve if a more conservative estimate is deemed appropriate. Refer to Benedict and others (2016) for additional discussion.
6) If the m and (or) embankment lengths are near the limits or beyond the range of the envelope data a caution or warning message, respectively, will appear in the "m range check" and (or) "Embankment length range check" cells above. For these cases judgment, must be used to assess the best estimate of clear-water abutment scour.

Modified Clear-Water Abutment-Scour Curve
(Benedict and others, 2016; Benedict and Caldwell, 2012)

1) If the bridge is a relief or swampy bridge with a length of 240 ft or less, the scour depth determined by embankment length for the left and right abutments should be based on the longest embankment length. NOTE: The "Use embankment length" from above should reflect the maximum embankment length from the left or right embankment if the bridge meets the criteria in item 1. Check to verify.
2) Use for single bridges only. Use original curve (Benedict and others, 2016; Benedict, 2003) for multiple bridges.
3) If the estimate of scour using the original envelope curves is less than that using the modified curve, then use the scour depth associated with the original curve.
4) If the m and (or) embankment lengths are near the limits or beyond the range of the envelope data a caution or warning message, respectively, will appear in the "m range check" and (or) "Embankment length range check" cells above. For these cases judgment must be used to assess the best estimate of clear-water abutment scour.

Relative Increase in Theoretical Clear-Water Abutment-Scour from the 100- to 500-Year Flows
(Benedict and others, 2016)

1) The 500-year flow adjustment coefficient (K_{500}) is used to calculate the relative abutment scour increase from 100- to 500-year flows.
2) The K_{500} is a helpful tool for gaining perspective on the relative increase of theoretical scour associated with the 100- to 500-year abutment-scour depth. However, the adjusted envelope curve values should not be considered a definitive estimate of the abutment scour associated with the 500-year flow.

Scour-Hole Topwidths

(Benedict and others, 2016; Benedict, 2003)

	Left Abutment		Right Abutment	
Use Abutment Scour-Hole Topwidth Curve (select from 1 or 2 below):	**1**		**1**	
(1) Any length bridge with a well defined channel or any bridge longer than 240 feet				
(2) Flood-plain relief or swampy bridge with length of 240 ft or less				
Abutment scour-hole topwidth:	**65.8**	ft	**65.8**	ft
Is scour depth outside range of graph?	**No**		**No**	

NOTE: The "Abutment scour-hole topwidth" is automatically calculated. The scour-hole topwidth equations coded in the spreadsheet limit the abutment-scour depth to 25 feet, which is beyond the range of the original graphs. The cell below the scour-hole topwidth will indicate if the abutment-scour depth exceeds the graph range and judgment must be used with regard to utilizing the estimated value.

Comments:

1	These and other limitations should be kept in mind when using the envelope curves to assess scour potential. The envelope curves are empirical methods that are based on limited field samples; it is possible that scour could exceed the envelope curves; therefore, application of a safety factor may be prudent. Application of the envelope curves is constrained to the range of data and site characteristics used to develop the envelope curves. The uncertainty associated with the envelope curves increases near the limits of the data range. The live-bed scour data have the largest uncertainty.
2	The envelope curves do not account for unusual site conditions such as: debris; channel bank failures; pressure flow; unusual flow patterns created by unique site conditions; unusual pier geometries; and washout of approach road embankments.
3	The field data generally represent scour associated with flows approaching the 100-year flow magnitude but should not be considered a definitive estimate of the scour depth associated with the 100-year flow. Similarly, the 500-year flow adjustment coefficients can be used to provide perspective on the relative increase in theoretical scour associated with the 100- to 500-year flow condition, but should not be considered a definitive estimate of the scour depth associated with the 500-year flow.
4	Subsurface soils can impede or promote scour. Therefore, assessing the potential effect of subsurface soils on scour is important.
5	

Clear-Water Contraction-Scour Estimate

(occurs in the overbank region)

(Option to fill in/modify gray shaded cells. Other cells are selected/calculated automatically.)

Bridge Number:	2710009530800	**Stream:**	Bagshaw Swamp	**Date of Analysis:**	8/2/21
County:	Jasper	**Road:**	I-95 Southbound		
				Bridge Length:	130 ft
Physiographic Region:	Coastal Plain	**Multiple Bridge?**	No		
		Relief Bridge?	No	**Drainage Area:**	18.6 sq mi
Latitude:	32°22'38" DMS	**Swampy, Poorly Defined Channel?**	Yes		
Longitude:	81°1'50" DMS			**Drainage Area Check:**	DA OUTSIDE RANGE (Below)

Comparison of Geometric-Contraction Ratios [m]

	m Value	Quality of Source Data
m from model:	0.76	Good
m from road plans:	No Data	No Data
m from topographic map:	0.73	Good
m from FEMA/Other map:	No Data	Not Usable
USE m: (from "Site Info" Sheet)	0.76	
m range check: (from "EQUATIONS" Sheet)	OK	

****NOTES:** If the geometric-contraction ratio is greater than 0.95 message is **OUTSIDE RANGE**.
If the geometric-contraction ratio is between 0 and 0.85 message is **OK**.
If the geometric-contraction ratio is between 0.85 and 0.95 message is **CAUTION**.

**NOTE: The "USE m" value is automatically pulled from the Site Info Sheet.

Guidance:

(Benedict and others, 2016; Benedict and Caldwell, 2006)

1) For the Piedmont data the maximum m for clear-water overbank contraction scour was 0.85.
2) For the Coastal Plain data the maximum m for clear-water overbank contraction scour was 0.95 with data sparse for m greater than 0.9.
3) Caution must be used when m nears or exceeds the upper limits of the data and the "m range check" cell above should be used to help evaluate the final selection of m.

Clear-Water Contraction-Scour Depth from Envelope Curves

	Left Overbank		Right Overbank	
Clear-Water Contraction-Scour Curve (Benedict and others, 2016; Benedict and Caldwell, 2006)				
Clear-water contraction-scour depth by geometric-contraction ratio m:	4.7	ft	4.7	ft
Final Selected Clear-Water Contraction-Scour Depth:	**4.7**	ft	**4.7**	ft
Relative Increase in Theoretical Clear-Water Contraction Scour from the 100- to 500-Year Flows (Benedict and others, 2016):				
500-yr flow coefficient:	1.46		1.46	
Clear-water contraction-scour by 500-year flow coefficient:	**6.9**	ft	**6.9**	ft

****NOTE:** The "Selected clear-water overbank-contraction-scour depth" value is automatically selected, but can be overridden by typing in another value. If the originally selected value of overbank-contraction-scour depth is overridden, justification should be provided in the comments below.

Guidance:

Clear-Water Contraction-Scour Curve

(Benedict and others, 2016; Benedict and Caldwell, 2006)

1) If the m is near the limits or beyond the range of the envelope data a caution or warning message, respectively, will appear in the "m range check" cell above. For these cases judgment must be used to assess the best estimate of clear-water overbank-contraction scour.

Relative Increase in Theoretical Clear-Water Contraction-Scour from the 100- to 500-Year Flows
(Benedict and others, 2016)

1) The 500-year flow adjustment coefficient (K_{500}) is used to calculate the relative clear-water contraction scour increase from 100- to 500-year flows.
2) The K_{500} is a helpful tool for gaining perspective on the relative increase of theoretical scour associated with the 100- to 500-year clear-water contraction-scour depth. However, the adjusted envelope curve values should not be considered a definitive estimate of the scour associated with the 500-year flow.

Comments:

1	These and other limitations should be kept in mind when using the envelope curves to assess scour potential. The envelope curves are empirical methods that are based on limited field samples; it is possible that scour could exceed the envelope curves; therefore, application of a safety factor may be prudent. Application of the envelope curves is constrained to the range of data and site characteristics used to develop the envelope curves. The uncertainty associated with the envelope curves increases near the limits of the data range. The live-bed scour data have the largest uncertainty.
2	The envelope curves do not account for unusual site conditions such as: debris; channel bank failures; pressure flow; unusual flow patterns created by unique site conditions; unusual pier geometries; and washout of approach road embankments.
3	The field data generally represent scour associated with flows approaching the 100-year flow magnitude but should not be considered a definitive estimate of the scour depth associated with the 100-year flow. Similarly, the 500-year flow adjustment coefficients can be used to provide perspective on the relative increase in theoretical scour associated with the 100- to 500-year flow condition, but should not be considered a definitive estimate of the scour depth associated with the 500-year flow.
4	Subsurface soils can impede or promote scour. Therefore, assessing the potential effect of subsurface soils on scour is important.

Live-Bed Contraction-Scour Estimate

(occurs in the channel region)

(Option to fill in/modify gray shaded cells. Other cells are selected/calculated automatically.)

Bridge Number:	2710009530800	**Stream:**	Bagshaw Swamp	**Date of Analysis:**	8/2/21
County:	Jasper	**Road:**	I-95 Southbound		
				Bridge Length:	130 ft
Physiographic Region:	Coastal Plain	**Multiple Bridge?**	No		
		Relief Bridge?	No	**Drainage Area:**	18.6 sq mi
		Swampy, Poorly Defined Channel?	Yes		
Latitude:	32°22'38" DMS				
Longitude:	81°1'50" DMS				

Drainage Area Check -- Original Curve (Benedict and others, 2016; Benedict and Caldwell, 2009): DA IN RANGE

Drainage Area Check -- Modified Curve (Benedict and others, 2016; Benedict and Caldwell, 2012): DA IN RANGE

Comparison of Geometric-Contraction Ratios [m]

	m Value	Quality of Source Data
m from model:	0.76	Good
m from road plans:	No Data	No Data
m from topographic map:	0.73	Good
m from FEMA/Other map:	No Data	Not Usable
USE m: (from "Site Info" Sheet)	0.76	

m range check -- Original Curve (Benedict and Caldwell, 2009) (m <=0.82): OK

m range check -- Modified Curve (Benedict and Caldwell, 2012) (m <=0.90): OK

**NOTE: The "USE m" value is automatically pulled from the Site Info Sheet.

Guidance:

Original Live-Bed Contraction-Scour Curve:
(Benedict and others, 2016; Benedict and Caldwell, 2009)
NOTE: Only the field envelope curve for live-bed contraction scour is used in the spreadsheet template. The user may refer to Benedict and others (2016) for application of the dimensionless envelope curve, if deemed appropriate.

Limits:
1) For Piedmont and Coastal Plain sites the maximum m =0.82.
2) Limited clear-water scour data suggests that it may be appropriate to extend the live-bed curve beyond a value of 0.82; however caution and judgment must be used.
3) Drainage area should fall within range of the measured data and caution should be used as drainage area approaches limits of data.
4) Because of uncertainty associated with the live-bed contraction-scour data, caution and judgment must be used in the final estimate of live-bed contraction scour.

Modified Live-Bed Contraction-Scour Curve:
(Benedict and others, 2016; Benedict and Caldwell, 2012)

Limits:
1) For Piedmont and Coastal Plain sites the maximum m =0.9.
2) Drainage area should be 200 square miles or less.
3) Because of uncertainty associated with the live-bed contraction-scour data, caution and judgment must be used in the final estimate of live-bed contraction scour.

Live-Bed Contraction-Scour Depth from Envelope Curves (NOTE: Only the Field Envelope Curves are Used)

	Scour Depth	
Original Field Envelope Curve for Live-Bed Contraction-Scour Curve (Benedict and others, 2016; Benedict and Caldwell, 2009):		
Live-bed contraction-scour depth:	N/A	ft
Modified Field Envelope Curve for Live-Bed Contraction-Scour Curve (Benedict and others, 2016; Benedict and Caldwell, 2012):		
Live-bed contraction-scour depth:	N/A	ft
Final Selected Live-Bed Contraction-Scour Depth:		
Final live-bed contraction-scour curve selection:	**Automatic Selection**	
Final selected live-bed contraction-scour depth:	**N/A**	ft
Relative Increase in Theoretical Live-Bed Contraction Scour from the 100- to 500-Year Flows (Benedict and others, 2016):		
500-yr flow coefficient:	1.32	
Live-bed contraction-scour by 500-year flow coefficient:	**N/A**	ft

Guidance:

Original and Modified Live-Bed Contraction-Scour Curve
(Benedict and others, 2016; Benedict and Caldwell, 2012; Benedict and Caldwell, 2009)

NOTE: Only the field envelope curve for live-bed contraction scour is used in the spreadsheet template. The user may refer to Benedict and others (2016) for application of the dimensionless envelope curve, if deemed appropriate.

1) If drainage area is 200 square miles or less, then use the live-bed contraction-scour estimate based on the modified envelope curve (Benedict and Caldwell, 2012). Otherwise, use the estimate based on the original envelope curve (Benedict and others, 2016; Benedict and Caldwell, 2009).

2) If site is a relief bridge or is swampy with a poorly defined channel, it will be assumed that live-bed contraction scour will not occur and the scour depths in the above cells will be set to "N/A."

Relative Increase in Theoretical Live-Bed Contraction-Scour from the 100- to 500-Year Flows
(Benedict and others, 2016)

1) The 500-year flow adjustment coefficient (K_{500}) is used to calculate the relative abutment scour increase from 100- to 500-year flows.

2) The K_{500} is a helpful tool for gaining perspective on the relative increase of theoretical scour associated with the 100- to 500-year live-bed contraction-scour depth. However, the adjusted envelope curve values should not be considered a definitive estimate of the scour associated with the 500-year flow.

Comments:

1	These and other limitations should be kept in mind when using the envelope curves to assess scour potential. The envelope curves are empirical methods that are based on limited field samples; it is possible that scour could exceed the envelope curves; therefore, application of a safety factor may be prudent. Application of the envelope curves is constrained to the range of data and site characteristics used to develop the envelope curves. The uncertainty associated with the envelope curves increases near the limits of the data range. The live-bed scour data have the largest uncertainty.
2	The envelope curves do not account for unusual site conditions such as: debris; channel bank failures; pressure flow; unusual flow patterns created by unique site conditions; unusual pier geometries; and washout of approach road embankments.
3	The field data generally represent scour associated with flows approaching the 100-year flow magnitude but should not be considered a definitive estimate of the scour depth associated with the 100-year flow. Similarly, the 500-year flow adjustment coefficients can be used to provide perspective on the relative increase in theoretical scour associated with the 100- to 500-year flow condition, but should not be considered a definitive estimate of the scour depth associated with the 500-year flow.
4	Subsurface soils can impede or promote scour. Therefore, assessing the potential effect of subsurface soils on scour is important.

Pier Scour Estimate

1

(Fill in gray shaded cells. Other cells are selected/calculated automatically.)

Bridge Number:	2710009530800		**Stream:**	Bagshaw Swamp		**Date of Analysis:**	8/2/21	
County:	Jasper		**Road:**	I-95 Southbound				
Physiographic Region:	Coastal Plain			**Multiple Bridge?**	No	**Bridge Length:**	130	ft
				Relief Bridge?	No			
Latitude:	32°22'38"	**DMS**		**Swampy, Poorly**	Yes	**Drainage Area:**	18.6	sq mi
Longitude:	81°1'50"	**DMS**		**Defined Channel?**				

Guidance:

Use of Pier Scour Table below
- See cell comments for guidance on using the Pier Scour Table below.

Pier Scour Computations
- If a pier or bent falls anywhere on the overbank, pier scour will be computed for both the abutment and overbank regions.
- If there are piers or bents of varying geometries on the same overbank, use the worst case pier geometry in both the abutment and overbank areas.
- When a pier is on the floodplain, but near the channel bank, the user must decide if the pier should be considered to be a channel pier or not; in addition to the proximity of the pier to the bank, the user should consider other factors such as bends that may increase potential for scour.

Pier Scour Table

(Benedict and others, 2016; Benedict and Caldwell, 2009; Benedict and Caldwell, 2006)

	Left Abutment	Left Overbank	Channel	Right Overbank	Right Abutment
Location of pier	LABUT	LOB	CH	ROB	RABUT
Type of pier or bent **(choose from list)**	No Pier or Bent	Multiple Column Pier	Multiple Column Pier	No Pier or Bent	No Pier or Bent
Envelope curve used **(choose from list)**		SC Clear Water	SC Clear Water		
Pier width (feet)		1.7	1.7		
Pier length (feet) **(should not be less than pier width)**		15	15		
Angle of attack (degrees) **(should not exceed 90)**		0	0		
Multiple column pier or bent? **(choose from list)**		Yes	Yes		
Estimate of minimum spacing between columns (feet)		7.75	7.75		
Column spacing to width ratio **(should be between 2 and 10)**	N/A	4.6	4.6	N/A	N/A
Skew coefficient [Based on guidance in Benedict and others (2016) and HEC-18]	N/A	1.00	1.00	N/A	N/A
Skew coefficient (selected value; **should not exceed a value of 5**)	N/A	1.00	1.00	N/A	N/A
Envelope curve used in pier scour estimate	0.00	SC Clear Water	SC Clear Water	0.00	0.00
Pier scour from envelope (feet) (no adjustment)	0.0	3.1	3.1	0.0	0.0
Pier scour adjusted for skew (feet)	0.0	3.1	3.05	0.0	0.0
Final selected pier scour depth (feet)	**0.0**	**3.1**	**3.1**	**0.0**	**0.0**
500-year flow coefficient:	1.09	1.09	1.09	1.09	1.09
Relative Increase in Theoretical Pier-Scour from the 100- to 500-Year Flows (Benedict and others, 2016):	**0.0**	**3.3**	**3.3**	**0.0**	**0.0**

****NOTE:** The K_{500} is a helpful tool for gaining perspective on the relative increase of theoretical scour associated with the 100- to 500-year clear-water contraction-scour depth. However, the adjusted envelope curve values should not be considered a definitive estimate of the scour associated with the 500-year flow.

Comments:

1	These and other limitations should be kept in mind when using the envelope curves to assess scour potential. The envelope curves are empirical methods that are based on limited field samples; it is possible that scour could exceed the envelope curves; therefore, application of a safety factor may be prudent. Application of the envelope curves is constrained to the range of data and site characteristics used to develop the envelope curves. The uncertainty associated with the envelope curves increases near the limits of the data range. The live-bed scour data have the largest uncertainty.
2	The envelope curves do not account for unusual site conditions such as: debris; channel bank failures; pressure flow; unusual flow patterns created by unique site conditions; unusual pier geometries; and washout of approach road embankments.
3	The field data generally represent scour associated with flows approaching the 100-year flow magnitude but should not be considered a definitive estimate of the scour depth associated with the 100-year flow. Similarly, the 500-year flow adjustment coefficients can be used to provide perspective on the relative increase in theoretical scour associated with the 100- to 500-year flow condition, but should not be considered a definitive estimate of the scour depth associated with the 500-year flow.
4	Subsurface soils can impede or promote scour. Therefore, assessing the potential effect of subsurface soils on scour is important.

Pile Penetration Table for Scour Estimates Using Flows Approaching the 100-year Flow

Scour analysis using USGS Bridge-Scour Envelope Curves

(Fill in gray shaded cells. Other cells are selected/calculated automatically.)

Bridge Number:	2710009530800	**Stream:**	Bagshaw Swamp	**Date of Analysis:**	8/2/21
County:	Jasper	**Road:**	I-95 Southbound		
				Bridge Length:	130 ft
Physiographic Region:	Coastal Plain	**Multiple Bridge?**	No		
		Relief Bridge?	No	**Drainage Area:**	18.6 sq mi
Latitude:	32°22'38" DMS	**Swampy, Poorly Defined Channel?**	Yes		
Longitude:	81°1'50" DMS				

NOTE: Bents are listed from left to right looking downstream

GUIDANCE FOR LEFT AND RIGHT ABUTMENT SCOUR:

Refer to Benedict and others (2016) and Benedict (2003) for additional guidance.

1) Do not include clear-water overbank scour depth in abutment-scour area.

2) If site is in the Piedmont region and the abutment-scour depth is less than or equal to 5 feet then add pier-scour depth for determining total scour.

3) If the pier in the abutment area is a multiple column bent/pier with minimal skew or a solid, long pier with no skew, and the pier width is less than or equal to 2.3 ft, then do not add pier scour to total scour. (NOTE: The exception to this guidance is for sites in the Piedmont with abutment-scour depths less than or equal to 5 ft as noted in item 2 above.)

4) The spreadsheet assumes that abutment scour will always occur at the left and right abutments. The spreadsheet will automatically make an initial determination regarding the inclusion of pier scour in the total scour estimate. The user should review this initial determination and if appropriate override the automated value by typing "Yes" or "No" (case sensitive) in the "Use pier scour?" column. If the pier is skewed, the user should apply judgment to determine if pier scour should be included in the total scour estimate, especially for long solid piers where a pier skew can cause large scour depths.

5) If the site is a relief or swampy bridge that is 240 ft or less, the abutment-scour depth will be applicable from toe-to-toe; if the relief or swampy bridge is greater than 240 ft, the abutment scour-hole depths will be limited to the abutment scour-hole topwidths and the clear-water overbank contraction scour will be applied to the remaining overbank area. The spreadsheet will automatically determine if there is any overbank area on which overbank contraction scour will occur.

6) If clear-water overbank contraction scour depth (with no adjustment for pier scour) is greater than the abutment scour depth (with no adjustment for pier scour), then the clear-water overbank contraction scour depth will be used as the best representation of the abutment scour depth. The spreadsheet will automatically determine if the clear-water overbank contraction scour depth is to be used in place of the abutment scour depth.

GUIDANCE FOR LEFT AND RIGHT OVERBANK CONTRACTION SCOUR:

Refer to Benedict and others (2016) and Benedict and Caldwell (2006) for additional guidance.

1) If the abutment-scour hole topwidth is greater than the overbank width then it will be assumed that the abutment-scour depth will cover the entire overbank area and there will be no clear-water overbank scour applied to the bridge overbank. However, if the abutment-scour hole topwidth is less than the overbank width then it will be assumed that clear-water overbank scour occurs in the overbank area not affected by the abutment scour hole.

2) The spreadsheet will automatically determine if clear-water overbank scour should be applied or not.

3) If clear-water overbank scour is determined to be applicable to the overbank area, then the spreadsheet will automatically apply the calculated pier scour to the overbank as well.

GUIDANCE FOR LIVE-BED CHANNEL SCOUR:

Refer to Benedict and others (2016) and Benedict and Caldwell (2009) for additional guidance.

1) If the main channel is well defined and considered to be live-bed in nature, it will be assumed that the live-bed contraction scour and channel pier scour will be included in the estimate for total scour in the main channel. The spreadsheet will automatically determine if these scour components are to be included in the estimate of total scour in the main channel.

2) Live-bed contraction scour will not be applied to a relief bridge or to a bridge with a swampy, poorly defined channel; at such bridges, it will be assumed that clear-water scour conditions prevail and the procedures for applying clear-water abutment and contraction scour, as noted previously, will be used. The spreadsheet will automatically determine if live-bed scour should or should not be applied to the channel.

GENERAL GUIDANCE:

1) Drainage area should fall within the range of measured data and caution should be used as drainage area approaches limits of the data or exceeds the data range.

2) If the m and (or) embankment lengths are near the limits or beyond the range of the envelope data caution should be used.

3) User should review automatically determined values to assure that selected values are reasonable.

Scour region	Pier location	Use clear-water abutment scour?	Clear-water abutment scour from USGS curves (feet)	Use clear-water overbank contraction scour?	Clear-water overbank contraction scour from USGS curves (feet)	Use live-bed channel contraction scour?	Live-bed channel contraction scour from USGS curves (feet)	Use pier scour?	Pier scour (feet)	Total scour at bent (feet)	Computed embedment of pile from consultant (feet)	Remaining pile penetration (feet)	Embedment below thalweg from consultant (feet)	Remaining pile penetration (at thalweg) (feet)
Left Abutment	LABUT	Yes	6.48	No	0.00	No	0.00	No	0.00	6.48	23.20	16.72	20.00	13.52
Left Overbank	LOB	No	0.00	No	0.00	No	0.00	No	0.00	N/A	23.20	N/A	20.00	N/A
Channel	CH	No	0.00	No	0.00	No	0.00	No	0.00	N/A	21.50	N/A	20.00	N/A
Right Overbank	ROB	No	0.00	No	0.00	No	0.00	No	0.00	N/A	22.00	N/A	20.00	N/A
Right Abutment	RABUT	Yes	6.48	No	0.00	No	0.00	No	0.00	6.48	22.00	15.52	20.00	13.52

	Comments:	2
1	These and other limitations should be kept in mind when using the envelope curves to assess scour potential. The envelope curves are empirical methods that are based on limited field samples; it is possible that scour could exceed the envelope curves; therefore, application of a safety factor may be prudent. Application of the envelope curves is constrained to the range of data and site characteristics used to develop the envelope curves. The uncertainty associated with the envelope curves increases near the limits of the data range. The live-bed scour data have the largest uncertainty.	
2	The envelope curves do not account for unusual site conditions such as: debris; channel bank failures; pressure flow; unusual flow patterns created by unique site conditions; unusual pier geometries; and washout of approach road embankments.	
3	The field data generally represent scour associated with flows approaching the 100-year flow magnitude but should not be considered a definitive estimate of the scour depth associated with the 100-year flow. Similarly, the 500-year flow adjustment coefficients can be used to provide perspective on the relative increase in theoretical scour associated with the 100- to 500-year flow condition, but should not be considered a definitive estimate of the scour depth associated with the 500-year flow.	
4	Subsurface soils can impede or promote scour. Therefore, assessing the potential effect of subsurface soils on scour is important.	
5		

Pile Penetration Table for Scour Estimates Using Flows Approaching the 100-year Flow and Adjusted by the 500-year Flow Adjustment Coefficient

Scour analysis using USGS Bridge-Scour Envelope Curves

(Fill in gray shaded cells. Other cells are selected/calculated automatically.)

Bridge Number:	2710009530800	**Stream:**	Bagshaw Swamp	**Date of Analysis:**	8/2/21
County:	Jasper	**Road:**	I-95 Southbound		
				Bridge Length:	130 ft
Physiographic Region:	Coastal Plain	**Multiple Bridge?**	No		
		Relief Bridge?	No	**Drainage Area:**	18.6 sq mi
Latitude:	32°22'38" DMS	**Swampy, Poorly Defined Channel?**	Yes		
Longitude:	81°1'50" DMS				

NOTE: Bents are listed from left to right looking downstream

GUIDANCE FOR LEFT AND RIGHT ABUTMENT SCOUR:

Refer to Benedict and others (2016) and Benedict (2003) for additional guidance.

1) Do not include clear-water overbank scour depth in abutment-scour area.

2) If site is in the Piedmont region and the abutment-scour depth is less than or equal to 5 feet then add pier-scour depth for determining total scour.

3) If the pier in the abutment area is a multiple column bent/pier with minimal skew or a solid, long pier with no skew, and the pier width is less than or equal to 2.3 ft, then do not add pier scour to total scour. (NOTE: The exception to this guidance is for sites in the Piedmont with abutment-scour depths less than or equal to 5 ft as noted in item 2 above.)

4) The spreadsheet assumes that abutment scour will always occur at the left and right abutments. The spreadsheet will automatically make an initial determination regarding the inclusion of pier scour in the total scour estimate. The user should review this initial determination and if appropriate override the automated value by typing "Yes" or "No" (case sensitive) in the "Use pier scour?" column. If the pier is skewed, the user should apply judgment to determine if pier scour should be included in the total scour estimate, especially for long solid piers where a pier skew can cause large scour depths.

5) If the site is a relief or swampy bridge that is 240 ft or less, the abutment-scour depth will be applicable from toe-to-toe; if the relief or swampy bridge is greater than 240 ft, the abutment scour-hole depths will be limited to the abutment scour-hole topwidths and the clear-water overbank contraction scour will be applied to the remaining overbank area. The spreadsheet will automatically determine if there is any overbank area on which overbank contraction scour will occur.

6) If clear-water overbank contraction scour depth (with no adjustment for pier scour) is greater than the abutment scour depth (with no adjustment for pier scour), then the clear-water overbank contraction scour depth will be used as the best representation of the abutment scour depth. The spreadsheet will automatically determine if the clear-water overbank contraction scour depth is to be used in place of the abutment scour depth.

GUIDANCE FOR LEFT AND RIGHT OVERBANK CONTRACTION SCOUR:

Refer to Benedict and others (2016) and Benedict and Caldwell (2006) for additional guidance.

1) If the abutment-scour hole topwidth is greater than the overbank width then it will be assumed that the abutment-scour depth will cover the entire overbank area and there will be no clear-water overbank scour applied to the bridge overbank. However, if the abutment-scour hole topwidth is less than the overbank width then it will be assumed that clear-water overbank scour occurs in the overbank area not affected by the abutment scour hole.

2) The spreadsheet will automatically determine if clear-water overbank scour should be applied or not.

3) If clear-water overbank scour is determined to be applicable to the overbank area, then the spreadsheet will automatically apply the calculated pier scour to the overbank as well.

GUIDANCE FOR LIVE-BED CHANNEL SCOUR:

Refer to Benedict and others (2016) and Benedict and Caldwell (2009) for additional guidance.

1) If the main channel is well defined and considered to be live-bed in nature, it will be assumed that the live-bed contraction scour and channel pier scour will be included in the estimate for total scour in the main channel. The spreadsheet will automatically determine if these scour components are to be included in the estimate of total scour in the main channel.

2) Live-bed contraction scour will not be applied to a relief bridge or to a bridge with a swampy, poorly defined channel; at such bridges, it will be assumed that clear-water scour conditions prevail and the procedures for applying clear-water abutment and contraction scour, as noted previously, will be used. The spreadsheet will automatically determine if live-bed scour should or should not be applied to the channel.

GENERAL GUIDANCE:

1) Drainage area should fall within the range of measured data and caution should be used as drainage area approaches limits of the data or exceeds the data range.

2) If the m and (or) embankment lengths are near the limits or beyond the range of the envelope data caution should be used.

3) User should review automatically determined values to assure that selected values are reasonable.

Scour region	Pier location	Use clear-water abutment scour?	Clear-water abutment scour from USGS curves (feet)	Use clear-water overbank contraction scour?	Clear-water overbank contraction scour from USGS curves (feet)	Use live-bed channel contraction scour?	Live-bed channel contraction scour from USGS curves (feet)	Use pier scour?	Pier scour (feet)	Total scour at bent (feet)	Computed embedment of pile from consultant (feet)	Remaining pile penetration (feet)	Embedment below thalweg from consultant (feet)	Remaining pile penetration (at thalweg) (feet)
Left Abutment	LABUT	Yes	7.80	No	0.00	No	0.00	No	0.00	7.80	23.20	15.40	20.00	12.20
Left Overbank	LOB	No	0.00	No	0.00	No	0.00	No	0.00	N/A	23.20	N/A	20.00	N/A
Channel	CH	No	0.00	No	0.00	No	0.00	No	0.00	N/A	21.50	N/A	20.00	N/A
Right Overbank	ROB	No	0.00	No	0.00	No	0.00	No	0.00	N/A	22.00	N/A	20.00	N/A
Right Abutment	RABUT	Yes	7.80	No	0.00	No	0.00	No	0.00	7.80	22.00	14.20	20.00	12.20

	Comments:	2
1	These and other limitations should be kept in mind when using the envelope curves to assess scour potential. The envelope curves are empirical methods that are based on limited field samples; it is possible that scour could exceed the envelope curves; therefore, application of a safety factor may be prudent. Application of the envelope curves is constrained to the range of data and site characteristics used to develop the envelope curves. The uncertainty associated with the envelope curves increases near the limits of the data range. The live-bed scour data have the largest uncertainty.	
2	The envelope curves do not account for unusual site conditions such as: debris; channel bank failures; pressure flow; unusual flow patterns created by unique site conditions; unusual pier geometries; and washout of approach road embankments.	
3	The field data generally represent scour associated with flows approaching the 100-year flow magnitude but should not be considered a definitive estimate of the scour depth associated with the 100-year flow. Similarly, the 500-year flow adjustment coefficients can be used to provide perspective on the relative increase in theoretical scour associated with the 100- to 500-year flow condition, but should not be considered a definitive estimate of the scour depth associated with the 500-year flow.	
4	Subsurface soils can impede or promote scour. Therefore, assessing the potential effect of subsurface soils on scour is important.	
5		

Application of Selected Envelope-Curve Equations

Do not modify this worksheet. This worksheet uses data entered in other worksheets of this workbook and uses the various South Carolina Bridge-Scour Envelope Curves to calculate the upper bound of selected scour parameters.

Estimate of Upper Bound of Clear-Water Abutment-Scour Depth from Envelope Curves

I. Estimate from abutment-length envelope curves -- Original Curves (Benedict and others, 2016; Benedict, 2003)

		Left Abutment		Right Abutment	
Coastal Plain	Scour Depth:	7.9	ft	7.9	ft
	Embankment Length:	235	ft	235	ft
	Embankment Length Check:	OK		OK	

NOTES:
If embankment length is greater than 7,440 ft it is **OUTSIDE RANGE**.
If embankment length is greater than 2,000 ft but less than 7,440 ft use **CAUTION**.
If embankment length is between 0 and 2,000 ft it is **OK**.

Piedmont	Scour Depth:	6.0	ft	6.0	ft
	Embankment Length:	235.0		235.0	
	Embankment Length Check:	OK		OK	

NOTES:
If embankment length is greater than 950 ft it is **OUTSIDE RANGE**.
If embankment length is between 0 and 950 ft it is **OK**.

II. Estimate from the geometric contraction ratio m -- Original Curves (Benedict and others, 2016; Benedict, 2003)

		Left Abutment		Right Abutment	
Coastal Plain	Scour Depth:	11.5	ft	11.5	ft
	Contraction Ratio:	0.76		0.76	
	Contraction Ratio Check:	OK		OK	

NOTES:
If contraction ratio is greater than 0.98 it is **OUTSIDE RANGE.**
If contraction ratio is greater than 0.9 but less than 0.98 use **CAUTION.**
If contraction ratio is between 0 and 0.9 it is **OK.**

Piedmont	Scour Depth:	16.3	ft	16.3	ft
	Contraction Ratio:	0.76		0.76	
	Contraction Ratio Check:	OK		OK	

NOTES:
If contraction ratio is greater than 0.86 it is **OUTSIDE RANGE.**
If contraction ratio is greater than 0.82 but less than 0.86 use **CAUTION.**
If contraction ratio is between 0 and 0.82 it is **OK.**

III. Estimate by embankment-length category -- Modified Curves (Benedict and others, 2016; Benedict and Caldwell, 2012)

Coastal Plain

	Left Abutment		Right Abutment	
Initial Estimate of Scour Depth (by Category):	8.42	ft	8.42	ft
Final Selection of Scour Depth (by Category):	8.4	ft	8.4	ft
Initial Estimate of Scour Depth (by Interpolation):	6.5	ft	6.5	ft
Final Selection of Scour Depth (by Interpolation):	6.5	ft	6.5	ft
Embankment Length:	235	ft	235	ft
Embankment Length Check:	OK		OK	
Contraction Ratio:	0.76		0.76	
Contraction Ratio Check:	OK		OK	

Interpolation Table

Embankment Length Category (ft)	Lower m Limit	m used in equation	Abutment-Scour Depth (ft)
0	0.00	0.00	0.0
100	0.25	0.76	2.6
200	0.50	0.76	5.4
300	0.65	0.76	8.4
400	0.76	0.76	11.3
500	0.84	0.84	14.9

NOTES:

If embankment length is greater than 500 ft it is **OUTSIDE RANGE**.
If embankment length is between 0 and 500 ft it is **OK**.
If contraction ratio is greater than 0.9 it is **OUTSIDE RANGE.**
If contraction ratio is between 0 and 0.9 it is **OK.**

Piedmont

Initial Estimate of Scour Depth (by Category):	6.6	ft	6.6	ft
Final Selection of Scour Depth (by Category):	6.6	ft	6.6	ft
Initial Estimate of Scour Depth (by Interpolation):	5.3	ft	5.3	ft
Final Selection of Scour Depth (by Interpolation):	5.3	ft	5.3	ft
Embankment Length:	235	ft	235	ft
Embankment Length Check:	OK		OK	
Contraction Ratio:	0.76		0.76	
Contraction Ratio Check:	OK		OK	

Interpolation Table

Embankment Length Category (ft)	Lower m Limit	m used in equation	Abutment-Scour Depth (ft)
0	0.00	0.00	0.0
100	0.14	0.76	2.3
200	0.25	0.76	4.7
300	0.34	0.76	6.6
400	0.42	0.76	8.5
500	0.50	0.76	10.3

NOTES:

If embankment length is greater than 500 ft it is **OUTSIDE RANGE**.
If embankment length is between 0 and 500 ft it is **OK**.
If contraction ratio is greater than 0.85 it is **OUTSIDE RANGE.**
If contraction ratio is between 0 and 0.85 it is **OK.**

Estimate of Clear-Water Abutment-Scour Hole Topwidth from Envelope Curve (Benedict and others, 2016; Benedict, 2003)

Using "final selected abutment-scour depth"

	Left Abutment		Right Abutment	
Any length bridge with well defined channel	65.8	ft	65.8	ft
Is scour depth greater than 18 feet and therefore outside range of graph?	No		No	
Relief or swampy bridge with length of 240 ft or less	74.0	ft	74.0	ft
Is scour depth greater than 23.6 feet and therefore outside range of graph?	No		No	

NOTES:
If scour depth is outside the range of the graph then cell is highlighted in **red.**
If scour depth is within the range of the graph then cell is highlighted in **green.**

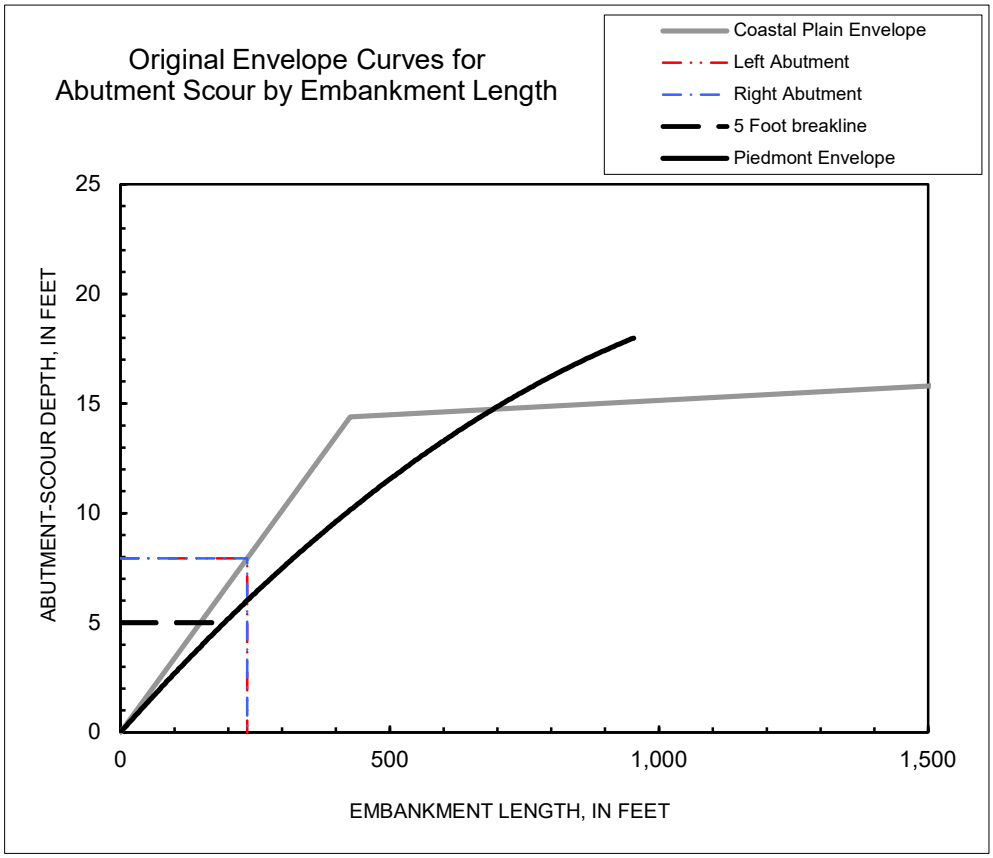
Estimate of Clear-Water Overbank Contraction-Scour Depth from Envelope Curves (Benedict and others, 2016; Benedict and Caldwell, 2006)

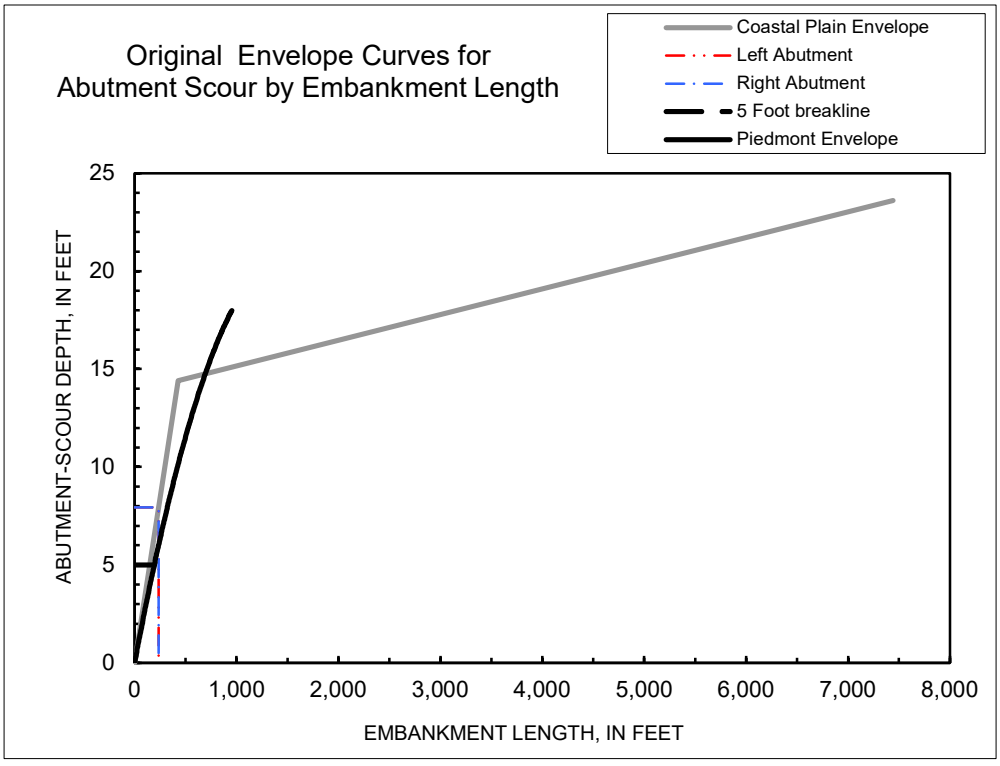
	Left Overbank		Right Overbank	
Scour Depth:	4.7	ft	4.7	ft
Contraction Ratio:	0.76		0.76	
Contraction Ratio Check:	OK		OK	

NOTES:
If contraction ratio is greater than 0.95 it is **OUTSIDE RANGE.**
If contraction ratio is greater than 0.85 but less than 0.95 use **CAUTION.**
If contraction ratio is between 0 and 0.85 it is **OK.**

Bridge Number: 2710009530800 **1**
County: Jasper
Stream: Bagshaw Swamp
Road: I-95 Southbound
Region: Coastal Plain

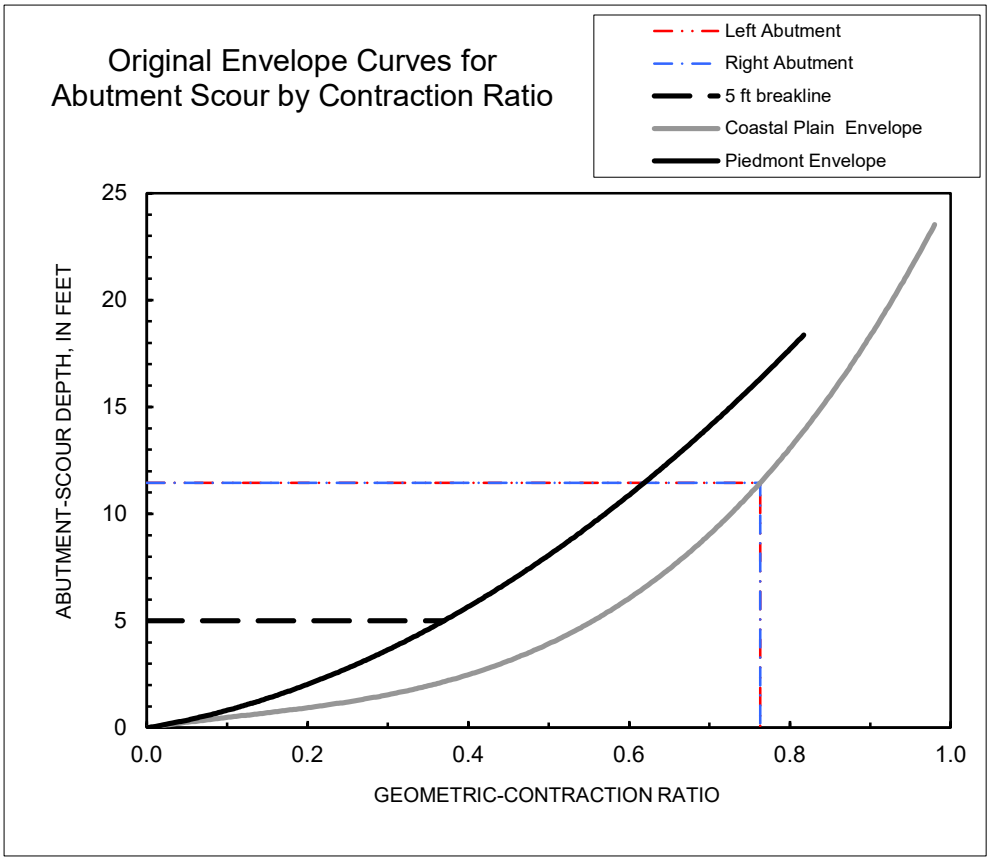
Original Clear-Water Abutment-Scour Envelope Curves (Benedict and others, 2016; Benedict, 2003)

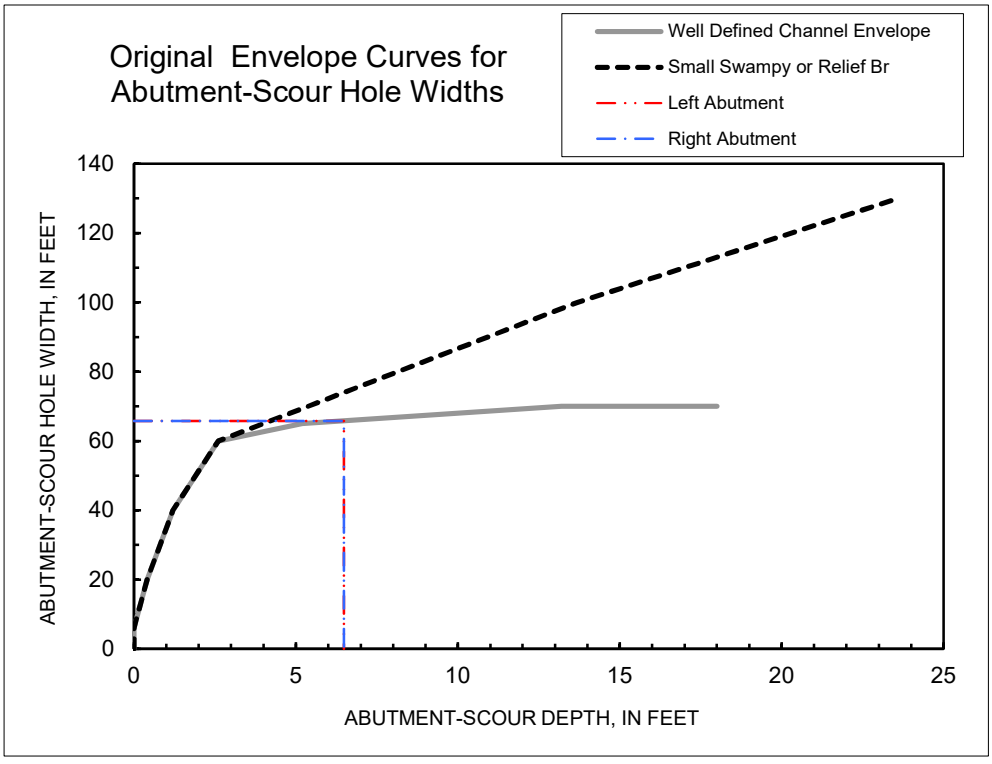




Bridge Number: 2710009530800 **2**
County: Jasper
Stream: Bagshaw Swamp
Road: I-95 Southbound
Region: Coastal Plain

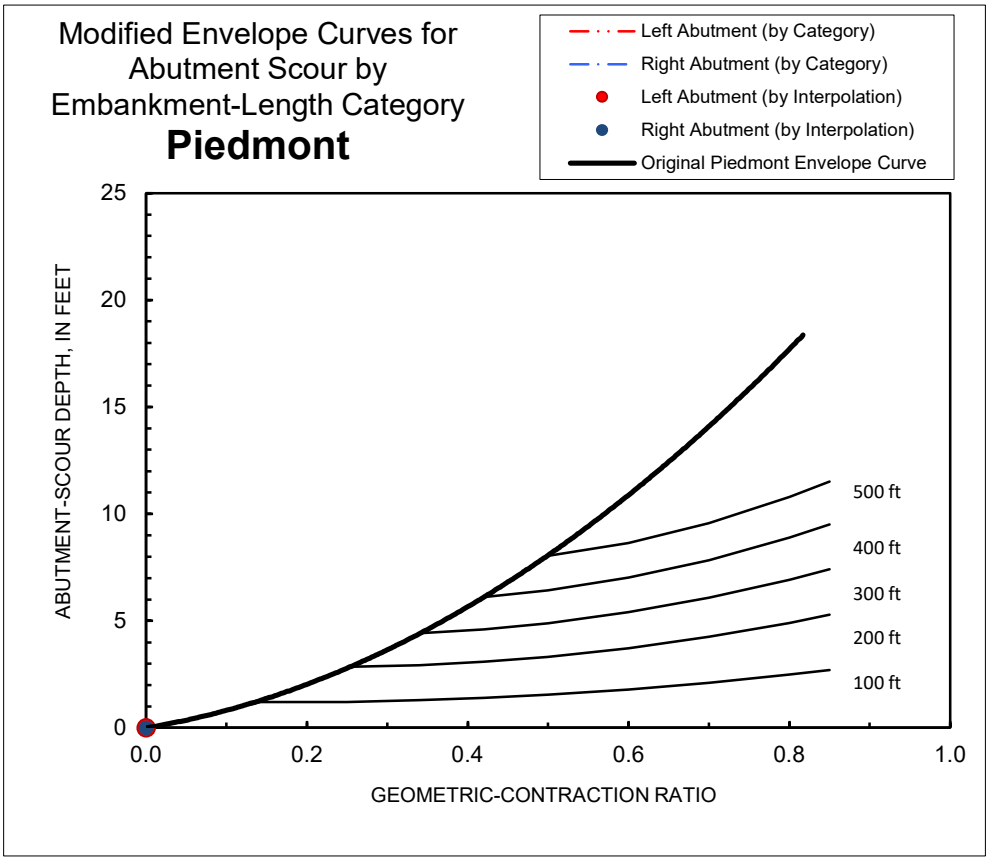
Original Clear-Water Abutment-Scour Envelope Curves (Benedict and others, 2016; Benedict, 2003)

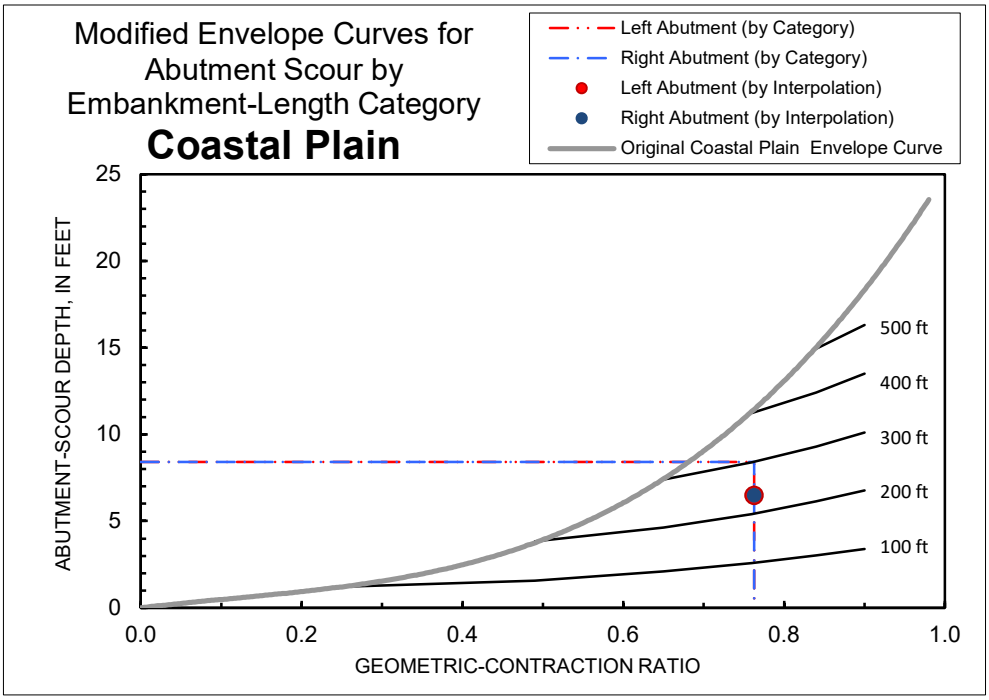




Bridge Number: 2710009530800 **3**
County: Jasper
Stream: Bagshaw Swamp
Road: I-95 Southbound
Region: Coastal Plain

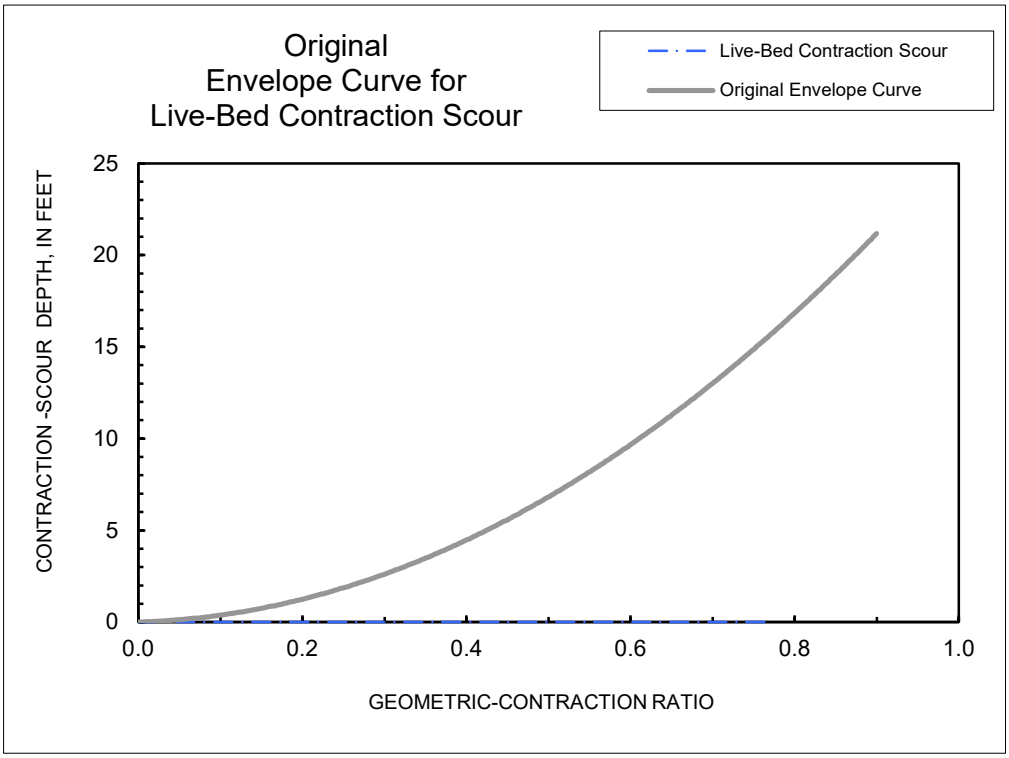
Modified Clear-Water Abutment-Scour Envelope Curves (Benedict and others, 2016; Benedict and Caldwell, 2012)



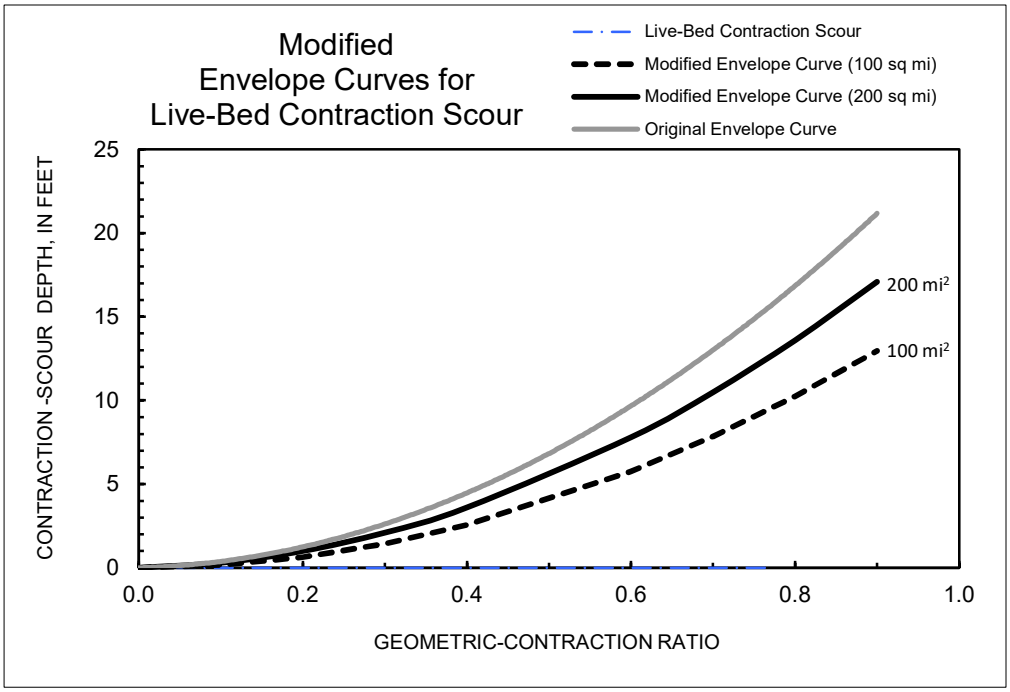


Bridge Number: 2710009530800 **4**
County: Jasper
Stream: Bagshaw Swamp
Road: I-95 Southbound
Region: Coastal Plain

Original Live-Bed Channel Contraction-Scour Envelope Curve (Benedict and others, 2016; Benedict and Caldwell, 2009)

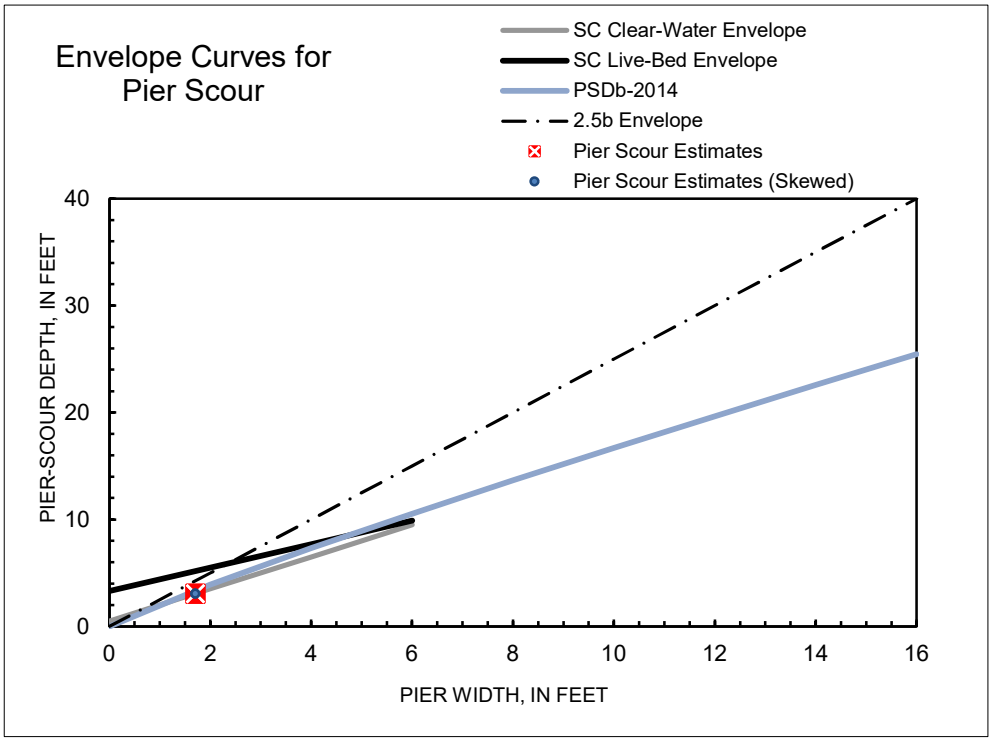


Modified Live-Bed Channel Contraction-Scour Envelope Curves (Benedict and others, 2016; Benedict and Caldwell, 2012)

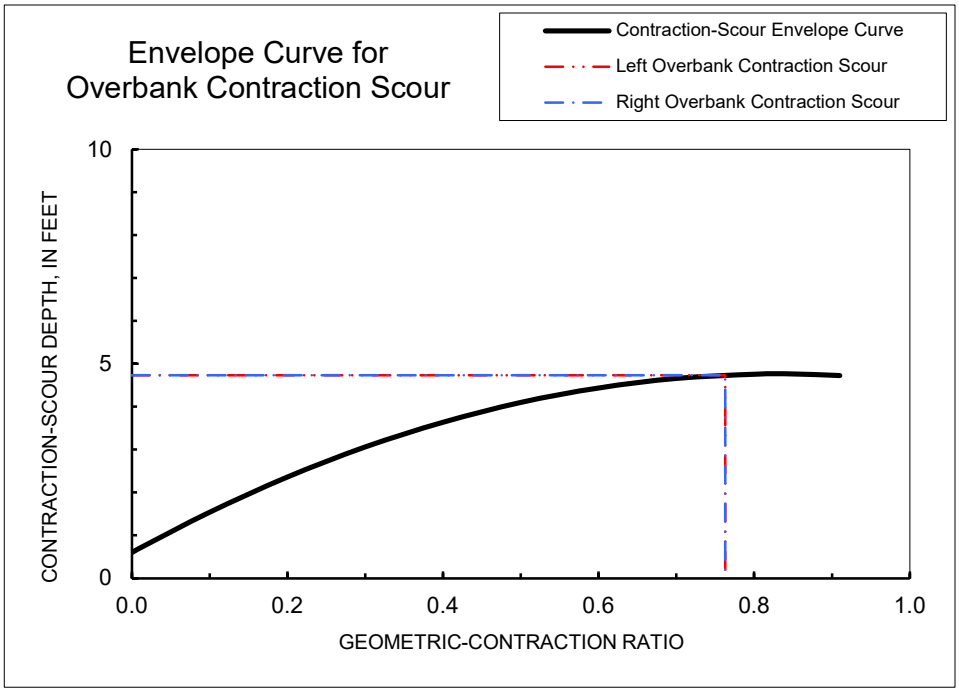


Bridge Number: 2710009530800 **5**
County: Jasper
Stream: Bagshaw Swamp
Road: I-95 Southbound
Region: Coastal Plain

Pier-Scour Envelope Curves (Benedict and others, 2016; Benedict and Caldwell, 2006; 2009)

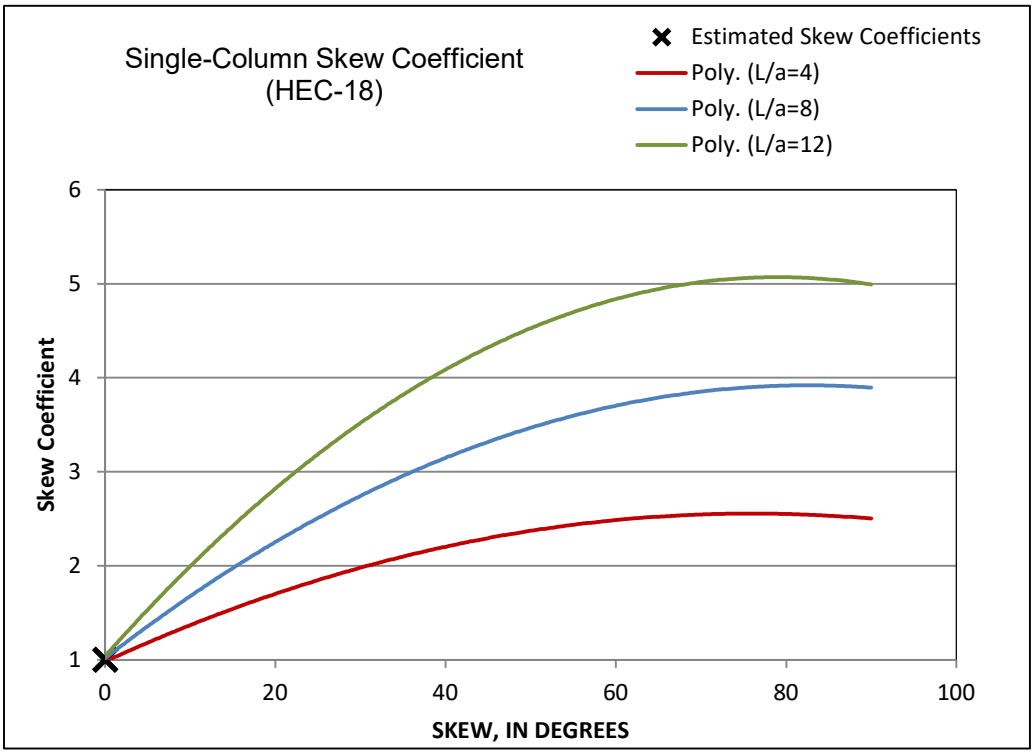


Clear-Water Overbank Contraction-Scour Envelope Curve (Benedict and others, 2016; Benedict and Caldwell, 2006)



Bridge Number: 2710009530800 **6**
County: Jasper
Stream: Bagshaw Swamp
Road: I-95 Southbound
Region: Coastal Plain

Pier-Scour Skew Coefficients



Data for Graphs

Estimate of Abutment-Scour -- Original Abutment-Scour Envelope Curves (Benedict and others, 2016; Benedict, 2003)

Use the following envelope curve: Coastal Plain (Left Abutment) / Coastal Plain (Right Abutment)

Abutment Scour by Embankment Length

Left Abutment

Embankment Length (ft)	Scour Depth (ft)
0	7.9
235	7.9
235	0

Right Abutment

Embankment Length (ft)	Scour Depth (ft)
0	7.9
235	7.9
235	0

5 ft break line

Embankment Length (ft)	Scour Depth (ft)
0	5
194	5

Abutment Scour by m

Left Abutment

m	Scour Depth (ft)
0	11.5
0.76	11.5
0.76	0

Right Abutment

m	Scour Depth (ft)
0	11.5
0.76	11.5
0.76	0

5 ft break line

m	Scour Depth (ft)
0	5
0.37	5

Estimate of Abutment-Scour -- Modified Abutment-Scour Envelope Curves (Benedict and others, 2016; Benedict and Caldwell, 2012)

Piedmont

By Category

Left Abutment

m	Scour Depth (ft)
0	0.0
0.00	0.0
0.00	0

Right Abutment

m	Scour Depth (ft)
0	0.0
0.00	0.0
0.00	0

By Interpolation

m	Scour Depth (ft)
0	0.0
0.00	0.0
0.00	0

m	Scour Depth (ft)
0	0.0
0.00	0.0
0.00	0

Coastal Plain

By Category

Left Abutment

m	Scour Depth (ft)
0	8.4
0.76	8.4
0.76	0

Right Abutment

m	Scour Depth (ft)
0	8.4
0.76	8.4
0.76	0

By Interpolation

m	Scour Depth (ft)
0	6.5
0.76	6.5
0.76	0

m	Scour Depth (ft)
0	6.5
0.76	6.5
0.76	0

Coastal Plain and Piedmont Clear-Water Overbank Contraction-Scour Envelope Curve by m (Benedict and others, 2016; Benedict and Caldwell, 2006)

Left Overbank

m	Scour Depth (ft)
0	4.7
0.76	4.7
0.76	0

Right Overbank

m	Scour Depth (ft)
0	4.7
0.76	4.7
0.76	0

Coastal Plain and Piedmont Live-Bed Channel Contraction-Scour Envelope Curve by m

Original Live-Bed Channel Contraction Scour (Benedict and Caldwell, 2009)

m	Scour Depth (ft)
0	N/A
0.76	N/A
0.76	0.0

Modified Live-Bed Channel Contraction Scour (Benedict and Caldwell, 2012)

m	Scour Depth (ft)
0	N/A
0.76	N/A
0.76	0.0

Abutment-Scour Hole Topwidths (Benedict and others, 2016; Benedict, 2003)

Use the following envelope curve: Long Bridge (Left Abutment) / Long Bridge (Right Abutment)

Left Abutment

Scour Depth (ft)	Scour Topwidth (ft)
0	65.8
6.5	65.8
6.5	0

Right Abutment

Scour Depth (ft)	Scour Topwidth (ft)
0	65.8
6.5	65.8
6.5	0

Envelope Curve Data

Abutment-Scour Depth by Embankment Length Original Curve (Benedict, 2003)

Coastal Plain Abut Length (ft)	Coastal Plain Scour Depth (ft)	Piedmont Abut Length (ft)	Piedmont Scour Depth (ft)
0	0	0	0
426.5	14.4	18.4	0.6
7440.6	23.6	112.3	3.1
		181.4	4.6
		408.5	9.7
		571.8	12.9
		606.4	13.7
		675	14.2
		952.9	18

Envelope Curve Data

Pier Scour Envelopes (Benedict and Caldwell, 2006; 2009)

Pier Width (ft)	SC Clear-Water Scour Depth (ft)	SC Live-Bed Scour Depth (ft)	National Scour Depth (ft)	2.5b Scour Depth (ft)	PSDb-2014 Scour Depth (ft)
0	0.5	3.3	4.1	0.0	0.0
2	3.5	5.5	7.1	5.0	3.9
4	6.5	7.7	10.1	10.0	7.3
6	9.5	9.9	13.1	15.0	10.5
8			16.1	20.0	13.6
10			19.1	25.0	16.7
12			22.1	30.0	19.7
14			25.1	35	22.6
16				40.0	25.5

Envelope Curve Data

Abutment-Scour Depth by Contraction Ratio
Original Curve (Benedict, 2003)

Coastal Plain

m	Scour Depth (ft)
0	0
0.32	1.69
0.67	8.18
0.77	11.75
0.81	13.55
0.82	14.03
0.98	23.53

Piedmont Sands

m	Scour Depth (ft)
0	0
0.022	0.6
0.372	4.6
0.668	13.7
0.817	18

Envelope Curve Data

Abutment-Scour Hole Topwidth
Original Curve (Benedict, 2003)

Long Bridges		Small Swampy Bridges	
Scour Depth (ft)	Scour Topwidth (ft)	Scour Depth (ft)	Scour Topwidth (ft)
0	0	0	0
0	6	0	6
0.4	20	0.4	20
1.2	40	1.2	40
2.6	60	2.6	60
5.2	65	13.7	100
13.2	70	23.6	130
18	70		

Skew Coefficients from HEC-18

Correction Factor, K_2, for Angle of Attack, θ, of the Flow.

Angle	L/a=4	L/a=8	L/a=12
0	1.00	1.00	1.00
15	1.50	2.00	2.50
30	2.00	2.75	3.50
45	2.30	3.30	4.30
90	2.50	3.90	5.00

Angle = skew angle of flow, in degrees; L = length of pier, in feet; a = pier width, in feet

Envelope Curve Data

Modified Abutment-Scour Envelope Curves (Benedict and others, 2016; Benedict and Caldwell, 2012)

Piedmont

	Embankment Length Category (ft)				
	100	200	300	400	500
m	Scour Depth (ft)	Scour Depth (ft)	Scour Depth (ft)	Scour Depth (ft)	Scour Depth (ft)
0.130	1.20				
0.25	1.21	2.84			
0.34	1.29	2.92	4.42		
0.42	1.40	3.08	4.60	6.12	
0.5	1.55	3.31	4.89	6.43	8.04
0.6	1.80	3.72	5.40	7.02	8.65
0.7	2.11	4.25	6.08	7.84	9.57
0.8	2.49	4.91	6.92	8.89	10.79
0.85	2.70	5.28	7.41	9.50	11.52

Coastal Plain

	Embankment Length Category (ft)				
	100	200	300	400	500
m	Scour Depth (ft)	Scour Depth (ft)	Scour Depth (ft)	Scour Depth (ft)	Scour Depth (ft)
0.25	1.22				
0.49	1.57	3.84			
0.65	2.10	4.62	7.40		
0.76	2.60	5.42	8.39	11.24	
0.84	3.03	6.14	9.30	12.42	14.94
0.90	3.40	6.76	10.10	13.50	16.30

Envelope Curve Data

Coastal Plain and Piedmont
Clear-Water Overbank Contraction Scour
(Benedict and Caldwell, 2006)

m	Scour Depth (ft)
0	0.60
0.02	0.80
0.1	1.54
0.2	2.36
0.3	3.06
0.4	3.64
0.5	4.10
0.6	4.44
0.7	4.66
0.8	4.76
0.85	4.77
0.91	4.73

Envelope Curve Data

Coastal Plain and Piedmont
Original Live-Bed Channel Contraction Scour
(Benedict and Caldwell, 2009)

m	Scour Depth (ft)
0	0.0
0.02	0.04
0.1	0.38
0.2	1.25
0.3	2.61
0.4	4.47
0.5	6.83
0.6	9.67
0.7	13.01
0.8	16.85
0.85	18.95
0.9	21.18

Envelope Curve Data

Coastal Plain and Piedmont
Modified Live-Bed Channel Contraction Scour

(Benedict and Caldwell, 2012)

	Drainage Area (sq mi)	
	100	200
m	Scour Depth (ft)	Scour Depth (ft)
0.000	0.00	0.00
0.1	0.16	0.30
0.2	0.64	1.00
0.3	1.44	2.10
0.4	2.56	3.60
0.6	5.76	7.80
0.7	7.84	10.50
0.8	10.24	13.60
0.9	12.96	17.10

ABUTMENT-SCOUR DATA

SCDOT Bridge Number	County	Road	Stream	Latitude (DMS)	Longitude (DMS)	Analysis date	Physiographic Province	Multiple bridge?	Relief bridge?	Swampy, Poorly Defined Channel?	Bridge length (feet)	Drainage area (sq mi)	Drainage area check (original envelope)	Drainage area check (modified envelope)	Quality of SCDOT Plan Data
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	DA IN RANGE	DA IN RANGE	No Data

CLEAR-WATER CONTRACTION-SCOUR DATA

SCDOT Bridge Number	County	Road	Stream	Latitude (DMS)	Longitude (DMS)	Analysis date	Physiographic Province	Multiple bridge?	Relief bridge?	Swampy, Poorly Defined Channel?	Bridge length (feet)	Drainage area (sq mi)	Drainage area check	Plan m	Topo m
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	DA OUTSIDE RANGE (Below)	No Data	0.73

LIVE-BED CONTRACTION-SCOUR DATA

SCDOT Bridge Number	County	Road	Stream	Latitude (DMS)	Longitude (DMS)	Analysis date	Physiographic Province	Multiple bridge?	Relief bridge?	Swampy, Poorly Defined Channel?	Bridge length (feet)	Drainage area (sq mi)	Drainage area check (original curve)	Drainage area check (modified curve)	Plan m
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	DA IN RANGE	DA IN RANGE	No Data

PIER-SCOUR DATA

SCDOT Bridge Number	County	Road	Stream	Latitude (DMS)	Longitude (DMS)	Analysis date	Physiographic Province	Multiple bridge?	Relief bridge?	Swampy, Poorly Defined Channel?	Bridge length (feet)	Drainage area (sq mi)	Location of pier	Pier or bent type	Envelope curve used
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	LABUT	No Pier or Bent	0
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	LOB	Multiple Column Pier	SC Clear Water
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	CH	Multiple Column Pier	SC Clear Water
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	ROB	No Pier or Bent	0
2710009530800	Jasper	95 Southboun	Bagshaw Swamp	32°22'38"	81°1'50"	8/2/21	Coastal Plain	No	No	Yes	130	18.6	RABUT	No Pier or Bent	0

Quality of Topo Map Data	Quality of FEMA/Other Map Data	Plan m	Topo m	FEMA/Other m	Used m	m check (original envelope)	m check (modified envelope)	Plan (left abutment length) (feet)	Topo (left abutment length) (feet)	FEMA/Other (left abutment length) (feet)	Used (left abutment length) (feet)	Left abutment length check (original envelope)	Left abutment length check (modified envelope)	Plan (right abutment length) (feet)	Topo (right abutment length) (feet)
Good	Not Usable	No Data	0.73	No Data	0.76	OK	OK	No Data	120	No Data	235	OK	OK	No Data	235

FEMA/Other m	Used m	m check	Left overbank scour depth (feet)	Right overbank scour depth (feet)	Selected left overbank scour depth (feet)	Selected right overbank scour depth (feet)
No Data	0.76	OK	4.7	4.7	4.7	4.7

Topo m	FEMA/Other m	Used m	m check (original curve)	m check (modified curve)	Original channel scour depth (feet)	Modified channel scour depth (feet)	Selected channel scour depth (feet)
0.73	No Data	0.76	OK	OK	N/A	N/A	N/A

PENETRATION TABLE

Pier width (feet)	Pier length (feet)	Angle of attack (degrees)	Multiple column bent?	Minimum spacing between columns (feet)	Column spacing to width ratio	Skew coefficient (single pier - HEC-18)		Skew coefficient used	Envelope curve used in pier scour estimate	Pier scour from envelope (feet) (no adjustment)	Pier scour adjusted for skew (feet)	Use abutment scour at pier?	Clear-water abutment scour from USGS curves (feet)	Use overbank contraction scour at pier?	Clear-water overbank contraction scour from USGS curves (feet)
N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	0.00	0.0	0.0	Yes	6.5	No	0.0
1.7	15	0	Yes	7.75	4.56	1.00		1.00	SC Clear Water	3.1	3.1	No	0.0	No	0.0
1.7	15	0	Yes	7.75	4.56	1.00		1.00	SC Clear Water	3.1	3.1	No	0.0	No	0.0
N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	0.00	0.0	0.0	No	0.0	No	0.0
N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	0.00	0.0	0.0	Yes	6.5	No	0.0

FEMA/Other (right abutment length) (feet)	Used (right abutment length) (feet)	Right abutment length check (original envelope)	Right abutment length check (modified envelope)	Original left abutment depth by m (feet)	Original right abutment depth by m (feet)	Original left abutment depth by length (feet)	Original right abutment depth by length (feet)	Modified left abutment depth by Category (feet)	Modified right abutment depth by Category (feet)	Modified left abutment depth by Interpolation (feet)	Modified right abutment depth by Interpolation (feet)	Left abutment depth selected (feet)	Right abutment depth selected (feet)	Left abutment hole width (feet)	Right abutment hole width (feet)
No Data	235	OK	OK	11.45	11.45	7.94	7.94	8.42	8.42	6.5	6.48	6.48	6.48	65.80	65.80

Use live-bed channel contraction scour at pier?	Live-bed contraction scour from USGS curves (feet)	Use pier scour?	Pier scour (feet)	Total scour at bent (feet)	Computed embedment of pile from consultant (feet)	Remaining pile penetration (feet)	Embedment below thalweg from consultant (feet)	Remaining pile penetration (at thalweg) (feet)
No	0.0	No	0.0	6.48	23.20	16.72	20.00	13.52
No	0.0	No	0.0	N/A	23.20	N/A	20.00	N/A
No	0.0	No	0.0	N/A	21.50	N/A	20.00	N/A
No	0.0	No	0.0	N/A	22.00	N/A	20.00	N/A
No	0.0	No	0.0	6.48	22.00	15.52	20.00	13.52

Hydraulic Toolbox HEC-18 Scour Analysis

Project Data

Project Title: I-95 Southbound Bridge over Bagshaw Swamp - Jasper County

Designer: MWH

Project Date: Friday, August 6, 2021

Project Units: U.S. Customary Units

Notes:

Bridge Scour Analysis: Bridge Scour Analysis

Notes

Contraction Scour

Contraction & Long Term Scour is applied method due to greater scour.

Live Bed Contraction Scour Depth 3.83 ft

Local Scour at Piers

Pier Name: Bent 2

Computation Method: HEC-18

Pier Scour Depth 1.06 ft

Total Scour at Pier 1.06 ft

Pier Name: Bent 3

Computation Method: HEC-18

Pier Scour Depth 1.08 ft

Total Scour at Pier 1.08 ft

Pier Name: Bent 4

Computation Method: HEC-18

Pier Scour Depth 1.06 ft

Total Scour at Pier 1.06 ft

Local Scour at Abutments

Left Abutment

Abutment Scour Method: HIRE Method

Abutment Scour Depth 3.61 ft

Total Scour at Abutment 3.61 ft

Right Abutment

Abutment Scour Method: HIRE Method

Abutment Scour Depth 3.64 ft

Total Scour at Abutment 3.64 ft

Contraction Scour

Contraction Scour

Computation Type: Clear-Water and Live-Bed Scour

Input Parameters

Average Depth Upstream of Contraction: 3.70 ft

D50: 0.000660 ft

Average Velocity Upstream: 0.47 ft/s

Results of Scour Condition

Critical velocity above which bed material of size D and smaller will be transported: 1.21 ft/s

Contraction Scour Condition: Clear-Water

Live Bed and/or Clear Water Input Parameters

Flow in Contracted Section: 172.00 cfs

Bottom Width in Contracted Section: 30.00 ft

Depth Prior to Scour in Contracted Section: 4.90 ft

Temperature of Water: 60.00 ºF

Slope of Energy Grade Line at Approach Section: 0.0000 ft/ft

Flow in Contracted Section: 172.00 cfs

Flow Upstream that is Transporting Sediment: 110.00 cfs

Width in Contracted Section: 30.00 ft

Width Upstream that is Transporting Sediment: 63.00 ft

Depth Prior to Scour in Contracted Section: 4.90 ft

Unit Weight of Water: 62.40 lb/ft^3

Unit Weight of Sediment: 165.00 lb/ft^3

Results of Clear Water Method

Diameter of the smallest nontransportable particle in the bed material: 0.000825 ft

Average Depth in Contracted Section after Scour: 4.22 ft

Scour Depth: -0.68 ft

Results of Live Bed Method

Shear Velocity: 0.07 ft/s

Fall Velocity: 0.08 ft/s

Average Depth in Contracted Section after Scour: 8.73 ft

Scour Depth for Live Bed: 3.83 ft

Shear Applied to Bed by Live-Bed Scour: 0.0006 lb/ft^2

Shear Required for Movement of D50 Particle: 0.0026 lb/ft^2

Recommendations

Recommended Scour Depth: -0.68 ft

Left Bank Contraction Scour

Contraction Scour

Computation Type: Clear-Water and Live-Bed Scour

Input Parameters

Average Depth Upstream of Contraction: 0.00 ft

D50: 0.000000 ft

Average Velocity Upstream: 0.00 ft/s

Results of Scour Condition

Critical velocity above which bed material of size D and smaller will be transported: 0.00 ft/s

Contraction Scour Condition: Live-Bed

Live Bed and/or Clear Water Input Parameters

Temperature of Water: 60.00 ºF

Slope of Energy Grade Line at Approach Section: 0.0000 ft/ft

Flow in Contracted Section: 0.00 cfs

Flow Upstream that is Transporting Sediment: 0.00 cfs

Width in Contracted Section: 0.00 ft

Width Upstream that is Transporting Sediment: 0.00 ft

Depth Prior to Scour in Contracted Section: 0.00 ft

Unit Weight of Water: 62.40 lb/ft^3

Unit Weight of Sediment: 165.00 lb/ft^3

Right Bank Contraction Scour

Contraction Scour

Computation Type: Clear-Water and Live-Bed Scour

Input Parameters

Average Depth Upstream of Contraction: 0.00 ft

D50: 0.000000 ft

Average Velocity Upstream: 0.00 ft/s

Results of Scour Condition

Critical velocity above which bed material of size D and smaller will be transported: 0.00 ft/s

Contraction Scour Condition: Live-Bed

Live Bed and/or Clear Water Input Parameters

Temperature of Water: 60.00 ºF

Slope of Energy Grade Line at Approach Section: 0.0000 ft/ft

Flow in Contracted Section: 0.00 cfs

Flow Upstream that is Transporting Sediment: 0.00 cfs

Width in Contracted Section: 0.00 ft

Width Upstream that is Transporting Sediment: 0.00 ft

Depth Prior to Scour in Contracted Section: 0.00 ft

Unit Weight of Water: 62.40 lb/ft^3

Unit Weight of Sediment: 165.00 lb/ft^3

Pier Details

Pier Name: Bent 2

Pier Scour

Computation Type: HEC-18

Input Parameters

Pier Shape: Round Nose

Bed Condition: Clear-Water Scour

Depth Upstream of Pier: 2.70 ft

Velocity Upstream of Pier: 0.35 ft/s

Width of Pier: 1.67 ft

Length of Pier: 1.67 ft

Angle of Attack: 0.00 Degrees

Result Parameters

Froude Number Upstream: 0.04

Correction Factor for Pier Nose Shape (K1): 1.00

Correction Factor of Angle of Attack (K2): 1.00

Pier Length to Pier Width (L/a): 1.00

Correction Factor for Bed Condition (K3): 1.10

Computed Scour Depth: 1.06 ft

Maximum Scour Depth Check: 4.01 ft

Scour Depth: 1.06 ft

Pier Name: Bent 3

Pier Scour

Computation Type: HEC-18

Input Parameters

Pier Shape: Round Nose

Bed Condition: Clear-Water Scour

Depth Upstream of Pier: 2.90 ft

Velocity Upstream of Pier: 0.36 ft/s

Width of Pier: 1.67 ft

Length of Pier: 1.67 ft

Angle of Attack: 0.00 Degrees

Result Parameters

Froude Number Upstream: 0.04

Correction Factor for Pier Nose Shape (K1): 1.00

Correction Factor of Angle of Attack (K2): 1.00

Pier Length to Pier Width (L/a): 1.00

Correction Factor for Bed Condition (K3): 1.10

Computed Scour Depth: 1.08 ft

Maximum Scour Depth Check: 4.01 ft

Scour Depth: 1.08 ft

Pier Name: Bent 4

Pier Scour

Computation Type: HEC-18

Input Parameters

Pier Shape: Round Nose

Bed Condition: Clear-Water Scour

Depth Upstream of Pier: 2.70 ft

Velocity Upstream of Pier: 0.35 ft/s

Width of Pier: 1.67 ft

Length of Pier: 1.67 ft

Angle of Attack: 0.00 Degrees

Result Parameters

Froude Number Upstream: 0.04

Correction Factor for Pier Nose Shape (K1): 1.00

Correction Factor of Angle of Attack (K2): 1.00

Pier Length to Pier Width (L/a): 1.00

Correction Factor for Bed Condition (K3): 1.10

Computed Scour Depth: 1.06 ft

Maximum Scour Depth Check: 4.01 ft

Scour Depth: 1.06 ft

Left Abutment Details

Abutment Scour

Computation Type: HIRE

Input Parameters

HIRE Method

Abutment Type: Spill-through abutment

Angle of Embankment to Flow: 90.00 Degrees

Centerline Length of Embankment: 125.00 ft

Projected Length of Embankment: 125.00 ft

Velocity at Toe of Abutment: 0.72 ft/s

Depth of Flow at Abutment Toe: 2.00 ft

Result Parameters

Froude Number: 0.09

Length to Depth Ratio: 62.50

Scour Hole Depth from HIRE Method: 3.61 ft

Right Abutment Details

Abutment Scour

Computation Type: HIRE

Input Parameters

HIRE Method

Abutment Type: Spill-through abutment

Angle of Embankment to Flow: 90.00 Degrees

Centerline Length of Embankment: 0.00 ft

Projected Length of Embankment: 0.00 ft

Velocity at Toe of Abutment: 0.65 ft/s

Depth of Flow at Abutment Toe: 2.10 ft

Result Parameters

Froude Number: 0.08

Length to Depth Ratio: 0.00

Scour Hole Depth from HIRE Method: 3.64 ft

FINAL SEISMIC DESIGN SUMMARY REPORT

I-95 SB Over Bagshaw Swamp Bridge Replacement Project

*Project ID P*030260

Prepared for

SCDOT

955 Park Street

Columbia, SC 29201

Prepared by

Infrastructure Consulting & Engineering

1021 Briargate Circle

Columbia, SC 29210

August 3, 2021

Rev- November 29, 2021

1. Project Description: The proposed bridge is a new, jointless bridge that will carry I-95 over Bagshaw Swamp in Jasper County, South Carolina. This bridge will replace the existing bridge, which is structurally deficient.

The bridge is located at latitude 32°22'38"N and longitude 81°01'50"W, respectively. As described in the Geotechnical Design Manual (*GDM*), this site is in the Lower Coastal Plane (Surry Scarp) of South Carolina, a region with a potential significant seismic activity, making seismic analysis an important part of the overall design.

The bridge design consists of four continuous flat slab spans (30'- 30'- 40'- 30') totaling 130ft. The roadway centerline and the bridge are straight. All bents are parallel to each other and are not skewed. The total deck width is 68.75ft out-to-out. The 2 end bents consist of a single row of 14x89 HP piles, and the 3 interior bents consist of a single row of 20" PSC Piles. All piles are embedded in a reinforced concrete cap. The bridge has no expansion joints. The end bents will have reinforced concrete wing walls. Additional information is provided in the Final Bridge Plans.

The purpose of this Final Seismic Design Summary Report is to document the strategy used to meet the seismic performance criteria according to the SCDOT *Seismic Design Specifications for Highway Bridges (2008)* (*SDS*), SCDOT *Bridge Design Memorandum 0115* (*DM0115*), the Geo-seismic requirements according to the *SCDOT Geotechnical Design Manual (GDM)*, version 2.0 (2019) and the *Geotechnical Design Bulletins*.

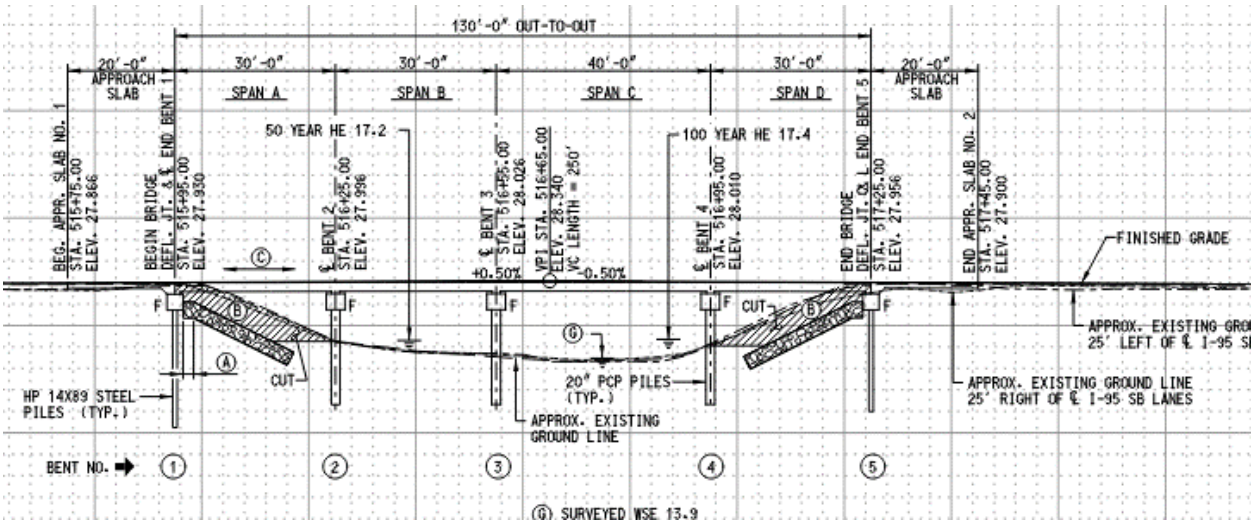


Figure 1: Final Bridge Profile.

The soil profile within 100 feet of the ground surface is generally represented by three horizons or four if the roadway embankment fill is included. Aside from the artificial fill of the roadway embankment construction, the two upper horizons encountered in the borings are fluvial deposits of Pleistocene geologic age. The upper horizon is heavily weathered varying in thickness between 6 and 12 feet thick and contains sandy clays and clayey sands. Beneath the clayey upper horizon, is a light gray grading to dark gray, fine to coarse sand with varying degrees of silt and clay. This saturated layer ranges between 20 and 35 feet

thick and increases in density with increasing depth. The upper part of this layer is susceptible to soil shear strength loss if the ground motions rise to intensities estimated from the 1886 Charleston earthquake. The basement horizon encountered in the borings is an undifferentiated deposit of Miocene geologic age. The layer is a dark greenish gray amalgamation of silts, sandy silts, clays, sandy clays, clayey and silty sands.

Final geotechnical analysis identified liquefiable soils at this site. The effects of liquefaction were assumed to occur during and after the seismic event in accordance with Section 13.3.2 of the *GDM*, so liquefied and non-liquefied cases were analyzed. Liquefaction was included by a reduction in the friction angle in the liquefiable soils. Detailed geotechnical analysis can be found in the Final Geotechnical Report.

From the Final Geotechnical report, ground water was observed as standing water at the ground surface to about 3 feet below the ground surface. For purpose of engineering analyses, the ground water level was assumed at the existing ground surface or approximately 15 feet NAVD88.

Scour was not an issue at this project site.

2. Seismic Design Criteria & Objectives:

2.1 Seismic Design Specifications- The purpose of this Final Seismic Design Summary Report is to document the strategy used to meet the seismic performance criteria according to the *SCDOT SDS, SCDOT Bridge Design Memorandum 0115 (DM0115)* and any applicable geotechnical requirements on the *GDM and the Geotechnical Design Bulletins*. This Final Seismic Summary Report describes the overall expected seismic performance of the structure, and it is submitted to the Department with the Final Bridge Plans.

2.2 Operational Classification (OC)- Since the bridge is located on I-95, the structure is classified as Operational Classification I (OC I) per Table 3.1 of the *SDS*.

2.3 Design Earthquakes- Per Table 3.2 in the *SDS*, the bridge structure which is classified as OC I was analyzed for the Safety Evaluation Earthquake (SEE), defined as a ground shaking having a 3% probability of exceedance in 75 years. Potential liquefiable soils are anticipated, and geotechnical mitigation is not proposed, so the structure seismic analysis was performed for the Functional Evaluation Earthquake (FEE), defined as a ground shaking having a 15% probability of exceedance in 75 years. See Table 1 below.

Table 1: Seismic Models Analyzed.

Model #	Models Analyzed
1	SEE Compression Not Liquefied
2	SEE Compression Liquefied
3	FEE Compression Not Liquefied
4	FEE Compression Liquefied

2.4 Seismic Site Stiffness- According to the site Geotechnical report, the Seismic Site Stiffness ($V^*_{s,H}$) is 1734.69 ft/sec.

2.5 Seismic Design Category (SDC)- According to the site Geotechnical report (Section 4), the Geotechnical Design Criteria indicate S_{D1} equals 0.48g for the SEE and 0.12g for the FEE. Thus, the SDC is defined as "C" per Table 3.5 of the *SDS* for OC I. The 3-Point ADRS curves and data for the FEE and SEE are in Figure 2 and Table 2, respectively. The typical damping of 5% has been assumed (*SDS* Section 5.2.3).

Table 2: ADRS Curves Data.

FEE		SEE	
T	S_a	T	S_a
0	0.135	0	0.374
0.01	0.163	0.02	0.454
0.03	0.19	0.04	0.534
0.04	0.217	0.06	0.614
0.06	0.245	0.08	0.694
0.07	0.272	0.09	0.774
0.08	0.299	0.11	0.854
0.11	0.299	0.15	0.854
0.14	0.299	0.19	0.854
0.17	0.299	0.23	0.854
0.19	0.299	0.26	0.854
0.22	0.299	0.3	0.854
0.25	0.299	0.34	0.854
0.28	0.299	0.38	0.854
0.31	0.299	0.41	0.854
0.33	0.299	0.45	0.854
0.36	0.299	0.49	0.854
0.39	0.299	0.53	0.854
0.42	0.299	0.56	0.854
0.57	0.219	0.71	0.681
0.72	0.173	0.85	0.566
0.87	0.143	0.99	0.484
1.03	0.122	1.14	0.423
1.18	0.106	1.28	0.376
1.33	0.094	1.42	0.338
1.48	0.084	1.57	0.307
1.63	0.076	1.71	0.281
1.78	0.07	1.85	0.26
1.94	0.064	2	0.241
2.09	0.06	2.14	0.225
2.24	0.056	2.28	0.211
2.39	0.052	2.43	0.198
2.54	0.049	2.57	0.187
2.7	0.046	2.71	0.177
2.85	0.044	2.86	0.168
3	0.042	3	0.16

Project ID:	P030260			Latitude:	32.3773
Route:	I-95	County:	27 - Jasper	Longitude:	81.0304
Project:	I-95 Bridge Replacement over Bagshaw Swamp				

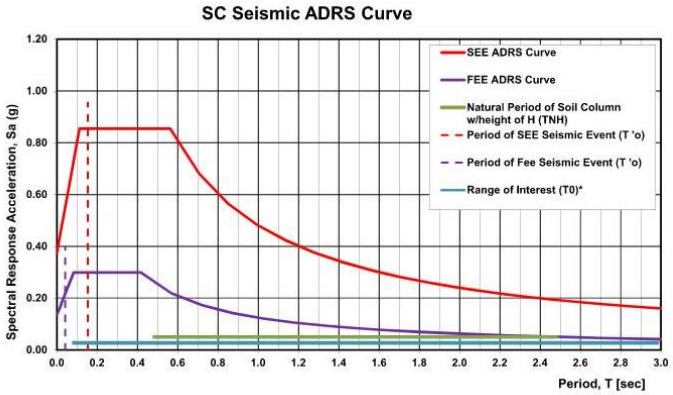
Design EQ	PGA	S_{DS}	S_{D1}	M_W	R	PGV	D_{s5-95}	T'_o
	g	g	g	-	km	inches/sec	sec	sec
FEE	0.14	0.30	0.12	7.30	98.37	4.75	34.52	0.04
SEE	0.37	0.85	0.48	7.30	94.40	18.28	33.88	0.15

Fundamental Period of Structure, T_s'	Range of Interest' sec		$V'_{s,H}$	H	T_{NH} sec	
sec	$0.5*T_s$	$2.0*T_s$	ft/sec	ft	$(4*H)/V'_{s,H}$	$(6*H)/V'_{s,H}$
0.13	0.07	0.26	1734.69	791.00	0.48	2.48
1.88	0.94	3.76				

Designer:	S. Biswas-Lowcountry RPG
Date:	10/30/2020

Damping:	5%
Geologic Condition:	Geologically Realistic (Q = 100)*
	SCCP
ADRS Location within Soil Column:	At Ground Surface

South Carolina Coastal Plain



FEE Data		SEE Data	
T	S_a	T	S_a
0.00	0.135	0.00	0.374
0.01	0.163	0.02	0.454
0.03	0.190	0.04	0.534
0.04	0.217	0.06	0.614
0.06	0.245	0.08	0.694
0.07	0.272	0.09	0.774
To 0.08	0.299	0.11	To 0.854
0.11	0.299	0.15	0.854
0.14	0.299	0.19	0.854
0.17	0.299	0.23	0.854
0.19	0.299	0.26	0.854
0.22	0.299	0.30	0.854
0.25	0.299	0.34	0.854
0.28	0.299	0.38	0.854
0.31	0.299	0.41	0.854
0.33	0.299	0.45	0.854
0.36	0.299	0.49	0.854
0.39	0.299	0.53	0.854
Ts 0.42	0.299	0.56	Ts 0.854
0.57	0.219	0.71	0.681
0.72	0.173	0.85	0.566
0.87	0.143	0.99	0.484
1.03	0.122	1.14	0.423
1.18	0.106	1.28	0.376
1.33	0.094	1.42	0.338
1.48	0.084	1.57	0.307
1.63	0.076	1.71	0.281
1.78	0.070	1.85	0.260
1.94	0.064	2.00	0.241
2.09	0.060	2.14	0.225
2.24	0.056	2.28	0.211
2.39	0.052	2.43	0.198
2.54	0.049	2.57	0.187
2.70	0.046	2.71	0.177
2.85	0.044	2.86	0.168
3.00	0.042	3.00	0.160

Figure 2: ADRS Curves for SEE & FEE
(ADRS Curves and Natural Period of Soil Column provided by SCDOT-See Geotechnical Report Exhibit C-1)

2.6 Expected Seismic Performance and Damage Levels- As per the *SDS*, for analysis purposes, the entire bridge system is referred to as the "global" model, and individual bents or end bents are referred as "local" model. "Local" also refers to bridge components as per Table 5. The *SDS* Table 3.3 requires for the global performance objectives that for the SEE, the level of damage should be repairable and the level of service to be maintained. For the FEE, the global performance objectives should be that the level of damage should be minimum and the level of service immediate. The *SDS* Table 3.4 provides the local damage objectives. The global damage levels and global service levels required for this project according to Table 3.3 of the *SDS* were achieved with this design. The bridge local components damage level objectives according to Table 3.4 of the *SDS* were also achieved with this design. There is no expected risk of collapse. See Table 3 below.

Table 3: Global Seismic Performance Objectives.

Design Earthquake	Performance Level	Objective for OC I
FEE	Service	Immediate
	Damage	Minimum
SEE	Service	Maintained
	Damage	Repairable

Per Table 6.1 of the *SDS*, for OC I, plastic hinges were not allowed below ground at interior bents and end bents for this project.

2.7 Displacement & Ductility Criteria to be satisfied- Table 4 illustrates the substructure unit quantitative damage criteria as per the SCDOT *DM0115,* Table 7.1 as a measure of the maximum ductility demand.

Table 4: Substructure Unit Quantitative Damage Criteria (OC I)

Structural Component	Maximum Ductility Demand, μ_d	
	FEE	SEE
PSC Pile Interior Bents	1.0*	2.0*

*As per SCDOT *DM0115*

The required minimum ductility capacity for the final bridge design is 3.0, as per *SDS* Section 7.1.3 Please refer to Section 4 of this report to see the results.

Table 5 shows the local damage level objectives from Table 3.4 of the *SDS*.

Table 5: Local Seismic Performance Objectives.

Bridge Component	Design Earthquake	Objective for OC I
Connection Components[1]	FEE	Repairable
	SEE	Significant
Interior Bent Restraint Components[2]	FEE	Minimal
	SEE	Minimal[4]
End Bent Restraint Components[2]	**FEE**	**Minimal**
	SEE	Significant
Capacity Protected Components[3]	FEE	Minimal
	SEE	Minimal
Interior Bent Piles	FEE	Minimal
	SEE	Repairable
End Bent Piles	FEE	Minimal
	SEE	Minimal
End Bent Ear Walls	FEE	Minimal
	SEE	Significant

1. Includes expansion joints and bearings.
2. Includes shear keys, anchor bolts, and dowel bars.
3. Includes bent caps, footings, and oversized drilled shafts.
4. When shear keys are not designed to fuse.

2.8 Seismic Analysis & Design Software- To accurately model the seismic demands on the structure, a Multi-modal Spectral Analysis (MSA) was performed using the latest version (23) of CSiBridge software. Separate models for soil-structure interaction (SSI) were developed using LPILE 2018 software. These models were used in conjunction with the CSiBridge models to calibrate and to accurately evaluate the seismic response of the structure, including converging the points-of-fixity for the end and interior bent piles. Information on the LPILE models, the Shear Strength Loss Susceptibility Analysis, as well as the seismic geotechnical results can be found in the Final Bridge Geotechnical Report.

3. Seismic Design Approach and Analysis Performed

3.1 Seismic Design Approach- Four Multimodal Spectral Analyses (MSA) were performed as stated in Section 2.3 and Table 1 of this report. As per *SDS* Section 5.5.1, a minimum of 90% of the mass participation in the longitudinal and transverse directions were targeted and obtained in each analysis.

See section 4 of this report.

Due to potential for liquefaction under the seismic loading at the project site, (*SDS* Section 4.7) liquefied and non-liquefied models were analyzed to define the upper and the lower boundaries to capture the region between the stiff and flexible conditions.

Per Section 5.2.4 of the *SDS*, the fundamental period of the structure was compared to the characteristic ground motion period corresponding to the peak energy input spectrum to check if the displacement demands determined from elastic analysis shall be multiplied by the displacement magnification factor. See Modal, Period & Mass Participation results in Section 4 of this report.

A pushover analysis was performed (*SDS* Section 3.13.3). The pushover analysis provided the plastic hinge data and the displacement data needed to check against the demand data provided by the MSA. The ratio between displacement demand and the yield displacement was used to calculate the maximum ductility demands to be checked against *SDS* Table 7.1, revised in the *DM0115*. See results in section 4 of this report.

The displacement demands obtained from the MSA analyses were compared accordingly to each bent displacement calculated using pushover analysis, as required for a SDC C bridge.

The global displacement criteria satisfied the *SDS* Equation (7-1). The substructure ductility demands were obtained using the yield displacements calculated with pushover analysis and the displacement demands from the MSA models, as per *SDS* Section 7.1.2. The ductility capacity for a particular member as defined in *SDS* Section 6.5.2 was calculated as required by SCDOT *DM0115* Revisions to Section 7.1.3, using expected material properties as per *SDS* Section 6.6 and moment-curvature analysis for prestressed concrete as per *SDS* Section 6.7.4.

Table 3 shows the global seismic performance objectives from Table 3.3 of the *SDS*. Definitions for the terms in Tables 3 and 4 can be found in Section 3.4 of the *SDS*.

3.2 Demand Analysis- The global seismic displacement demands were obtained from the Multimode Spectral Analysis (MSA) for the compression non-liquefied and liquefied models following the requirements in Section 5 of the *SDS* and are presented in section 4 of this report.

As previously stated, four modal analyses were performed for number of modes listed in the table below, and in all cases met the required 12 mode shapes set by Section 5.5.1 of the *SDS*. As per Section 5.3 of the *SDS* compression models were run. Since there are not expansion joints, tension models were not needed. Points of fixity for the end and interior bent piles were determined by iterating between the LPILE Soil Structure Interaction (SSI) models and CSiBridge MSA models until the forces obtained from the MSA model when input into the SSI model result in displacements were within a +/- 10% difference according to *SDS* Figure 5.9. The initial points of fixity were based on the point of zero deflection.

To consider the effects of the soil at the end bents in the model, the abutment stiffness was evaluated. The end bents were modeled as a free-standing bent with piles and the backwall pressure was modeled with foundation soil springs. The total stiffness from the backwall was computed using the Log-Spiral-Rankine (LSR) Method better known as the Shamsabadi Method as per the *GDM* Chapter 14, Section 14.4.4. Due to MSA modeling limitations, the stiffnesses of the two end bent foundation springs were averaged. In this project the wing walls were not considered to add to the soil resistance of the end bents, so they were not included. They were assumed sacrificial elements; therefore, no extra connection reinforcement was used between the backwall and the wingwalls.

Following Section 6.6 of the *SDS*, expected material properties were used in all models and appropriate calculations to maintain consistent assumptions. The models also adhered to the unconfined and confined concrete requirements when applicable (*SDS 6.6*).

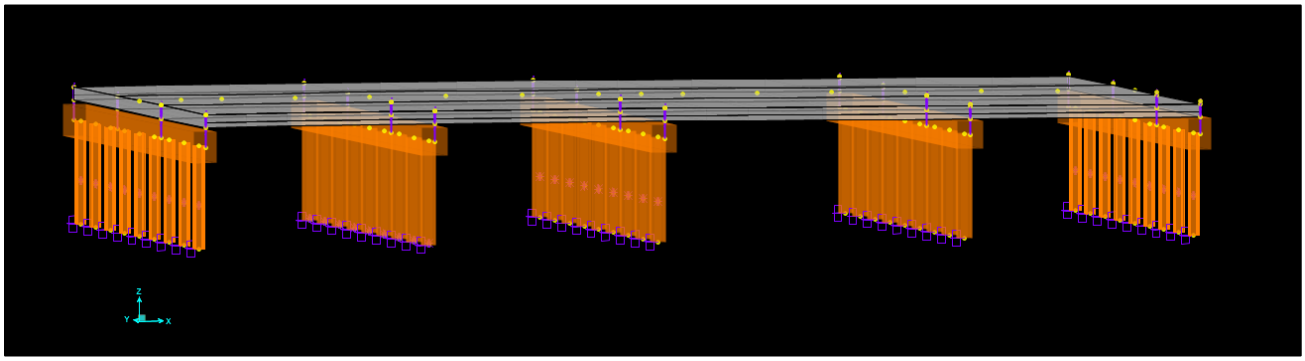


Figure 4: CSiBridge Model.

3.3 Capacity Analysis- Four pushover analyses were performed, one with no-liquefaction and one with liquefaction for the SEE and one with no-liquefaction and one with liquefaction for the FEE respectively, to determine the seismic yield displacements and capacities for ductile PSC piles. The members ductility capacities were calculated with these values according to Section 7.1.3 of the *SDS, DM0115* revision.

4. Seismic Modeling Results Analysis:

4.1 Mass Participation Ratio and Fundamental Periods- The four modal analyses were performed for number of modes listed in Table 4 below, and in all cases met the required 12 mode shapes set by Section 5.5.1 of the *SDS*. Per Section 5.2.4 of the *SDS*, the fundamental period of the structure was compared to the characteristic ground motion period corresponding to the peak energy input spectrum to determine if the global displacement demands obtained from elastic analysis should be multiplied by the displacement magnification factor. This comparison showed that displacement magnification was required for the transverse direction for this structure. All modal mass participation and period results are provided below for the 4 analyzed cases, in Table 6 and Table 7 respectively.

The structure fundamental period was checked against the natural period of the soil column (TNH) and the Range of interest (T0) following the guidance in *GDM* Section 12.0. See Figure 2.

Table 6: Number of Modes and Mass Participation

Mode Shapes & Mass Participation:

Number of Spans =	4
Min. Number of Mode Shapes =	12
Min. Mass Participation =	90 %

			Longitudinal		Transverse	
Model	# Modes	Check	Mass %	Check	Mass %	Check
FEE Liquified	36	OK	99.32	OK	95.24	OK
FEE	240	OK	99.55	OK	97.09	OK
SEE Liquified	36	OK	99.13	OK	94.72	OK
SEE	42	OK	99.06	OK	93.73	OK

Table 7: Displacement Magnification for Short Period Structures Check

Displacement Magnification for Short Period Structures:

If bridge is considered a 'short period structure', displacements obtaind from elastic analysis shall be multiplied by R_T in accordance with Section 5.2.4 of the SCDOT Seismic Design Specification.

If required (req'd), displacement magnification applied as post-processing of model output.

Event	T_s
SEE	0.854
FEE	0.299

Longitudinal: Axial Load = 50.0 k; M_p = 249.0 k-ft

Transverse: Axial Load = 50.0 k; M_p = 249.0 k-ft

	Longitudinal				Transverse			
Model	Fund. Period, T	T*	T*/T	Req'd?	Fund. Period, T	T*	T*/T	Req'd?
FEE Liquified	1.88	0.37	0.20	No	0.16	0.37	2.33	Yes
FEE	1.49	0.37	0.25	No	0.13	0.37	2.88	Yes
SEE Liquified	1.69	1.07	0.63	No	0.81	1.07	1.32	Yes
SEE	1.44	1.07	0.74	No	0.52	1.07	2.04	Yes

Displacement Magnification for Interior Bents	Longitudinal					Transverse				
Model	T*/T	Demand M (k-ft)	M_p (k-ft)	R	R_T	T*/T	Demand M (k-ft)	M_p (k-ft)	R	R_T
FEE Liquified	0.20	1070	249	4.30	1.00	2.33	172	249	0.69	1.00
FEE	0.25	1021	249	4.10	1.00	2.88	216	249	0.87	1.00
SEE Liquified	0.63	2044	249	8.21	1.00	1.32	750	249	3.01	1.22
SEE	0.74	1787	249	7.18	1.00	2.04	651	249	2.61	1.64

4.2 Displacement and Ductility Demand-

The seismic displacement demands were obtained from the MSA models following the procedures in Chapter 5 of the *SDS*. These demands were compared to the displacements calculated using pushover analysis. All checks for global ductility demand were satisfied and can be seen in the results analysis below. Table 4 shows the maximum ductility demand allowed as per *SDS* Table 7.1 and *DM0115*.

Global Displacement Demand was checked against Displacement Capacity to comply with SDS Eq. 7-1. See Table 8. The substructure unit ductility demand requirements are demonstrated presented in Table 9, below.

Table 8: Global Displacement Criteria

Δd	<	$\Delta_{c,g}$	SDS Eq 7-1

$\Delta_{d,g}$ (in)	Displacement Demand
$\Delta_{c,g}$ (in)	Displacement Capacity

Model:	FEE Liquified

Bent No.	Longitudinal Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	4.45	31.10	OK
3	2.08	28.50	OK
4	5.47	23.80	OK

Bent No.	Transverse Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	0.28	26.11	OK
3	0.24	27.93	OK
4	0.17	24.36	OK

Model:	FEE

Bent No.	Longitudinal Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	3.99	17.45	OK
3	1.73	14.28	OK
4	4.51	18.98	OK

Bent No.	Transverse Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	0.24	19.84	OK
3	0.22	19.86	OK
4	0.18	19.30	OK

Model:	SEE Liquified

Bent No.	Longitudinal Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	10.37	29.70	OK
3	8.61	27.27	OK
4	9.93	31.30	OK

Bent No.	Transverse Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	1.93	28.13	OK
3	2.58	29.14	OK
4	4.01	29.90	OK

Model:	SEE

Bent No.	Longitudinal Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	7.93	13.40	OK
3	7.41	12.90	OK
4	9.25	15.10	OK

Bent No.	Transverse Direction		
	$\Delta_{d,g}$ (in)	$\Delta_{c,g}$ (in)	Check
2	2.00	19.13	OK
3	1.61	15.80	OK
4	1.33	19.13	OK

Table 9: Substructure Unit Quantitative Criteria Check

From Section 7.1.2, SCDOT Seismic Design Spec.

Substructure Unit Ductility Demand

Term	Definition
$\Delta_{d,g}$	Displacement demand at top of column/pile/shaft from MSA model.
$\Delta_{y,g}$	Yield displacement at top of column/pile/shaft at yield in PO model.

Model: FEE Liquified

Bent No.	Longitudinal Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	4.45	5.50	0.81	1.0	OK
3	2.08	5.55	0.37	1.0	OK
4	5.47	7.25	0.75	1.0	OK

Bent No.	Transverse Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	0.28	6.13	0.05	1.0	OK
3	0.24	6.14	0.04	1.0	OK
4	0.17	6.11	0.03	1.0	OK

Model: SEE Liquified

Bent No.	Longitudinal Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	10.37	8.86	1.17	2.0	OK
3	8.61	6.90	1.25	2.0	OK
4	9.93	8.42	1.18	2.0	OK

Bent No.	Transverse Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	1.93	6.34	0.30	2.0	OK
3	2.58	6.18	0.42	2.0	OK
4	4.01	6.11	0.66	2.0	OK

Model: FEE

Bent No.	Longitudinal Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	3.99	4.56	0.87	1.0	OK
3	1.73	4.00	0.43	1.0	OK
4	4.51	4.78	0.94	1.0	OK

Bent No.	Transverse Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	0.24	6.25	0.04	1.0	OK
3	0.22	6.36	0.03	1.0	OK
4	0.18	6.24	0.03	1.0	OK

Model: SEE

Bent No.	Longitudinal Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	7.93	4.18	1.90	2.0	OK
3	7.41	4.30	1.72	2.0	OK
4	9.25	4.68	1.98	2.0	OK

Bent No.	Transverse Direction				
	$\Delta_{d,g}$ (in)	$\Delta_{y,g}$ (in)	μ_d	$\mu_{d,max}$	Check
2	2.00	6.15	0.33	2.0	OK
3	1.61	3.88	0.41	2.0	OK
4	1.33	6.15	0.22	2.0	OK

4.3 Ductility Capacity-

The required minimum ductility capacity of 3.0 at each bent for the final bridge design was achieved in all models and can be seen in the result analysis below, in Table 10. The member displacement capacity was calculated as per Section 6.5.2 of the SDS. The ductility capacity was determined as per Section 7.1.3 of the SDS and DM0115.

Table 10: Ductility Capacity

Local Ductility Check of Columns

fy =	243	ksi	
dbl =	0.6	in	
Lsp =	0.15 fye dbl		SDS Eq 6-6
Lsp	21.87	in	Strain Penetration DM0115
ϕ_Y	1.628E-04	in^{-1}	*Idealized yield curvature*
ϕ_u	2.058E-03	in^{-1}	*Ultimate curvature*
ϕ_p	1.896E-03	in^{-1}	*Idealized plastic curvature capacity (difference between the ultimate and idealized yield curvatures)*
*D**	20	in	Diameter or cross section section in direction of bending
$\mu_{c,min}$	3		

FEE Longitudinal (One Cantilever Segment)

Bent	L_{pof} (ft)	$L_{p,long}$ (in)	$\Theta_{p,long}$ (rad)	$\Delta_{p,long}$ (in)	$\Delta_{y,long}$ (in)	$\Delta_{c,long}$ (in)	μ_c	Check
2	14.50	20.00	0.04	6.2	2.082	8.299	3.99	OK
3	16.70	20.00	0.04	7.2	2.681	9.899	3.69	OK
4	11.48	20.00	0.04	4.8	1.383	6.226	4.50	OK

FEE Transverse (Two Cantilever Segment)

Bent	L_{pof} (ft)	Upper L' (ft)	Lower L' (ft)	$L_{p,upper}$ (in)	$L_{p,lower}$ (in)	$\Theta_{p,upper}$ (rad)	$\Theta_{p,lower}$ (rad)	$\Delta_{p,upper}$ (in)	$\Delta_{p,lower}$ (in)	$\Delta_{y,upper}$ (in)	$\Delta_{y,lower}$ (in)	$\Delta_{c,upper}$ (in)	$\Delta_{c,lower}$ (in)	$\mu_{c,upper}$	$\mu_{c,lower}$	Check
2	133.00	66.50	66.50	63.84	63.8	0.121	0.121	92.70	92.70	36.477	36.477	129.18	129.18	3.54	3.54	OK
3	51.08	25.54	25.54	24.52	24.5	0.046	0.046	13.68	13.68	5.851	5.851	19.53	19.53	3.34	3.34	OK
4	122.75	61.38	61.38	58.92	58.9	0.112	0.112	78.97	78.97	31.210	31.210	110.18	110.18	3.53	3.53	OK

FEE - Liquified - Longitudinal (One Cantilever Segment)

Bent	L_{pof} (ft)	$L_{p,long}$ (in)	$\Theta_{p,long}$ (rad)	$\Delta_{p,long}$ (in)	$\Delta_{y,long}$ (in)	$\Delta_{c,long}$ (in)	μ_c	Check
2	15.75	20.00	0.04	6.8	2.413	9.199	3.81	OK
3	13.08	20.00	0.04	5.6	1.736	7.309	4.21	OK
4	24.25	23.28	0.04	12.3	5.312	17.640	3.32	OK

FEE - Liquified - FEE Transverse (Two Cantilever Segment)

Bent	L_{pof} (ft)	Upper L' (ft)	Lower L' (ft)	$L_{p,upper}$ (in)	$L_{p,lower}$ (in)	$\Theta_{p,upper}$ (rad)	$\Theta_{p,lower}$ (rad)	$\Delta_{p,upper}$ (in)	$\Delta_{p,lower}$ (in)	$\Delta_{y,upper}$ (in)	$\Delta_{y,lower}$ (in)	$\Delta_{c,upper}$ (in)	$\Delta_{c,lower}$ (in)	$\mu_{c,upper}$	$\mu_{c,lower}$	Check
2	55.25	27.63	27.63	26.52	26.5	0.050	0.050	16.00	16.00	6.776	6.776	22.77	22.77	3.36	3.36	OK
3	55.50	27.75	27.75	26.64	26.6	0.050	0.050	16.14	16.14	6.834	6.834	22.98	22.98	3.36	3.36	OK
4	54.92	27.46	27.46	26.36	26.4	0.050	0.050	15.81	15.81	6.700	6.700	22.51	22.51	3.36	3.36	OK

SEE Longitudinal (One Cantilever Segment)

Bent	L_{pof} (ft)	$L_{p,long}$ (in)	$\Theta_{p,long}$ (rad)	$\Delta_{p,long}$ (in)	$\Delta_{y,long}$ (in)	$\Delta_{c,long}$ (in)	μ_c	Check
2	16.75	20.00	0.04	7.2	2.695	9.936	3.69	OK
3	13.70	20.00	0.04	5.9	1.883	7.736	4.11	OK
4	13.98	20.00	0.04	6.0	1.951	7.932	4.06	OK

SEE Transverse (Two Cantilever Segment)

Bent	L_{pof} (ft)	Upper L' (ft)	Lower L' (ft)	$L_{p,upper}$ (in)	$L_{p,lower}$ (in)	$\Theta_{p,upper}$ (rad)	$\Theta_{p,lower}$ (rad)	$\Delta_{p,upper}$ (in)	$\Delta_{p,lower}$ (in)	$\Delta_{y,upper}$ (in)	$\Delta_{y,lower}$ (in)	$\Delta_{c,upper}$ (in)	$\Delta_{c,lower}$ (in)	$\mu_{c,upper}$	$\mu_{c,lower}$	Check
2	55.67	27.83	27.83	26.72	26.7	0.051	0.051	16.24	16.24	6.873	6.873	23.11	23.11	3.36	3.36	OK
3	34.58	17.29	17.29	20.00	20.0	0.038	0.038	7.49	7.49	2.855	2.855	10.34	10.34	3.62	3.62	OK
4	62.42	31.21	31.21	29.96	30.0	0.057	0.057	20.42	20.42	8.526	8.526	28.94	28.94	3.39	3.39	OK

SEE - Liquified - Longitudinal (One Cantilever Segment)

Bent	L_{pof} (ft)	$L_{p,long}$ (in)	$\Theta_{p,long}$ (rad)	$\Delta_{p,long}$ (in)	$\Delta_{y,long}$ (in)	$\Delta_{c,long}$ (in)	μ_c	Check
2	21.75	20.88	0.04	9.9	4.342	14.259	3.28	OK
3	22.45	21.55	0.04	10.6	4.604	15.169	3.29	OK
4	30.23	29.02	0.06	19.2	8.028	27.184	3.39	OK

SEE - Liquified - Transverse (Two Cantilever Segment)

Bent	L_{pof} (ft)	Upper L' (ft)	Lower L' (ft)	$L_{p,upper}$ (in)	$L_{p,lower}$ (in)	$\Theta_{p,upper}$ (rad)	$\Theta_{p,lower}$ (rad)	$\Delta_{p,upper}$ (in)	$\Delta_{p,lower}$ (in)	$\Delta_{y,upper}$ (in)	$\Delta_{y,lower}$ (in)	$\Delta_{c,upper}$ (in)	$\Delta_{c,lower}$ (in)	$\mu_{c,upper}$	$\mu_{c,lower}$	Check
2	68.42	34.21	34.21	32.84	32.8	0.062	0.062	24.53	24.53	10.145	10.145	34.68	34.68	3.4	3.4	OK
3	35.33	17.67	17.67	20.00	20.0	0.038	0.038	7.66	7.66	2.968	2.968	10.63	10.63	3.6	3.6	OK
4	53.17	26.58	26.58	25.52	25.5	0.048	0.048	14.81	14.81	6.305	6.305	21.12	21.12	3.3	3.3	OK

For the capacity protected components check, see Table 11 below.

Table 11: Capacity Protected Components Check

Capacity Protected Component	Controlling Component	Controlling M_p (ft-k)	Controlling M_{po} (ft-k)	Cap. Prot. Comp. M_{NE}* (ft-k)	Check
End Bent Cap	HP14x89	608	730	971.4	OK
Interior Bent Cap	20" PSC Pile	249	299	555.3	OK
*M_Y can be used for simplicity. M_{NE} is always slightly higher than M_Y					

5.0 Approved Design Variances-

No approved design variances.

6.0 Seismic Detailing- As per Section 9 of the SDS, the minimum support length is not an issue due to the continuity of the superstructure, (no expansion joints). No shear keys were needed. As per *SDS* Section 9.4.4 the computed total required anchorage reinforcing rebars was satisfied. See also final bridge plans.

Superstructure to Substructure Connection:								
	Long. Shear Force, $V_{u,long}$ =	437.8	k			Smaller of elastic shear force or		
	Trans. Shear Force, $V_{u,trans}$ =	875.5	k			overstrength plastic hinge force.		
						(Vpo = 2Mpo/L; Seismic Design Manual, Eq. 6-51)		
	Anchor Bolt or Dowel Rod Contribution:							
	No. of Bolts or Dowels =	34						
	Cross Sectional Area, A_b =	0.79	in^2 / bolt or dowel				A25 Dowels	
	Tensile Strength, F_{ub} =	80	ksi			For ASTM 7064 GR. 60, F_T = 80 ksi min		
	Shear Strength, V_{ab} =	1031.4	k					
	ϕ_v =	0.85						
	Long. Shear Capacity, $\varphi_v V_{long}$ =	876.7	k	OK				
	Trans. Shear Capacity, $\varphi_v V_{trans}$ =	876.7	k	OK				

7.0 Seismic Hazard Mitigation- Geotechnical Seismic hazard mitigation was not needed at this location.

Appendix A

LPILE outputs

```
================================================================================

                    LPile for Windows, Version 2018-10.007

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Projects\18-42 I-95 Bridge Replacements Jasper
Co\Structures\Seismic\Rev1-Analysis\Lpile\Lpile\P-y-Springs\

Name of input data file:
LPILE_BS_20 PSC - Long.lp10

Name of output report file:
LPILE_BS_20 PSC - Long.lp10

Name of plot output file:
LPILE_BS_20 PSC - Long.lp10

Name of runtime message file:
LPILE_BS_20 PSC - Long.lp10



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------
```

Date: October 19, 2021 Time: 8:36:15

Problem Title

Project Name: I-95 over Bagshaw Swamp

Job Number: EN175299

Client: ICE

Engineer: Terracon (J. Cerceo)

Description: 20-inch Sq PSC

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
- Static loading specified

```
 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - p-y curves computed and reported at user-specified depths
 - Print using wide report formats



--------------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Number of pile sections defined                        =            1
Total length of pile                                   =       60.000 ft
Depth of ground surface below top of pile              =      10.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           20.0000
  2            60.000           20.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is an elastic pile
   Cross-sectional shape                               =     rectangular
   Length of section                                   =    60.000000 ft
   Width of top of section                             =    20.000000 in
```

```
   Width of bottom of section                          =    20.000000 in
   Top Section Depth                                   =    20.000000 in
   Bottom Section Depth                                =    20.000000 in
   Top Area                                            =   400.000000 sq. in
   Bottom Area                                         =   400.000000 sq. in
   Moment of Inertia at Top                            =       13333. in^4
   Moment of Inertia at Bottom                         =       13333. in^4
   Elastic Modulus                                     =     3605000. psi



-------------------------------------------------------------------------------
                        Ground Slope and Pile Batter Angles
-------------------------------------------------------------------------------

Ground Slope Angle                                     =        0.000 degrees
                                                       =        0.000 radians

Pile Batter Angle                                      =        0.000 degrees
                                                       =        0.000 radians


-------------------------------------------------------------------------------
                        Soil and Rock Layering Information
-------------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer           =    10.000000 ft
   Distance from top of pile to bottom of layer        =    11.000000 ft
   Effective unit weight at top of layer               =   115.000000 pcf
   Effective unit weight at bottom of layer            =   115.000000 pcf
   Undrained cohesion at top of layer                  =        1200. psf
   Undrained cohesion at bottom of layer               =        1200. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer           =    11.000000 ft
   Distance from top of pile to bottom of layer        =    17.000000 ft
   Effective unit weight at top of layer               =    52.600000 pcf
```

```
   Effective unit weight at bottom of layer            =    52.600000 pcf
   Undrained cohesion at top of layer                  =        1200. psf
   Undrained cohesion at bottom of layer               =        1200. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer           =    17.000000 ft
   Distance from top of pile to bottom of layer        =    38.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Friction angle at top of layer                      =    36.000000 deg.
   Friction angle at bottom of layer                   =    36.000000 deg.
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is stiff clay without free water

   Distance from top of pile to top of layer           =    38.000000 ft
   Distance from top of pile to bottom of layer        =    80.000000 ft
   Effective unit weight at top of layer               =    52.600000 pcf
   Effective unit weight at bottom of layer            =    52.600000 pcf
   Undrained cohesion at top of layer                  =        3500. psf
   Undrained cohesion at bottom of layer               =        3500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 20.000 ft below the pile tip)



--------------------------------------------------------------------------------
                         Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Undrained    Angle of
 E50
Layer           Name             Depth       Unit Wt.    Cohesion     Friction
 or            kpy
 Num.     (p-y Curve Type)         ft           pcf          psf          deg.
```

krm	pci						
1	Stiff Clay w/o	10.0000	115.0000	1200.	--	default	default
	Free Water, using k	11.0000	115.0000	1200.	--	default	default
2	Stiff Clay w/o	11.0000	52.6000	1200.	--	default	default
	Free Water, using k	17.0000	52.6000	1200.	--	default	default
3	Sand	17.0000	57.6000	--	36.0000	--	default
	(Reese, et al.)	38.0000	57.6000	--	36.0000	--	default
4	Stiff Clay	38.0000	52.6000	3500.	--	default	--
	w/o Free Water	80.0000	52.6000	3500.	--	default	--

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	10.000	0.9650	1.0000
2	80.000	0.9650	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 6

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 20000. lbs	M = 0.0000 in-lbs	250000.	No
2	1	V = 40000. lbs	M = 0.0000 in-lbs	250000.	No
3	1	V = 60000. lbs	M = 0.0000 in-lbs	250000.	No
4	1	V = 80000. lbs	M = 0.0000 in-lbs	250000.	No
5	1	V = 100000. lbs	M = 0.0000 in-lbs	250000.	No
6	4	y = 3.503000 in	M = 0.0000 in-lbs	250000.	N.A.

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Specified Depths for Output of p-y Curves

Lateral load-transfer (p-y) curves are computed and output at 14 depths.
(Note that load-transfer values are computeded at the specified depths and may differ from values computed at nodal points)

Depth No.	Depth Below Pile Head ft	Depth Below Ground Surface ft
1	10.500	0.500
2	11.500	1.500
3	12.500	2.500
4	13.500	3.500
5	14.500	4.500
6	15.500	5.500
7	16.500	6.500
8	17.500	7.500

9	18.500	8.500
10	19.500	9.500
11	20.500	10.500
12	21.500	11.500
13	22.500	12.500
14	23.500	13.500

Depth of ground surface below top of pile = 10.0000 ft

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

---

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	10.0000	0.00	N.A.	No	0.00	6396.
2	11.0000	1.0000	Yes	No	6396.	53128.
3	17.0000	8.7582	No	No	59524.	1557858.
4	38.0000	37.1217	No	No	1617382.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

---

p-y Curves Reported for Specified Depths

---

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	1	
Depth of top of Layer 1 below pile head	=	10.000	ft
Depth of p-y curve below pile head	=	10.500	ft
Depth of p-y curve below ground surface	=	0.500	ft
Equivalent depth of p-y curve	=	0.500	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	115.000	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	532.986	lb/in
Pcd	=	1500.000	lb/in
Pu	=	532.986	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	0.32024
0.00177	5.12379
0.00896	25.93920
0.02832	81.98068
0.06914	171.44387
0.14336	205.73264
0.26559	240.02141
0.45309	274.31019
0.72576	308.59896
1.10617	342.88773
1.61955	377.17650
2.29376	411.46528
3.15934	445.75405
4.24947	480.04282
5.60000	514.33160
7.00000	514.33160

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	2	
Depth of top of Layer 2 below pile head	=	11.000	ft
Depth of p-y curve below pile head	=	11.500	ft
Depth of p-y curve below ground surface	=	1.500	ft
Equivalent depth of p-y curve	=	1.500	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	94.200	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	594.624	lb/in
Pcd	=	1500.000	lb/in
Pu	=	594.624	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	0.96071
0.00177	15.37138
0.00896	77.81760
0.02832	153.01658
0.06914	191.27072
0.14336	229.52487
0.26559	267.77901
0.45309	306.03316
0.72576	344.28730
1.10617	382.54145
1.61955	420.79559
2.29376	459.04974
3.15934	497.30388
4.24947	535.55803
5.60000	573.81217
7.00000	573.81217

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	2	
Depth of top of Layer 2 below pile head	=	11.000	ft
Depth of p-y curve below pile head	=	12.500	ft
Depth of p-y curve below ground surface	=	2.500	ft
Equivalent depth of p-y curve	=	2.500	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	77.560	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	651.930	lb/in
Pcd	=	1500.000	lb/in
Pu	=	651.930	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	1.60119
0.00177	25.61896
0.00896	125.82241
0.02832	167.76322
0.06914	209.70402
0.14336	251.64483
0.26559	293.58563
0.45309	335.52644
0.72576	377.46724
1.10617	419.40805
1.61955	461.34885
2.29376	503.28965
3.15934	545.23046
4.24947	587.17126
5.60000	629.11207
7.00000	629.11207

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	2	
Depth of top of Layer 2 below pile head	=	11.000	ft
Depth of p-y curve below pile head	=	13.500	ft
Depth of p-y curve below ground surface	=	3.500	ft

Equivalent depth of p-y curve	=	3.500 ft
Pile diameter	=	20.000 in
Undrained cohesion	=	1200.000 psf
Average eff. unit weight	=	70.429 pcf
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
k_py	=	500. pci
Epsilon_50	=	0.00700
Pct	=	709.235 lb/in
Pcd	=	1500.000 lb/in
Pu	=	709.235 lb/in
y50	=	0.350 in
p-multiplier	=	0.96500
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	2.24166
0.00177	35.86655
0.00896	136.88239
0.02832	182.50985
0.06914	228.13731
0.14336	273.76478
0.26559	319.39224
0.45309	365.01970
0.72576	410.64717
1.10617	456.27463
1.61955	501.90209
2.29376	547.52956
3.15934	593.15702
4.24947	638.78448
5.60000	684.41194
7.00000	684.41194

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	2
Depth of top of Layer 2 below pile head	=	11.000 ft
Depth of p-y curve below pile head	=	14.500 ft
Depth of p-y curve below ground surface	=	4.500 ft
Equivalent depth of p-y curve	=	4.500 ft
Pile diameter	=	20.000 in
Undrained cohesion	=	1200.000 psf
Average eff. unit weight	=	66.467 pcf
Ground slope angle	=	0.000 degrees

Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	766.541	lb/in
Pcd	=	1500.000	lb/in
Pu	=	766.541	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	2.88213
0.00177	46.11413
0.00896	147.94236
0.02832	197.25648
0.06914	246.57060
0.14336	295.88473
0.26559	345.19885
0.45309	394.51297
0.72576	443.82709
1.10617	493.14121
1.61955	542.45533
2.29376	591.76945
3.15934	641.08357
4.24947	690.39769
5.60000	739.71181
7.00000	739.71181

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	2	
Depth of top of Layer 2 below pile head	=	11.000	ft
Depth of p-y curve below pile head	=	15.500	ft
Depth of p-y curve below ground surface	=	5.500	ft
Equivalent depth of p-y curve	=	5.500	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	63.945	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	823.846	lb/in

Pcd	=	1500.000	lb/in
Pu	=	823.846	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	3.52261
0.00177	56.36172
0.00896	159.00234
0.02832	212.00311
0.06914	265.00389
0.14336	318.00467
0.26559	371.00545
0.45309	424.00623
0.72576	477.00701
1.10617	530.00779
1.61955	583.00857
2.29376	636.00934
3.15934	689.01012
4.24947	742.01090
5.60000	795.01168
7.00000	795.01168

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	2	
Depth of top of Layer 2 below pile head	=	11.000	ft
Depth of p-y curve below pile head	=	16.500	ft
Depth of p-y curve below ground surface	=	6.500	ft
Equivalent depth of p-y curve	=	6.500	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	62.200	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	881.152	lb/in
Pcd	=	1500.000	lb/in
Pu	=	881.152	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	

Sloping Ground Factor = 1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	4.16308
0.00177	66.60930
0.00896	170.06231
0.02832	226.74975
0.06914	283.43718
0.14336	340.12462
0.26559	396.81205
0.45309	453.49949
0.72576	510.18693
1.10617	566.87436
1.61955	623.56180
2.29376	680.24924
3.15934	736.93667
4.24947	793.62411
5.60000	850.31154
7.00000	850.31154

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	= 3	
Depth of top of Layer 3 below pile head	= 17.000	ft
Depth of p-y curve below pile head	= 17.500	ft
Depth of p-y curve below ground surface	= 7.500	ft
Equiv. depth of p-y curve below ground surface	= 9.258	ft
Ground slope angle	= 0.000	degrees
Pile batter angle	= 0.000	degrees
Effective slope angle	= 0.000	degrees
Pile Diameter	= 20.000	in
Angle of Friction	= 36.000	degrees
Average Effective Unit Weight	= 61.253	pcf
k_py	= 96.574	pci
K active	= 0.260	
K passive	= 3.852	
K0	= 0.400	
Pst	= 1702.170	lb/in
Psd	= 3904.942	lb/in
Ps = Pst (shallow controls)	= 1702.170	lb/in
A (static)	= 0.8800	
B (static)	= 0.5000	
C = Pm/(Ym^(1/n))	= 1659.8267	
n = Pm/(m Ym)	= 1.6447	

m = (Pu-Pm)/(Yu-Ym)	=	1552.3794
Yk = [c/(kx)]^(n/(n-1))	=	0.0146 in
Pk	=	127.296 lb/in
Ym = b/60	=	0.3333 in
Pm = B ps	=	851.085 lb/in
Yu = 3b/80	=	0.7500 in
Pu = A Ps	=	1497.910 lb/in
Maximum Es value	=	8691.692 lb/in/in
p-multiplier	=	0.96500
y-multiplier	=	1.00000

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.01465	122.84061
0.04362	238.50784
0.07259	325.08670
0.10156	398.72990
0.13053	464.45778
0.15950	524.65610
0.18848	580.69061
0.21745	633.43325
0.24642	683.48261
0.27539	731.27155
0.30436	777.12561
0.33333	821.29721
0.54167	1133.39015
0.75000	1445.48309
0.90000	1445.48309
1.05000	1445.48309

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3
Depth of top of Layer 3 below pile head	=	17.000 ft
Depth of p-y curve below pile head	=	18.500 ft
Depth of p-y curve below ground surface	=	8.500 ft
Equiv. depth of p-y curve below ground surface	=	10.258 ft
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Pile Diameter	=	20.000 in

Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	60.824	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	2041.451	lb/in
Psd	=	4394.547	lb/in
Ps = Pst (shallow controls)	=	2041.451	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	1990.6676	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	1861.8035	
Yk = [c/(kx)]^(n/(n-1))	=	0.0169	in
Pk	=	166.676	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	1020.726	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	1796.477	lb/in
Maximum Es value	=	9850.584	lb/in/in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.01692	160.84198
0.04569	294.21821
0.07445	395.93128
0.10321	482.92671
0.13198	560.78225
0.16074	632.20326
0.18951	698.75570
0.21827	761.44645
0.24704	820.97016
0.27580	877.83099
0.30457	932.40917
0.33333	985.00022
0.54167	1359.30030
0.75000	1733.60039
0.90000	1733.60039
1.05000	1733.60039

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	19.500	ft
Depth of p-y curve below ground surface	=	9.500	ft
Equiv. depth of p-y curve below ground surface	=	11.258	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	60.484	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	2412.027	lb/in
Psd	=	4884.152	lb/in
Ps = Pst (shallow controls)	=	2412.027	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	2352.0250	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	2199.7688	
Yk = [c/(kx)]^(n/(n-1))	=	0.0195	in
Pk	=	214.662	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	1206.014	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	2122.584	lb/in
Maximum Es value	=	11009.476	lb/in/in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.01950	207.14856
0.04803	358.36047
0.07656	475.81551
0.10509	576.86876
0.13362	667.57314
0.16215	750.92983

0.19068	828.69738
0.21921	902.01545
0.24774	971.67463
0.27627	1038.25108
0.30480	1102.18069
0.33333	1163.80312
0.54167	1606.04831
0.75000	2048.29349
0.90000	2048.29349
1.05000	2048.29349

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	20.500	ft
Depth of p-y curve below ground surface	=	10.500	ft
Equiv. depth of p-y curve below ground surface	=	12.258	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	60.210	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	2813.854	lb/in
Psd	=	5373.758	lb/in
Ps = Pst (shallow controls)	=	2813.854	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	2743.8558	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	2566.2348	
Yk = [c/(kx)]^(n/(n-1))	=	0.0224	in
Pk	=	272.302	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	1406.927	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	2476.192	lb/in
Maximum Es value	=	12168.368	lb/in/in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.02238	262.77158
0.05065	431.77243
0.07892	565.40855
0.10718	681.09451
0.13545	785.26325
0.16372	881.17971
0.19199	970.78244
0.22026	1055.33857
0.24853	1135.73249
0.27680	1212.61166
0.30506	1286.46765
0.33333	1357.68455
0.54167	1873.60468
0.75000	2389.52481
0.90000	2389.52481
1.05000	2389.52481

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	21.500	ft
Depth of p-y curve below ground surface	=	11.500	ft
Equiv. depth of p-y curve below ground surface	=	13.258	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	59.983	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	3246.903	lb/in
Psd	=	5863.363	lb/in
Ps = Pst (shallow controls)	=	3246.903	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	

C = Pm/(Ym^(1/n))	=	3166.1319	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	2961.1753	
Yk = [c/(kx)]^(n/(n-1))	=	0.0256	in
Pk	=	340.693	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	1623.451	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	2857.274	lb/in
Maximum Es value	=	13327.260	lb/in/in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.02556	328.76908
0.05354	515.35455
0.08152	665.44270
0.10950	796.19988
0.13748	914.33585
0.16546	1023.34014
0.19344	1125.31409
0.22142	1221.64405
0.24940	1313.30404
0.27738	1401.01068
0.30535	1485.31015
0.33333	1566.63057
0.54167	2161.95018
0.75000	2757.26980
0.90000	2757.26980
1.05000	2757.26980

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	22.500	ft
Depth of p-y curve below ground surface	=	12.500	ft
Equiv. depth of p-y curve below ground surface	=	14.258	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees

Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	59.792	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	3711.154	lb/in
Psd	=	6352.968	lb/in
Ps = Pst (shallow controls)	=	3711.154	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	3618.8341	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	3384.5723	
Yk = [c/(kx)]^(n/(n-1))	=	0.0291	in
Pk	=	420.977	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	1855.577	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	3265.815	lb/in
Maximum Es value	=	14486.153	lb/in/in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.02906	406.24267
0.05672	610.06480
0.08438	776.70991
0.11204	922.83595
0.13971	1055.32285
0.16737	1177.84005
0.19503	1292.63037
0.22269	1401.18831
0.25035	1504.57137
0.27801	1603.56179
0.30567	1698.75828
0.33333	1790.63170
0.54167	2471.07175
0.75000	3151.51180
0.90000	3151.51180
1.05000	3151.51180

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	23.500	ft
Depth of p-y curve below ground surface	=	13.500	ft
Equiv. depth of p-y curve below ground surface	=	15.258	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	59.630	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	4206.593	lb/in
Psd	=	6842.573	lb/in
Ps = Pst (shallow controls)	=	4206.593	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	4101.9490	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	3836.4131	
Yk = [c/(kx)]^(n/(n-1))	=	0.0329	in
Pk	=	514.337	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	2103.297	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	3701.802	lb/in
Maximum Es value	=	15645.045	lb/in/in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.03288	496.33530
0.06019	716.91440
0.08750	900.05880
0.11482	1061.70710

```
       0.14213        1208.80366
       0.16945        1345.14922
       0.19676        1473.10338
       0.22408        1594.25514
       0.25139        1709.73746
       0.27870        1820.39328
       0.30602        1926.87069
       0.33333        2029.68129
       0.54167        2800.96017
       0.75000        3572.23906
       0.90000        3572.23906
       1.05000        3572.23906

The above p-y curve was computed using internal default values of k.




-------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 1
-------------------------------------------------------------------------------

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head                              =      20000.0 lbs
Applied moment at pile head                           =          0.0 in-lbs
Axial thrust load on pile head                        =     250000.0 lbs

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
lb/inch    lb/inch    lb/inch
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00     2.3841  -5.35E-06     20000.   -0.01410   625.0000   4.81E+10
0.00       0.00       0.00
    0.6000     2.2826    169378.     20000.   -0.01409   752.0335   4.81E+10
0.00       0.00       0.00
    1.2000     2.1813    338710.     20000.   -0.01405   879.0327   4.81E+10
0.00       0.00       0.00
    1.8000     2.0803    507951.     20000.   -0.01398      1006.   4.81E+10
0.00       0.00       0.00
    2.4000     1.9799    677055.     20000.   -0.01390      1133.   4.81E+10
0.00       0.00       0.00
    3.0000     1.8802    845977.     20000.   -0.01378      1259.   4.81E+10
```

```
0.00       0.00       0.00
    3.6000     1.7814   1014670.     20000.   -0.01364      1386.   4.81E+10
0.00       0.00       0.00
    4.2000     1.6838   1183090.     20000.   -0.01348      1512.   4.81E+10
0.00       0.00       0.00
    4.8000     1.5874   1351191.     20000.   -0.01329      1638.   4.81E+10
0.00       0.00       0.00
    5.4000     1.4924   1518927.     20000.   -0.01307      1764.   4.81E+10
0.00       0.00       0.00
    6.0000     1.3991   1686254.     20000.   -0.01283      1890.   4.81E+10
0.00       0.00       0.00
    6.6000     1.3076   1853127.     20000.   -0.01257      2015.   4.81E+10
0.00       0.00       0.00
    7.2000     1.2181   2019499.     20000.   -0.01228      2140.   4.81E+10
0.00       0.00       0.00
    7.8000     1.1308   2185328.     20000.   -0.01196      2264.   4.81E+10
0.00       0.00       0.00
    8.4000     1.0459   2350566.     20000.   -0.01162      2388.   4.81E+10
0.00       0.00       0.00
    9.0000     0.9634   2515172.     20000.   -0.01126      2511.   4.81E+10
0.00       0.00       0.00
    9.6000     0.8837   2679099.     20000.   -0.01087      2634.   4.81E+10
0.00       0.00       0.00
   10.2000     0.8069   2842303.     18902.   -0.01046      2757.   4.81E+10
-305.1201      2723.       0.00
   10.8000     0.7332   2988924.     16648.   -0.01002      2867.   4.81E+10
-320.8725      3151.       0.00
   11.4000     0.6626   3118105.     14293.   -0.00956      2964.   4.81E+10
-333.3012      3622.       0.00
   12.0000     0.5955   3229167.     11857.   -0.00909      3047.   4.81E+10
-343.4608      4153.       0.00
   12.6000     0.5318   3321553.      9352.   -0.00860      3116.   4.81E+10
-352.3035      4770.       0.00
   13.2000     0.4717   3394780.      6788.   -0.00809      3171.   4.81E+10
-359.7720      5492.       0.00
   13.8000     0.4152   3448442.      4176.   -0.00758      3211.   4.81E+10
-365.8042      6343.       0.00
   14.4000     0.3625   3482210.      1526.   -0.00706      3237.   4.81E+10
-370.3318      7355.       0.00
   15.0000     0.3135   3495841.     -1151.   -0.00654      3247.   4.81E+10
-373.2782      8572.       0.00
   15.6000     0.2684   3489179.     -3843.   -0.00602      3242.   4.81E+10
-374.5563     10049.       0.00
   16.2000     0.2269   3462160.     -6538.   -0.00550      3222.   4.81E+10
-374.0644     11869.       0.00
   16.8000     0.1892   3414815.     -9223.   -0.00498      3186.   4.81E+10
-371.6806     14143.       0.00
   17.4000     0.1552   3347282.    -12383.   -0.00447      3135.   4.81E+10
-506.2578     23485.       0.00
   18.0000     0.1248   3252601.    -15991.   -0.00398      3064.   4.81E+10
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-495.9577     28612.       0.00
   18.6000    0.09790   3131334.    -19490.   -0.00350      2974.   4.81E+10
-475.8336     34993.       0.00
   19.2000    0.07438   2984555.    -22806.   -0.00304      2863.   4.81E+10
-445.3674     43109.       0.00
   19.8000    0.05408   2813883.    -25863.   -0.00261      2735.   4.81E+10
-403.9131     53773.       0.00
   20.4000    0.03682   2621513.    -28579.   -0.00220      2591.   4.81E+10
-350.4074     68529.       0.00
   21.0000    0.02238   2410272.    -30831.   -0.00182      2433.   4.81E+10
-275.2623     88572.       0.00
   21.6000    0.01054   2184112.    -32314.   -0.00148      2263.   4.81E+10
-136.6802     93403.       0.00
   22.2000    0.00105   1950276.    -32858.   -0.00117      2088.   4.81E+10
-14.3473      98234.       0.00
   22.8000   -0.00633   1715172.    -32584.  -8.97E-04      1911.   4.81E+10
90.6047     103065.       0.00
   23.4000   -0.01186   1484301.    -31617.  -6.57E-04      1738.   4.81E+10
177.7413    107897.       0.00
   24.0000   -0.01579   1262245.    -30088.  -4.51E-04      1572.   4.81E+10
247.2375    112728.       0.00
   24.6000   -0.01836   1052665.    -28118.  -2.78E-04      1414.   4.81E+10
299.7809    117559.       0.00
   25.2000   -0.01979    858342.    -25828.  -1.35E-04      1269.   4.81E+10
336.4735    122390.       0.00
   25.8000   -0.02030    681231.    -23325.  -1.95E-05      1136.   4.81E+10
358.7330    127221.       0.00
   26.4000   -0.02008    522532.    -20708.   7.06E-05      1017.   4.81E+10
368.1994    132053.       0.00
   27.0000   -0.01929    382780.    -18063.   1.38E-04   912.0848   4.81E+10
366.6476    136884.       0.00
   27.6000   -0.01808    261932.    -15461.   1.87E-04   821.4486   4.81E+10
355.9099    141715.       0.00
   28.2000   -0.01660    159463.    -12964.   2.18E-04   744.5972   4.81E+10
337.8080    146546.       0.00
   28.8000   -0.01494     74463.    -10617.   2.36E-04   680.8476   4.81E+10
314.0967    151377.       0.00
   29.4000   -0.01320      5727.     -8455.   2.42E-04   629.2949   4.81E+10
286.4187    156208.       0.00
   30.0000   -0.01146    -48164.     -6502.   2.39E-04   661.1229   4.81E+10
256.2705    161040.       0.00
   30.6000   -0.00977    -88756.     -4769.   2.28E-04   691.5673   4.81E+10
224.9785    165871.       0.00
   31.2000   -0.00817   -117662.     -3262.   2.13E-04   713.2465   4.81E+10
193.6854    170702.       0.00
   31.8000   -0.00670   -136495.     -1977.   1.94E-04   727.3714   4.81E+10
163.3438    175533.       0.00
   32.4000   -0.00538   -146824.  -903.6458   1.73E-04   735.1179   4.81E+10
134.7180    180364.       0.00
   33.0000   -0.00421   -150129.   -28.4543   1.50E-04   737.5969   4.81E+10
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108.3908    185196.       0.00
   33.6000   -0.00321   -147775.   666.9429   1.28E-04   735.8313   4.81E+10
84.7751    190027.       0.00
   34.2000   -0.00237   -140986.      1203.   1.06E-04   730.7398   4.81E+10
64.1281    194858.       0.00
   34.8000   -0.00168   -130835.      1601.   8.61E-05   723.1264   4.81E+10
46.5676    199689.       0.00
   35.4000   -0.00113   -118235.      1885.   6.74E-05   713.6760   4.81E+10
32.0887    204520.       0.00
   36.0000  -7.08E-04   -103939.      2074.   5.08E-05   702.9542   4.81E+10
20.5802    209352.       0.00
   36.6000  -3.98E-04    -88548.      2191.   3.64E-05   691.4111   4.81E+10
11.8402    214183.       0.00
   37.2000  -1.84E-04    -72520.      2254.   2.43E-05   679.3898   4.81E+10
5.5895    219014.       0.00
   37.8000  -4.77E-05    -56182.      2279.   1.47E-05   667.1365   4.81E+10
1.4829    223845.       0.00
   38.4000   2.78E-05    -39752.      2179.   7.50E-06   654.8142   4.81E+10
-29.3089   7599375.       0.00
   39.0000   6.04E-05    -24831.      1844.   2.67E-06   643.6234   4.81E+10
-63.7084   7599375.       0.00
   39.6000   6.62E-05    -13206.      1363.  -1.82E-07   634.9045   4.81E+10
-69.8421   7599375.       0.00
   40.2000   5.77E-05     -5198.   892.5468  -1.56E-06   628.8985   4.81E+10
-60.9430   7599375.       0.00
   40.8000   4.37E-05  -347.7477   507.0955  -1.98E-06   625.2608   4.81E+10
-46.1269   7599375.       0.00
   41.4000   2.93E-05      2111.   229.7451  -1.84E-06   626.5835   4.81E+10
-30.9149   7599375.       0.00
   42.0000   1.72E-05      2967.    53.2685  -1.46E-06   627.2254   4.81E+10
-18.1064   7599375.       0.00
   42.6000   8.22E-06      2884.   -43.1461  -1.03E-06   627.1628   4.81E+10
-8.6755   7599375.       0.00
   43.2000   2.39E-06      2350.   -83.4754  -6.33E-07   626.7622   4.81E+10
-2.5271   7599375.       0.00
   43.8000  -8.97E-07      1684.   -89.1653  -3.31E-07   626.2629   4.81E+10
0.9466   7599375.       0.00
   44.4000  -2.37E-06      1067.   -76.7448  -1.25E-07   625.8001   4.81E+10
2.5035   7599375.       0.00
   45.0000  -2.70E-06   579.2263   -57.4865  -1.69E-09   625.4344   4.81E+10
2.8460   7599375.       0.00
   45.6000  -2.40E-06   239.0171   -38.1358   5.96E-08   625.1793   4.81E+10
2.5292   7599375.       0.00
   46.2000  -1.84E-06    29.8564   -22.0457   7.97E-08   625.0224   4.81E+10
1.9403   7599375.       0.00
   46.8000  -1.25E-06   -78.7283   -10.3182   7.61E-08   625.0590   4.81E+10
1.3174   7599375.       0.00
   47.4000  -7.43E-07  -118.9990    -2.7529   6.13E-08   625.0892   4.81E+10
0.7841   7599375.       0.00
   48.0000  -3.66E-07  -118.5899     1.4605   4.35E-08   625.0889   4.81E+10
```

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0.3863   7599375.       0.00
   48.6000  -1.17E-07   -98.1243     3.2955   2.72E-08   625.0736   4.81E+10
0.1235   7599375.       0.00
   49.2000   2.62E-08   -71.2325     3.6403   1.46E-08   625.0534   4.81E+10
-0.02768   7599375.       0.00
   49.8000   9.26E-08   -45.7564     3.1889   5.79E-09   625.0343   4.81E+10
-0.09772   7599375.       0.00
   50.4000   1.10E-07   -25.3339     2.4206   4.66E-10   625.0190   4.81E+10
-0.1157   7599375.       0.00
   51.0000   9.93E-08   -10.9014     1.6269  -2.25E-09   625.0082   4.81E+10
-0.1048   7599375.       0.00
   51.6000   7.72E-08    -1.8989     0.9562  -3.21E-09   625.0014   4.81E+10
-0.08151   7599375.       0.00
   52.2000   5.31E-08     2.8787     0.4609  -3.13E-09   625.0022   4.81E+10
-0.05606   7599375.       0.00
   52.8000   3.21E-08     4.7493     0.1371  -2.56E-09   625.0036   4.81E+10
-0.03389   7599375.       0.00
   53.4000   1.62E-08     4.8621   -0.04651  -1.84E-09   625.0036   4.81E+10
-0.01712   7599375.       0.00
   54.0000   5.57E-09     4.0862    -0.1293  -1.17E-09   625.0031   4.81E+10
-0.00588   7599375.       0.00
   54.6000  -6.62E-10     3.0042    -0.1480  -6.41E-10   625.0023   4.81E+10
6.98E-04   7599375.       0.00
   55.2000  -3.66E-09     1.9576    -0.1316  -2.69E-10   625.0015   4.81E+10
0.00386   7599375.       0.00
   55.8000  -4.54E-09     1.1106    -0.1004  -3.97E-11   625.0008   4.81E+10
0.00479   7599375.       0.00
   56.4000  -4.23E-09     0.5119   -0.06708   8.18E-11   625.0004   4.81E+10
0.00446   7599375.       0.00
   57.0000  -3.36E-09     0.1443   -0.03823   1.31E-10   625.0001   4.81E+10
0.00355   7599375.       0.00
   57.6000  -2.34E-09   -0.03918   -0.01655   1.39E-10   625.0000   4.81E+10
0.00247   7599375.       0.00
   58.2000  -1.36E-09   -0.09451   -0.00247   1.29E-10   625.0001   4.81E+10
0.00144   7599375.       0.00
   58.8000  -4.87E-10   -0.07517    0.00457   1.16E-10   625.0001   4.81E+10
5.14E-04   7599375.       0.00
   59.4000   3.08E-10   -0.02915    0.00525   1.08E-10   625.0000   4.81E+10
-3.25E-04   7599375.       0.00
   60.0000   1.07E-09       0.00       0.00   1.06E-10   625.0000   4.81E+10
-0.00113   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 1:

Pile-head deflection             =     2.38412583 inches
Computed slope at pile head      =    -0.01409889 radians
Maximum bending moment           =       3495841. inch-lbs
```

```
Maximum shear force              =        -32858. lbs
Depth of maximum bending moment  =    15.00000000 feet below pile head
Depth of maximum shear force     =    22.20000000 feet below pile head
Number of iterations             =             18
Number of zero deflection points =              6
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

```
Shear force at pile head                              =      40000.0 lbs
Applied moment at pile head                           =          0.0 in-lbs
Axial thrust load on pile head                        =     250000.0 lbs
```

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	6.1990	1.32E-05	40000.	-0.03395	625.0000	4.81E+10	0.00	0.00	0.00
0.6000	5.9546	349109.	40000.	-0.03392	886.8317	4.81E+10	0.00	0.00	0.00
1.2000	5.7105	698124.	40000.	-0.03384	1149.	4.81E+10	0.00	0.00	0.00
1.8000	5.4672	1046950.	40000.	-0.03371	1410.	4.81E+10	0.00	0.00	0.00
2.4000	5.2250	1395494.	40000.	-0.03353	1672.	4.81E+10	0.00	0.00	0.00
3.0000	4.9844	1743662.	40000.	-0.03330	1933.	4.81E+10	0.00	0.00	0.00
3.6000	4.7456	2091360.	40000.	-0.03301	2194.	4.81E+10	0.00	0.00	0.00
4.2000	4.5090	2438494.	40000.	-0.03267	2454.	4.81E+10	0.00	0.00	0.00
4.8000	4.2751	2784971.	40000.	-0.03228	2714.	4.81E+10	0.00	0.00	0.00
5.4000	4.0442	3130696.	40000.	-0.03184	2973.	4.81E+10	0.00	0.00	0.00
6.0000	3.8167	3475578.	40000.	-0.03134	3232.	4.81E+10	0.00	0.00	0.00
6.6000	3.5929	3819522.	40000.	-0.03079	3490.	4.81E+10			

```
0.00       0.00       0.00
    7.2000     3.3733   4162437.     40000.   -0.03020      3747.   4.81E+10
0.00       0.00       0.00
    7.8000     3.1581   4504229.     40000.   -0.02955      4003.   4.81E+10
0.00       0.00       0.00
    8.4000     2.9478   4844807.     40000.   -0.02885      4259.   4.81E+10
0.00       0.00       0.00
    9.0000     2.7427   5184078.     40000.   -0.02810      4513.   4.81E+10
0.00       0.00       0.00
    9.6000     2.5432   5521952.     40000.   -0.02729      4766.   4.81E+10
0.00       0.00       0.00
   10.2000     2.3497   5858337.     38565.   -0.02644      5019.   4.81E+10
-398.5788      1221.       0.00
   10.8000     2.1624   6172480.     35616.   -0.02554      5254.   4.81E+10
-420.5015      1400.       0.00
   11.4000     1.9819   6463160.     32525.   -0.02459      5472.   4.81E+10
-438.3155      1592.       0.00
   12.0000     1.8083   6729375.     29315.   -0.02361      5672.   4.81E+10
-453.3968      1805.       0.00
   12.6000     1.6419   6970271.     26001.   -0.02258      5853.   4.81E+10
-467.0058      2048.       0.00
   13.2000     1.4831   7185079.     22595.   -0.02152      6014.   4.81E+10
-479.0811      2326.       0.00
   13.8000     1.3321   7373114.     19108.   -0.02043      6155.   4.81E+10
-489.5575      2646.       0.00
   14.4000     1.1889   7533782.     15552.   -0.01931      6275.   4.81E+10
-498.3648      3018.       0.00
   15.0000     1.0539   7666583.     11938.   -0.01817      6375.   4.81E+10
-505.4273      3453.       0.00
   15.6000     0.9272   7771116.      8280.   -0.01702      6453.   4.81E+10
-510.6624      3965.       0.00
   16.2000     0.8089   7847081.      4591.   -0.01585      6510.   4.81E+10
-513.9798      4575.       0.00
   16.8000     0.6990   7894286.   885.9191   -0.01467      6546.   4.81E+10
-515.2799      5308.       0.00
   17.4000     0.5976   7912650.     -5268.   -0.01349      6559.   4.81E+10
-1194.     14387.       0.00
   18.0000     0.5048   7866973.    -13827.   -0.01230      6525.   4.81E+10
-1183.     16875.       0.00
   18.6000     0.4205   7757841.    -22267.   -0.01113      6443.   4.81E+10
-1161.     19889.       0.00
   19.2000     0.3445   7586407.    -30520.   -0.00998      6315.   4.81E+10
-1131.     23642.       0.00
   19.8000     0.2767   7354291.    -38515.   -0.00887      6141.   4.81E+10
-1090.     28357.       0.00
   20.4000     0.2168   7063702.    -46146.   -0.00779      5923.   4.81E+10
-1030.     34199.       0.00
   21.0000     0.1646   6717822.    -53276.   -0.00675      5663.   4.81E+10
-950.7185     41597.       0.00
   21.6000     0.1196   6320847.    -59764.   -0.00578      5366.   4.81E+10
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-851.5387     51282.       0.00
   22.2000    0.08137   5878023.    -65459.   -0.00486      5034.   4.81E+10
-730.5534     64642.       0.00
   22.8000    0.04952   5395742.    -70191.   -0.00402      4672.   4.81E+10
-583.7557     84869.       0.00
   23.4000    0.02350   4881745.    -73560.   -0.00325      4286.   4.81E+10
-352.1057    107897.       0.00
   24.0000    0.00273   4348179.    -74981.   -0.00256      3886.   4.81E+10
-42.7978    112728.       0.00
   24.6000   -0.01334   3811221.    -74351.   -0.00195      3483.   4.81E+10
217.8048    117559.       0.00
   25.2000   -0.02530   3284527.    -72019.   -0.00142      3088.   4.81E+10
430.1063    122390.       0.00
   25.8000   -0.03372   2779244.    -68325.  -9.61E-04      2709.   4.81E+10
595.8693    127221.       0.00
   26.4000   -0.03915   2304101.    -63596.  -5.81E-04      2353.   4.81E+10
717.9580    132053.       0.00
   27.0000   -0.04208   1865556.    -58131.  -2.68E-04      2024.   4.81E+10
800.0808    136884.       0.00
   27.6000   -0.04301   1467984.    -52203.  -1.87E-05      1726.   4.81E+10
846.5448    141715.       0.00
   28.2000   -0.04235   1113902.    -46052.   1.75E-04      1460.   4.81E+10
862.0272    146546.       0.00
   28.8000   -0.04049    804206.    -39884.   3.18E-04      1228.   4.81E+10
851.3697    151377.       0.00
   29.4000   -0.03777    538429.    -33869.   4.19E-04      1029.   4.81E+10
819.4005    156208.       0.00
   30.0000   -0.03446    314984.    -28144.   4.83E-04   861.2381   4.81E+10
770.7850    161040.       0.00
   30.6000   -0.03082    131412.    -22814.   5.16E-04   723.5590   4.81E+10
709.9058    165871.       0.00
   31.2000   -0.02703    -15394.    -17951.   5.25E-04   636.5456   4.81E+10
640.7731    170702.       0.00
   31.8000   -0.02326   -128978.    -13604.   5.14E-04   721.7339   4.81E+10
566.9616    175533.       0.00
   32.4000   -0.01962   -213137.     -9793.   4.89E-04   784.8526   4.81E+10
491.5735    180364.       0.00
   33.0000   -0.01622   -271754.     -6521.   4.52E-04   828.8158   4.81E+10
417.2233    185196.       0.00
   33.6000   -0.01311   -308670.     -3773.   4.09E-04   856.5024   4.81E+10
346.0424    190027.       0.00
   34.2000   -0.01033   -327563.     -1521.   3.61E-04   870.6724   4.81E+10
279.6982    194858.       0.00
   34.8000   -0.00791   -331869.   276.0818   3.12E-04   873.9016   4.81E+10
219.4259    199689.       0.00
   35.4000   -0.00585   -324710.      1664.   2.63E-04   868.5323   4.81E+10
166.0687    204520.       0.00
   36.0000   -0.00413   -308854.      2694.   2.15E-04   856.6407   4.81E+10
120.1225    209352.       0.00
   36.6000   -0.00275   -286688.      3421.   1.70E-04   840.0162   4.81E+10
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81.7836    214183.       0.00
   37.2000   -0.00168   -260205.      3899.   1.30E-04   820.1540   4.81E+10
50.9952    219014.       0.00
   37.8000  -8.84E-04   -231009.      4182.   9.27E-05   798.2565   4.81E+10
27.4919    223845.       0.00
   38.4000  -3.41E-04   -200325.      5577.   6.04E-05   775.2434   4.81E+10
360.1859   7599375.       0.00
   39.0000  -1.43E-05   -150914.      6928.   3.41E-05   738.1858   4.81E+10
15.0752   7599375.       0.00
   39.6000   1.50E-04   -100682.      6413.   1.53E-05   700.5115   4.81E+10
-158.2460   7599375.       0.00
   40.2000   2.06E-04    -58626.      5062.   3.34E-06   668.9694   4.81E+10
-216.9583   7599375.       0.00
   40.8000   1.98E-04    -27801.      3529.  -3.14E-06   645.8509   4.81E+10
-208.9353   7599375.       0.00
   41.4000   1.60E-04     -7800.      2167.  -5.80E-06   630.8501   4.81E+10
-169.2655   7599375.       0.00
   42.0000   1.14E-04      3428.      1123.  -6.13E-06   627.5712   4.81E+10
-120.7166   7599375.       0.00
   42.6000   7.21E-05      8398.   414.8911  -5.25E-06   631.2983   4.81E+10
-76.0702   7599375.       0.00
   43.2000   3.88E-05      9422.    -6.5012  -3.91E-06   632.0662   4.81E+10
-40.9832   7599375.       0.00
   43.8000   1.57E-05      8318.  -213.8763  -2.58E-06   631.2387   4.81E+10
-16.6210   7599375.       0.00
   44.4000   1.64E-06      6351.  -279.9315  -1.48E-06   629.7633   4.81E+10
-1.7277   7599375.       0.00
   45.0000  -5.62E-06      4293.  -264.7814  -6.87E-07   628.2194   4.81E+10
5.9361   7599375.       0.00
   45.6000  -8.26E-06      2541.  -212.0431  -1.75E-07   626.9055   4.81E+10
8.7135   7599375.       0.00
   46.2000  -8.15E-06      1240.  -149.7191   1.08E-07   625.9298   4.81E+10
8.5987   7599375.       0.00
   46.8000  -6.70E-06   384.3329   -93.3018   2.30E-07   625.2882   4.81E+10
7.0727   7599375.       0.00
   47.4000  -4.84E-06  -104.5802   -49.4468   2.51E-07   625.0784   4.81E+10
5.1092   7599375.       0.00
   48.0000  -3.09E-06  -328.6028   -19.3004   2.18E-07   625.2465   4.81E+10
3.2648   7599375.       0.00
   48.6000  -1.70E-06  -383.2912    -1.0875   1.65E-07   625.2875   4.81E+10
1.7944   7599375.       0.00
   49.2000  -7.20E-07  -344.8563     8.1092   1.10E-07   625.2586   4.81E+10
0.7603   7599375.       0.00
   49.8000  -1.13E-07  -266.9157    11.2737   6.44E-08   625.2002   4.81E+10
0.1187   7599375.       0.00
   50.4000   2.07E-07  -182.7476    10.9129   3.08E-08   625.1371   4.81E+10
-0.2190   7599375.       0.00
   51.0000   3.30E-07  -109.8806     8.8696   8.83E-09   625.0824   4.81E+10
-0.3486   7599375.       0.00
   51.6000   3.35E-07   -55.0566     6.3430  -3.52E-09   625.0413   4.81E+10
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-0.3532   7599375.       0.00
   52.2000   2.80E-07   -18.5283     4.0090  -9.03E-09   625.0139   4.81E+10
-0.2951   7599375.       0.00
   52.8000   2.05E-07     2.7055     2.1691  -1.02E-08   625.0020   4.81E+10
-0.2160   7599375.       0.00
   53.4000   1.33E-07    12.7435     0.8882  -9.06E-09   625.0096   4.81E+10
-0.1399   7599375.       0.00
   54.0000   7.42E-08    15.5277     0.1029  -6.94E-09   625.0116   4.81E+10
-0.07827   7599375.       0.00
   54.6000   3.26E-08    14.2499    -0.3026  -4.71E-09   625.0107   4.81E+10
-0.03436   7599375.       0.00
   55.2000   6.32E-09    11.1871    -0.4503  -2.81E-09   625.0084   4.81E+10
-0.00667   7599375.       0.00
   55.8000  -7.85E-09     7.7755    -0.4445  -1.39E-09   625.0058   4.81E+10
0.00829   7599375.       0.00
   56.4000  -1.36E-08     4.7913    -0.3628  -4.45E-10   625.0036   4.81E+10
0.01439   7599375.       0.00
   57.0000  -1.43E-08     2.5520    -0.2569   1.05E-10   625.0019   4.81E+10
0.01504   7599375.       0.00
   57.6000  -1.21E-08     1.0920    -0.1567   3.78E-10   625.0008   4.81E+10
0.01279   7599375.       0.00
   58.2000  -8.81E-09     0.2946   -0.07716   4.82E-10   625.0002   4.81E+10
0.00929   7599375.       0.00
   58.8000  -5.18E-09   -0.02095   -0.02404   5.03E-10   625.0000   4.81E+10
0.00546   7599375.       0.00
   59.4000  -1.57E-09   -0.05336    0.00158   4.97E-10   625.0000   4.81E+10
0.00165   7599375.       0.00
   60.0000   1.98E-09       0.00       0.00   4.93E-10   625.0000   4.81E+10
-0.00209   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 2:

Pile-head deflection             =     6.19900694 inches
Computed slope at pile head      =    -0.03394939 radians
Maximum bending moment           =       7912650. inch-lbs
Maximum shear force              =        -74981. lbs
Depth of maximum bending moment  =    17.40000000 feet below pile head
Depth of maximum shear force     =    24.00000000 feet below pile head
Number of iterations             =             17
Number of zero deflection points =              6



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                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 3
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Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 60000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 250000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	10.7343	-3.46E-05	60000.	-0.05645	625.0000	4.81E+10	0.00	0.00	0.00
0.6000	10.3279	533607.	60000.	-0.05641	1025.	4.81E+10	0.00	0.00	0.00
1.2000	9.9220	1067070.	60000.	-0.05629	1425.	4.81E+10	0.00	0.00	0.00
1.8000	9.5173	1600245.	60000.	-0.05609	1825.	4.81E+10	0.00	0.00	0.00
2.4000	9.1143	2132989.	60000.	-0.05581	2225.	4.81E+10	0.00	0.00	0.00
3.0000	8.7137	2665158.	60000.	-0.05545	2624.	4.81E+10	0.00	0.00	0.00
3.6000	8.3159	3196608.	60000.	-0.05501	3022.	4.81E+10	0.00	0.00	0.00
4.2000	7.9215	3727196.	60000.	-0.05449	3420.	4.81E+10	0.00	0.00	0.00
4.8000	7.5312	4256780.	60000.	-0.05389	3818.	4.81E+10	0.00	0.00	0.00
5.4000	7.1454	4785215.	60000.	-0.05322	4214.	4.81E+10	0.00	0.00	0.00
6.0000	6.7649	5312360.	60000.	-0.05246	4609.	4.81E+10	0.00	0.00	0.00
6.6000	6.3900	5838073.	60000.	-0.05163	5004.	4.81E+10	0.00	0.00	0.00
7.2000	6.0215	6362212.	60000.	-0.05071	5397.	4.81E+10	0.00	0.00	0.00
7.8000	5.6598	6884636.	60000.	-0.04972	5788.	4.81E+10	0.00	0.00	0.00
8.4000	5.3055	7405203.	60000.	-0.04865	6179.	4.81E+10	0.00	0.00	0.00
9.0000	4.9592	7923774.	60000.	-0.04750	6568.	4.81E+10	0.00	0.00	0.00
9.6000	4.6215	8440208.	60000.	-0.04628	6955.	4.81E+10	0.00	0.00	0.00
10.2000	4.2928	8954366.	58332.	-0.04497	7341.	4.81E+10			

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-463.3922   777.2075       0.00
   10.8000     3.9739   9442088.     54901.   -0.04360      7707.   4.81E+10
-489.5921   887.0630       0.00
   11.4000     3.6651   9901884.     51298.   -0.04215      8051.   4.81E+10
-511.1377      1004.       0.00
   12.0000     3.3670   1.03E+07     47552.   -0.04063      8374.   4.81E+10
-529.6280      1133.       0.00
   12.6000     3.0800   1.07E+07     43677.   -0.03905      8675.   4.81E+10
-546.5367      1278.       0.00
   13.2000     2.8046   1.11E+07     39687.   -0.03742      8952.   4.81E+10
-561.7995      1442.       0.00
   13.8000     2.5412   1.14E+07     35594.   -0.03573      9204.   4.81E+10
-575.3484      1630.       0.00
   14.4000     2.2901   1.17E+07     31409.   -0.03399      9432.   4.81E+10
-587.1105      1846.       0.00
   15.0000     2.0517   1.20E+07     27146.   -0.03221      9635.   4.81E+10
-597.0079      2095.       0.00
   15.6000     1.8262   1.23E+07     22819.   -0.03040      9813.   4.81E+10
-604.9570      2385.       0.00
   16.2000     1.6139   1.25E+07     18442.   -0.02855      9964.   4.81E+10
-610.8676      2725.       0.00
   16.8000     1.4151   1.26E+07     14030.   -0.02667     10089.   4.81E+10
-614.6421      3127.       0.00
   17.4000     1.2299   1.27E+07      6712.   -0.02477     10187.   4.81E+10
-1418.      8302.       0.00
   18.0000     1.0585   1.28E+07     -4104.   -0.02286     10228.   4.81E+10
-1586.     10790.       0.00
   18.6000     0.9008   1.28E+07    -16164.   -0.02094     10205.   4.81E+10
-1764.     14098.       0.00
   19.2000     0.7569   1.26E+07    -29538.   -0.01904     10110.   4.81E+10
-1951.     18559.       0.00
   19.8000     0.6267   1.24E+07    -43306.   -0.01716      9937.   4.81E+10
-1873.     21523.       0.00
   20.4000     0.5098   1.21E+07    -56416.   -0.01532      9689.   4.81E+10
-1768.     24972.       0.00
   21.0000     0.4060   1.17E+07    -68736.   -0.01355      9369.   4.81E+10
-1654.     29328.       0.00
   21.6000     0.3148   1.11E+07    -80212.   -0.01184      8983.   4.81E+10
-1534.     35087.       0.00
   22.2000     0.2356   1.05E+07    -90754.   -0.01021      8535.   4.81E+10
-1394.     42613.       0.00
   22.8000     0.1677   9873921.   -100186.   -0.00868      8030.   4.81E+10
-1226.     52610.       0.00
   23.4000     0.1105   9135115.   -108287.   -0.00726      7476.   4.81E+10
-1025.     66759.       0.00
   24.0000    0.06319   8340716.   -114799.   -0.00595      6881.   4.81E+10
-783.9904     89327.       0.00
   24.6000    0.02484   7503426.   -119082.   -0.00476      6253.   4.81E+10
-405.6504    117559.       0.00
   25.2000   -0.00541   6643083.   -120211.   -0.00370      5607.   4.81E+10
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91.9759    122390.       0.00
   25.8000   -0.02850   5785718.   -118067.   -0.00277      4964.   4.81E+10
503.6092    127221.       0.00
   26.4000   -0.04535   4952900.   -113260.   -0.00197      4340.   4.81E+10
831.7862    132053.       0.00
   27.0000   -0.05686   4161866.   -106599.   -0.00129      3746.   4.81E+10
1018.    128958.       0.00
   27.6000   -0.06388   3422506.    -98757.  -7.19E-04      3192.   4.81E+10
1160.    130728.       0.00
   28.2000   -0.06721   2742350.    -90020.  -2.57E-04      2682.   4.81E+10
1267.    135743.       0.00
   28.8000   -0.06758   2127144.    -80618.   1.08E-04      2220.   4.81E+10
1345.    143244.       0.00
   29.4000   -0.06566   1581065.    -70755.   3.85E-04      1811.   4.81E+10
1395.    152979.       0.00
   30.0000   -0.06203   1106881.    -60738.   5.87E-04      1455.   4.81E+10
1387.    161040.       0.00
   30.6000   -0.05721    704324.    -50998.   7.22E-04      1153.   4.81E+10
1318.    165871.       0.00
   31.2000   -0.05163    369902.    -41847.   8.03E-04   902.4268   4.81E+10
1224.    170702.       0.00
   31.8000   -0.04565     98836.    -33434.   8.38E-04   699.1272   4.81E+10
1113.    175533.       0.00
   32.4000   -0.03956   -114563.    -25860.   8.37E-04   710.9222   4.81E+10
991.0746    180364.       0.00
   33.0000   -0.03360   -276554.    -19180.   8.07E-04   832.4154   4.81E+10
864.2413    185196.       0.00
   33.6000   -0.02794   -393668.    -13415.   7.57E-04   920.2510   4.81E+10
737.2776    190027.       0.00
   34.2000   -0.02269   -472455.     -8550.   6.92E-04   979.3416   4.81E+10
614.2022    194858.       0.00
   34.8000   -0.01796   -519275.     -4545.   6.18E-04      1014.   4.81E+10
498.2264    199689.       0.00
   35.4000   -0.01379   -540127.     -1341.   5.39E-04      1030.   4.81E+10
391.8102    204520.       0.00
   36.0000   -0.01021   -540522.      1138.   4.58E-04      1030.   4.81E+10
296.7350    209352.       0.00
   36.6000   -0.00720   -525388.      2977.   3.78E-04      1019.   4.81E+10
214.1860    214183.       0.00
   37.2000   -0.00476   -499009.      4270.   3.01E-04   999.2570   4.81E+10
144.8403    219014.       0.00
   37.8000   -0.00286   -464987.      5111.   2.29E-04   973.7406   4.81E+10
88.9539    223845.       0.00
   38.4000   -0.00146   -426229.      7533.   1.62E-04   944.6716   4.81E+10
583.7896   2874350.       0.00
   39.0000  -5.23E-04   -357092.     11260.   1.04E-04   892.8187   4.81E+10
451.4990   6213729.       0.00
   39.6000   3.09E-05   -264452.     12768.   5.71E-05   823.3393   4.81E+10
-32.6064   7599375.       0.00
   40.2000   3.00E-04   -173432.     11512.   2.43E-05   755.0742   4.81E+10
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-316.3622   7599375.       0.00
   40.8000   3.82E-04    -98766.      8924.   3.96E-06   699.0742   4.81E+10
-402.6956   7599375.       0.00
   41.4000   3.57E-04    -44948.      6118.  -6.80E-06   658.7109   4.81E+10
-376.6017   7599375.       0.00
   42.0000   2.84E-04    -10641.      3685.  -1.10E-05   632.9809   4.81E+10
-299.3424   7599375.       0.00
   42.6000   1.99E-04      8150.      1851.  -1.12E-05   631.1128   4.81E+10
-209.9699   7599375.       0.00
   43.2000   1.23E-04     16055.   627.6781  -9.34E-06   637.0413   4.81E+10
-129.8753   7599375.       0.00
   43.8000   6.45E-05     17223.   -84.8765  -6.84E-06   637.9170   4.81E+10
-68.0565   7599375.       0.00
   44.4000   2.45E-05     14857.  -422.9138  -4.44E-06   636.1431   4.81E+10
-25.8427   7599375.       0.00
   45.0000   5.13E-07     11149.  -517.8971  -2.49E-06   633.3615   4.81E+10
-0.5415   7599375.       0.00
   45.6000  -1.14E-05      7409.  -476.3984  -1.10E-06   630.5565   4.81E+10
12.0689   7599375.       0.00
   46.2000  -1.54E-05      4292.  -374.4655  -2.28E-07   628.2194   4.81E+10
16.2458   7599375.       0.00
   46.8000  -1.47E-05      2017.  -260.0495   2.44E-07   626.5129   4.81E+10
15.5364   7599375.       0.00
   47.4000  -1.19E-05   546.8837  -159.0074   4.36E-07   625.4102   4.81E+10
12.5308   7599375.       0.00
   48.0000  -8.43E-06  -274.0307   -81.8471   4.57E-07   625.2055   4.81E+10
8.9026   7599375.       0.00
   48.6000  -5.29E-06  -633.3588   -29.6865   3.89E-07   625.4750   4.81E+10
5.5864   7599375.       0.00
   49.2000  -2.83E-06  -702.9171     1.1926   2.89E-07   625.5272   4.81E+10
2.9911   7599375.       0.00
   49.8000  -1.13E-06  -617.2254    16.2664   1.90E-07   625.4629   4.81E+10
1.1960   7599375.       0.00
   50.4000  -9.81E-08  -469.3656    20.9447   1.09E-07   625.3520   4.81E+10
0.1035   7599375.       0.00
   51.0000   4.31E-07  -316.0133    19.6803   4.98E-08   625.2370   4.81E+10
-0.4547   7599375.       0.00
   51.6000   6.19E-07  -186.1483    15.6918   1.22E-08   625.1396   4.81E+10
-0.6532   7599375.       0.00
   52.2000   6.06E-07   -90.0955    11.0369  -8.51E-09   625.0676   4.81E+10
-0.6398   7599375.       0.00
   52.8000   4.96E-07   -27.1861     6.8477  -1.73E-08   625.0204   4.81E+10
-0.5238   7599375.       0.00
   53.4000   3.57E-07     8.5742     3.6049  -1.87E-08   625.0064   4.81E+10
-0.3769   7599375.       0.00
   54.0000   2.27E-07    24.7915     1.3846  -1.62E-08   625.0186   4.81E+10
-0.2398   7599375.       0.00
   54.6000   1.24E-07    28.5709    0.05020  -1.22E-08   625.0214   4.81E+10
-0.1309   7599375.       0.00
   55.2000   5.16E-08    25.5582    -0.6170  -8.14E-09   625.0192   4.81E+10
```

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-0.05447   7599375.       0.00
   55.8000   6.79E-09    19.7148    -0.8389  -4.75E-09   625.0148   4.81E+10
-0.00716   7599375.       0.00
   56.4000  -1.68E-08    13.4949    -0.8010  -2.26E-09   625.0101   4.81E+10
0.01770   7599375.       0.00
   57.0000  -2.58E-08     8.1891    -0.6393  -6.37E-10   625.0061   4.81E+10
0.02721   7599375.       0.00
   57.6000  -2.60E-08     4.2916    -0.4427   2.97E-10   625.0032   4.81E+10
0.02739   7599375.       0.00
   58.2000  -2.15E-08     1.8130    -0.2624   7.55E-10   625.0014   4.81E+10
0.02269   7599375.       0.00
   58.8000  -1.51E-08     0.5101    -0.1234   9.29E-10   625.0004   4.81E+10
0.01592   7599375.       0.00
   59.4000  -8.13E-09    0.03272   -0.03518   9.69E-10   625.0000   4.81E+10
0.00858   7599375.       0.00
   60.0000  -1.13E-09       0.00       0.00   9.72E-10   625.0000   4.81E+10
0.00119   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 3:

Pile-head deflection             =    10.73430048 inches
Computed slope at pile head      =    -0.05644828 radians
Maximum bending moment           =      12804265. inch-lbs
Maximum shear force              =       -120211. lbs
Depth of maximum bending moment  =    18.00000000 feet below pile head
Depth of maximum shear force     =    25.20000000 feet below pile head
Number of iterations             =             21
Number of zero deflection points =              6



--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 4
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Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head                              =      80000.0 lbs
Applied moment at pile head                           =          0.0 in-lbs
Axial thrust load on pile head                        =     250000.0 lbs

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
```

lb/inch	lb/inch	lb/inch				
0.00	16.4584	4.28E-05	80000.	-0.08314	625.0000	4.81E+10
0.00	0.00	0.00				
0.6000	15.8598	725655.	80000.	-0.08309	1169.	4.81E+10
0.00	0.00	0.00				
1.2000	15.2619	1451115.	80000.	-0.08292	1713.	4.81E+10
0.00	0.00	0.00				
1.8000	14.6657	2176183.	80000.	-0.08265	2257.	4.81E+10
0.00	0.00	0.00				
2.4000	14.0717	2900664.	80000.	-0.08227	2800.	4.81E+10
0.00	0.00	0.00				
3.0000	13.4809	3624364.	80000.	-0.08178	3343.	4.81E+10
0.00	0.00	0.00				
3.6000	12.8941	4347086.	80000.	-0.08119	3885.	4.81E+10
0.00	0.00	0.00				
4.2000	12.3119	5068636.	80000.	-0.08048	4426.	4.81E+10
0.00	0.00	0.00				
4.8000	11.7351	5788819.	80000.	-0.07967	4967.	4.81E+10
0.00	0.00	0.00				
5.4000	11.1646	6507442.	80000.	-0.07875	5506.	4.81E+10
0.00	0.00	0.00				
6.0000	10.6012	7224310.	80000.	-0.07772	6043.	4.81E+10
0.00	0.00	0.00				
6.6000	10.0455	7939230.	80000.	-0.07658	6579.	4.81E+10
0.00	0.00	0.00				
7.2000	9.4984	8652009.	80000.	-0.07534	7114.	4.81E+10
0.00	0.00	0.00				
7.8000	8.9606	9362456.	80000.	-0.07399	7647.	4.81E+10
0.00	0.00	0.00				
8.4000	8.4329	1.01E+07	80000.	-0.07254	8178.	4.81E+10
0.00	0.00	0.00				
9.0000	7.9161	1.08E+07	80000.	-0.07097	8707.	4.81E+10
0.00	0.00	0.00				
9.6000	7.4108	1.15E+07	80000.	-0.06931	9233.	4.81E+10
0.00	0.00	0.00				
10.2000	6.9180	1.22E+07	78217.	-0.06754	9758.	4.81E+10
-495.2329	515.4191	0.00				
10.8000	6.4383	1.28E+07	74514.	-0.06566	10261.	4.81E+10
-533.4309	596.5380	0.00				
11.4000	5.9725	1.35E+07	70548.	-0.06369	10740.	4.81E+10
-568.2826	685.0813	0.00				
12.0000	5.5212	1.41E+07	66344.	-0.06162	11194.	4.81E+10
-599.3349	781.5733	0.00				
12.6000	5.0851	1.47E+07	61956.	-0.05947	11623.	4.81E+10
-619.5220	877.1836	0.00				
13.2000	4.6648	1.52E+07	57429.	-0.05723	12024.	4.81E+10
-638.0026	984.7385	0.00				
13.8000	4.2609	1.57E+07	52776.	-0.05492	12398.	4.81E+10

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-654.7090      1106.       0.00
   14.4000     3.8740   1.62E+07     48008.   -0.05253     12742.   4.81E+10
-669.5696      1244.       0.00
   15.0000     3.5044   1.66E+07     43141.   -0.05008     13058.   4.81E+10
-682.5079      1402.       0.00
   15.6000     3.1528   1.70E+07     38187.   -0.04757     13343.   4.81E+10
-693.4423      1584.       0.00
   16.2000     2.8194   1.73E+07     33163.   -0.04501     13599.   4.81E+10
-702.2854      1793.       0.00
   16.8000     2.5047   1.76E+07     28082.   -0.04239     13823.   4.81E+10
-708.9436      2038.       0.00
   17.4000     2.2090   1.79E+07     20425.   -0.03974     14016.   4.81E+10
-1418.       4622.       0.00
   18.0000     1.9325   1.80E+07      9609.   -0.03705     14151.   4.81E+10
-1586.       5910.       0.00
   18.6000     1.6755   1.81E+07     -2451.   -0.03434     14220.   4.81E+10
-1764.       7580.       0.00
   19.2000     1.4380   1.81E+07    -15825.   -0.03163     14217.   4.81E+10
-1951.       9769.       0.00
   19.8000     1.2201   1.80E+07    -30581.   -0.02892     14135.   4.81E+10
-2148.      12675.       0.00
   20.4000     1.0216   1.78E+07    -46789.   -0.02624     13965.   4.81E+10
-2354.      16593.       0.00
   21.0000     0.8422   1.74E+07    -64516.   -0.02360     13700.   4.81E+10
-2570.      21971.       0.00
   21.6000     0.6817   1.69E+07    -83120.   -0.02102     13332.   4.81E+10
-2598.      27435.       0.00
   22.2000     0.5395   1.63E+07   -101002.   -0.01853     12859.   4.81E+10
-2369.      31621.       0.00
   22.8000     0.4148   1.56E+07   -117226.   -0.01615     12291.   4.81E+10
-2137.      37097.       0.00
   23.4000     0.3070   1.47E+07   -131786.   -0.01388     11637.   4.81E+10
-1907.      44733.       0.00
   24.0000     0.2149   1.37E+07   -144592.   -0.01176     10905.   4.81E+10
-1650.      55283.       0.00
   24.6000     0.1377   1.26E+07   -155390.   -0.00978     10107.   4.81E+10
-1349.      70571.       0.00
   25.2000    0.07404   1.15E+07   -163810.   -0.00797      9254.   4.81E+10
-989.7535     96248.       0.00
   25.8000    0.02283   1.03E+07   -168825.   -0.00634      8359.   4.81E+10
-403.3553    127221.       0.00
   26.4000   -0.01726   9096621.   -169138.   -0.00489      7447.   4.81E+10
316.6091    132053.       0.00
   27.0000   -0.04754   7894607.   -164744.   -0.00361      6546.   4.81E+10
903.8567    136884.       0.00
   27.6000   -0.06931   6737320.   -157102.   -0.00252      5678.   4.81E+10
1219.    126616.       0.00
   28.2000   -0.08381   5641399.   -147498.   -0.00159      4856.   4.81E+10
1449.    124494.       0.00
   28.8000   -0.09222   4619078.   -136434.  -8.23E-04      4089.   4.81E+10
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1624.    126811.       0.00
   29.4000   -0.09565   3679714.   -124273.  -2.01E-04      3385.   4.81E+10
1754.    132001.       0.00
   30.0000   -0.09512   2830268.   -111326.   2.86E-04      2748.   4.81E+10
1843.    139491.       0.00
   30.6000   -0.09153   2075589.    -97868.   6.54E-04      2182.   4.81E+10
1896.    149112.       0.00
   31.2000   -0.08570   1418620.    -84148.   9.15E-04      1689.   4.81E+10
1915.    160905.       0.00
   31.8000   -0.07835    860558.    -70396.    0.00109      1270.   4.81E+10
1905.    175053.       0.00
   32.4000   -0.07006    401013.    -57220.    0.00118   925.7598   4.81E+10
1755.    180364.       0.00
   33.0000   -0.06135     32346.    -45221.    0.00121   649.2593   4.81E+10
1578.    185196.       0.00
   33.6000   -0.05259   -254530.    -34543.    0.00120   815.8977   4.81E+10
1388.    190027.       0.00
   34.2000   -0.04412   -469378.    -25247.    0.00114   977.0337   4.81E+10
1194.    194858.       0.00
   34.8000   -0.03615   -622204.    -17340.    0.00106      1092.   4.81E+10
1002.    199689.       0.00
   35.4000   -0.02885   -722894.    -10781.   9.60E-04      1167.   4.81E+10
819.3805    204520.       0.00
   36.0000   -0.02233   -780911.     -5495.   8.47E-04      1211.   4.81E+10
649.1415    209352.       0.00
   36.6000   -0.01665   -805067.     -1375.   7.28E-04      1229.   4.81E+10
495.2057    214183.       0.00
   37.2000   -0.01184   -803334.      1704.   6.08E-04      1228.   4.81E+10
360.0612    219014.       0.00
   37.8000   -0.00789   -782719.      3884.   4.89E-04      1212.   4.81E+10
245.3975    223845.       0.00
   38.4000   -0.00479   -749171.      7595.   3.74E-04      1187.   4.81E+10
785.5267   1179824.       0.00
   39.0000   -0.00250   -674700.     12826.   2.68E-04      1131.   4.81E+10
667.6918   1921211.       0.00
   39.6000  -9.38E-04   -565433.     17111.   1.75E-04      1049.   4.81E+10
522.5123   4008887.       0.00
   40.2000   1.56E-05   -428927.     18933.   1.00E-04   946.6955   4.81E+10
-16.4344   7599375.       0.00
   40.8000   5.07E-04   -293158.     17261.   4.63E-05   844.8684   4.81E+10
-447.9536   6361730.       0.00
   41.4000   6.82E-04   -180531.     13912.   1.08E-05   760.3984   4.81E+10
-482.4678   5091884.       0.00
   42.0000   6.63E-04    -92867.     10451.  -9.66E-06   694.6502   4.81E+10
-478.9897   5203653.       0.00
   42.6000   5.43E-04    -30008.      7086.  -1.89E-05   647.5064   4.81E+10
-455.7372   6041503.       0.00
   43.2000   3.91E-04      9233.      3959.  -2.04E-05   631.9245   4.81E+10
-412.8366   7599375.       0.00
   43.8000   2.49E-04     27070.      1526.  -1.77E-05   645.3024   4.81E+10
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-262.9284   7599375.       0.00
   44.4000   1.36E-04     31269.    61.5651  -1.33E-05   648.4521   4.81E+10
-143.8346   7599375.       0.00
   45.0000   5.72E-05     28004.  -673.4474  -8.89E-06   646.0032   4.81E+10
-60.3356   7599375.       0.00
   45.6000   8.26E-06     21604.  -922.0280  -5.17E-06   641.2029   4.81E+10
-8.7146   7599375.       0.00
   46.2000  -1.74E-05     14746.  -887.4694  -2.45E-06   636.0593   4.81E+10
18.3142   7599375.       0.00
   46.8000  -2.71E-05      8833.  -718.7312  -6.86E-07   631.6248   4.81E+10
28.5575   7599375.       0.00
   47.4000  -2.72E-05      4399.  -512.4389   3.05E-07   628.2989   4.81E+10
28.7459   7599375.       0.00
   48.0000  -2.27E-05      1453.  -322.8153   7.43E-07   626.0897   4.81E+10
23.9273   7599375.       0.00
   48.6000  -1.65E-05  -252.7141  -173.8391   8.33E-07   625.1895   4.81E+10
17.4549   7599375.       0.00
   49.2000  -1.07E-05     -1053.   -70.4288   7.35E-07   625.7900   4.81E+10
11.2702   7599375.       0.00
   49.8000  -5.95E-06     -1270.    -7.2319   5.61E-07   625.9522   4.81E+10
6.2845   7599375.       0.00
   50.4000  -2.60E-06     -1160.    25.2708   3.79E-07   625.8697   4.81E+10
2.7440   7599375.       0.00
   51.0000  -4.96E-07  -907.0003    37.0337   2.24E-07   625.6803   4.81E+10
0.5235   7599375.       0.00
   51.6000   6.30E-07  -627.0711    36.5254   1.09E-07   625.4703   4.81E+10
-0.6646   7599375.       0.00
   52.2000   1.08E-06  -381.4278    30.0326   3.38E-08   625.2861   4.81E+10
-1.1389   7599375.       0.00
   52.8000   1.12E-06  -194.7239    21.6879  -9.31E-09   625.1460   4.81E+10
-1.1790   7599375.       0.00
   53.4000   9.45E-07   -69.0883    13.8525  -2.91E-08   625.0518   4.81E+10
-0.9975   7599375.       0.00
   54.0000   6.99E-07     4.8572     7.6075  -3.39E-08   625.0036   4.81E+10
-0.7373   7599375.       0.00
   54.6000   4.57E-07    40.5815     3.2160  -3.05E-08   625.0304   4.81E+10
-0.4826   7599375.       0.00
   55.2000   2.60E-07    51.2774     0.4919  -2.36E-08   625.0385   4.81E+10
-0.2741   7599375.       0.00
   55.8000   1.17E-07    47.7498    -0.9413  -1.62E-08   625.0358   4.81E+10
-0.1240   7599375.       0.00
   56.4000   2.68E-08    37.7813    -1.4893  -9.77E-09   625.0283   4.81E+10
-0.02824   7599375.       0.00
   57.0000  -2.32E-08    26.3386    -1.5028  -4.97E-09   625.0198   4.81E+10
0.02451   7599375.       0.00
   57.6000  -4.48E-08    16.1591    -1.2444  -1.79E-09   625.0121   4.81E+10
0.04727   7599375.       0.00
   58.2000  -4.89E-08     8.4259    -0.8883   5.58E-11   625.0063   4.81E+10
0.05164   7599375.       0.00
   58.8000  -4.40E-08     3.3677    -0.5352   9.39E-10   625.0025   4.81E+10
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0.04643   7599375.       0.00
   59.4000  -3.54E-08     0.7153    -0.2336   1.24E-09   625.0005   4.81E+10
0.03737   7599375.       0.00
   60.0000  -2.61E-08       0.00       0.00   1.30E-09   625.0000   4.81E+10
0.02750   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 4:

Pile-head deflection             =    16.45839296 inches
Computed slope at pile head      =    -0.08314173 radians
Maximum bending moment           =      18127049. inch-lbs
Maximum shear force              =       -169138. lbs
Depth of maximum bending moment  =    18.60000000 feet below pile head
Depth of maximum shear force     =    26.40000000 feet below pile head
Number of iterations             =             26
Number of zero deflection points =              5



--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 5
--------------------------------------------------------------------------------

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head                              =     100000.0 lbs
Applied moment at pile head                           =          0.0 in-lbs
Axial thrust load on pile head                        =     250000.0 lbs

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
lb/inch    lb/inch    lb/inch
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    23.7471   9.88E-06    100000.    -0.1152   625.0000   4.81E+10
0.00       0.00       0.00
    0.6000    22.9178    927342.    100000.    -0.1151      1321.   4.81E+10
0.00       0.00       0.00
    1.2000    22.0894   1854433.    100000.    -0.1149      2016.   4.81E+10
0.00       0.00       0.00
    1.8000    21.2630   2781025.    100000.    -0.1146      2711.   4.81E+10
0.00       0.00       0.00
    2.4000    20.4397   3706866.    100000.    -0.1141      3405.   4.81E+10
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```
0.00       0.00       0.00
    3.0000    19.6203   4631708.    100000.    -0.1135      4099.   4.81E+10
0.00       0.00       0.00
    3.6000    18.8059   5555302.    100000.    -0.1127      4791.   4.81E+10
0.00       0.00       0.00
    4.2000    17.9976   6477397.    100000.    -0.1118      5483.   4.81E+10
0.00       0.00       0.00
    4.8000    17.1962   7397746.    100000.    -0.1108      6173.   4.81E+10
0.00       0.00       0.00
    5.4000    16.4027   8316101.    100000.    -0.1096      6862.   4.81E+10
0.00       0.00       0.00
    6.0000    15.6183   9232213.    100000.    -0.1083      7549.   4.81E+10
0.00       0.00       0.00
    6.6000    14.8438   1.01E+07    100000.    -0.1068      8234.   4.81E+10
0.00       0.00       0.00
    7.2000    14.0802   1.11E+07    100000.    -0.1052      8918.   4.81E+10
0.00       0.00       0.00
    7.8000    13.3286   1.20E+07    100000.    -0.1035      9598.   4.81E+10
0.00       0.00       0.00
    8.4000    12.5899   1.29E+07    100000.    -0.1016     10277.   4.81E+10
0.00       0.00       0.00
    9.0000    11.8651   1.38E+07    100000.   -0.09964     10953.   4.81E+10
0.00       0.00       0.00
    9.6000    11.1551   1.47E+07    100000.   -0.09751     11626.   4.81E+10
0.00       0.00       0.00
   10.2000    10.4609   1.56E+07     98217.   -0.09525     12296.   4.81E+10
-495.2329   340.8575       0.00
   10.8000     9.7835   1.64E+07     94514.   -0.09285     12944.   4.81E+10
-533.4308   392.5688       0.00
   11.4000     9.1238   1.73E+07     90548.   -0.09033     13568.   4.81E+10
-568.2825   448.4552       0.00
   12.0000     8.4828   1.81E+07     86337.   -0.08768     14166.   4.81E+10
-601.4625   510.5083       0.00
   12.6000     7.8612   1.88E+07     81887.   -0.08492     14737.   4.81E+10
-634.6424   581.2638       0.00
   13.2000     7.2599   1.95E+07     77198.   -0.08205     15279.   4.81E+10
-667.8224   662.3128       0.00
   13.8000     6.6797   2.02E+07     72270.   -0.07907     15792.   4.81E+10
-701.0023   755.6086       0.00
   14.4000     6.1213   2.09E+07     67103.   -0.07599     16273.   4.81E+10
-734.1823   863.5664       0.00
   15.0000     5.5853   2.15E+07     61700.   -0.07282     16722.   4.81E+10
-766.8596   988.5491       0.00
   15.6000     5.0726   2.20E+07     56127.   -0.06957     17136.   4.81E+10
-780.9882      1109.       0.00
   16.2000     4.5836   2.25E+07     50461.   -0.06623     17516.   4.81E+10
-793.0035      1246.       0.00
   16.8000     4.1188   2.30E+07     44716.   -0.06282     17860.   4.81E+10
-802.8169      1403.       0.00
   17.4000     3.6789   2.34E+07     36721.   -0.05935     18169.   4.81E+10
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-1418.      2775.       0.00
   18.0000     3.2642   2.37E+07     25905.   -0.05582     18417.   4.81E+10
-1586.      3499.       0.00
   18.6000     2.8750   2.40E+07     13845.   -0.05225     18599.   4.81E+10
-1764.      4417.       0.00
   19.2000     2.5117   2.41E+07   470.7559   -0.04865     18708.   4.81E+10
-1951.      5593.       0.00
   19.8000     2.1745   2.41E+07    -14286.   -0.04504     18735.   4.81E+10
-2148.      7112.       0.00
   20.4000     1.8632   2.41E+07    -30493.   -0.04143     18675.   4.81E+10
-2354.      9097.       0.00
   21.0000     1.5779   2.39E+07    -48221.   -0.03784     18518.   4.81E+10
-2570.     11727.       0.00
   21.6000     1.3184   2.35E+07    -67537.   -0.03429     18256.   4.81E+10
-2796.     15267.       0.00
   22.2000     1.0842   2.30E+07    -88510.   -0.03080     17881.   4.81E+10
-3030.     20125.       0.00
   22.8000     0.8748   2.23E+07   -111210.   -0.02741     17384.   4.81E+10
-3275.     26955.       0.00
   23.4000     0.6895   2.15E+07   -134907.   -0.02412     16754.   4.81E+10
-3308.     34540.       0.00
   24.0000     0.5274   2.05E+07   -157319.   -0.02098     15992.   4.81E+10
-2918.     39831.       0.00
   24.6000     0.3874   1.93E+07   -176959.   -0.01800     15112.   4.81E+10
-2538.     47166.       0.00
   25.2000     0.2683   1.80E+07   -193889.   -0.01520     14129.   4.81E+10
-2165.     58108.       0.00
   25.8000     0.1685   1.66E+07   -207952.   -0.01261     13059.   4.81E+10
-1741.     74410.       0.00
   26.4000    0.08664   1.51E+07   -218677.   -0.01024     11917.   4.81E+10
-1238.    102857.       0.00
   27.0000    0.02101   1.35E+07   -224571.   -0.00811     10725.   4.81E+10
-399.4626    136884.       0.00
   27.6000   -0.03009   1.19E+07   -223876.   -0.00621      9514.   4.81E+10
592.3010    141715.       0.00
   28.2000   -0.06841   1.03E+07   -217133.   -0.00455      8324.   4.81E+10
1281.    134801.       0.00
   28.8000   -0.09567   8741489.   -206543.   -0.00313      7181.   4.81E+10
1661.    125002.       0.00
   29.4000    -0.1135   7301889.   -193559.   -0.00193      6101.   4.81E+10
1946.    123444.       0.00
   30.0000    -0.1234   5961188.   -178781.  -9.35E-04      5096.   4.81E+10
2159.    125945.       0.00
   30.6000    -0.1270   4730814.   -162681.  -1.34E-04      4173.   4.81E+10
2313.    131164.       0.00
   31.2000    -0.1254   3619060.   -145666.   4.91E-04      3339.   4.81E+10
2414.    138615.       0.00
   31.8000    -0.1199   2631457.   -128095.   9.59E-04      2599.   4.81E+10
2467.    148166.       0.00
   32.4000    -0.1116   1771039.   -110295.    0.00129      1953.   4.81E+10
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2477.    159886.       0.00
   33.0000    -0.1013   1038575.    -92561.    0.00150      1404.   4.81E+10
2449.    173987.       0.00
   33.6000   -0.08998    432766.    -75197.    0.00161   949.5749   4.81E+10
2375.    190027.       0.00
   34.2000   -0.07815    -50055.    -59034.    0.00164   662.5413   4.81E+10
2115.    194858.       0.00
   34.8000   -0.06639   -423215.    -44791.    0.00160   942.4110   4.81E+10
1841.    199689.       0.00
   35.4000   -0.05508   -700811.    -32530.    0.00152      1151.   4.81E+10
1564.    204520.       0.00
   36.0000   -0.04452   -897116.    -22238.    0.00140      1298.   4.81E+10
1295.    209352.       0.00
   36.6000   -0.03493  -1026071.    -13836.    0.00125      1395.   4.81E+10
1039.    214183.       0.00
   37.2000   -0.02645  -1100875.     -7198.    0.00110      1451.   4.81E+10
804.6860    219014.       0.00
   37.8000   -0.01916  -1133669.     -2157.   9.28E-04      1475.   4.81E+10
595.6893    223845.       0.00
   38.4000   -0.01309  -1135275.      3623.   7.58E-04      1476.   4.81E+10
1010.    555425.       0.00
   39.0000   -0.00824  -1084230.     10496.   5.92E-04      1438.   4.81E+10
899.5359    785673.       0.00
   39.6000   -0.00457   -986259.     16528.   4.37E-04      1365.   4.81E+10
776.0465   1223589.       0.00
   40.2000   -0.00195   -847793.     21582.   2.99E-04      1261.   4.81E+10
627.5992   2313423.       0.00
   40.8000  -2.54E-04   -676564.     24807.   1.85E-04      1132.   4.81E+10
268.4609   7599375.       0.00
   41.4000   7.15E-04   -491234.     24016.   9.78E-05   993.4258   4.81E+10
-488.1419   4916387.       0.00
   42.0000    0.00115   -331078.     20278.   3.62E-05   873.3087   4.81E+10
-550.2632   3432254.       0.00
   42.6000    0.00124   -199358.     16282.  -3.49E-06   774.5188   4.81E+10
-559.8275   3259342.       0.00
   43.2000    0.00110    -96606.     12308.  -2.57E-05   697.4546   4.81E+10
-544.1718   3548833.       0.00
   43.8000   8.67E-04    -22038.      8504.  -3.45E-05   641.5284   4.81E+10
-512.2956   4253366.       0.00
   44.4000   6.07E-04     25979.      4973.  -3.42E-05   644.4843   4.81E+10
-468.5075   5560907.       0.00
   45.0000   3.74E-04     49701.      1866.  -2.86E-05   662.2761   4.81E+10
-394.7655   7599375.       0.00
   45.6000   1.95E-04     52946.  -296.6937  -2.09E-05   664.7094   4.81E+10
-205.8585   7599375.       0.00
   46.2000   7.32E-05     45504.     -1316.  -1.35E-05   659.1282   4.81E+10
-77.2212   7599375.       0.00
   46.8000   3.62E-07     34047.     -1595.  -7.56E-06   650.5355   4.81E+10
-0.3826   7599375.       0.00
   47.4000  -3.57E-05     22561.     -1461.  -3.32E-06   641.9210   4.81E+10
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37.6991   7599375.       0.00
   48.0000  -4.75E-05     13024.     -1145.  -6.56E-07   634.7677   4.81E+10
50.0987   7599375.       0.00
   48.6000  -4.52E-05      6079.  -792.7644   7.74E-07   629.5595   4.81E+10
47.6732   7599375.       0.00
   49.2000  -3.63E-05      1605.  -483.1622   1.35E-06   626.2037   4.81E+10
38.3274   7599375.       0.00
   49.8000  -2.57E-05  -883.0182  -247.4267   1.40E-06   625.6623   4.81E+10
27.1547   7599375.       0.00
   50.4000  -1.61E-05     -1963.   -88.5162   1.19E-06   626.4723   4.81E+10
16.9871   7599375.       0.00
   51.0000  -8.58E-06     -2162.     5.2323   8.82E-07   626.6215   4.81E+10
9.0541   7599375.       0.00
   51.6000  -3.39E-06     -1891.    50.7229   5.78E-07   626.4182   4.81E+10
3.5821   7599375.       0.00
   52.2000  -2.49E-07     -1434.    64.5640   3.29E-07   626.0752   4.81E+10
0.2626   7599375.       0.00
   52.8000   1.35E-06  -962.3438    60.3792   1.50E-07   625.7218   4.81E+10
-1.4250   7599375.       0.00
   53.4000   1.91E-06  -564.6913    47.9870   3.56E-08   625.4235   4.81E+10
-2.0172   7599375.       0.00
   54.0000   1.86E-06  -271.4594    33.6452  -2.70E-08   625.2036   4.81E+10
-1.9666   7599375.       0.00
   54.6000   1.52E-06   -80.1028    20.7804  -5.33E-08   625.0601   4.81E+10
-1.6070   7599375.       0.00
   55.2000   1.10E-06    27.9705    10.8332  -5.72E-08   625.0210   4.81E+10
-1.1561   7599375.       0.00
   55.8000   6.98E-07    76.1015     4.0173  -4.94E-08   625.0571   4.81E+10
-0.7372   7599375.       0.00
   56.4000   3.84E-07    85.9971   -0.09390  -3.73E-08   625.0645   4.81E+10
-0.4048   7599375.       0.00
   57.0000   1.61E-07    74.8835    -2.1646  -2.52E-08   625.0562   4.81E+10
-0.1704   7599375.       0.00
   57.6000   2.00E-08    54.9182    -2.8540  -1.55E-08   625.0412   4.81E+10
-0.02115   7599375.       0.00
   58.2000  -6.21E-08    33.8415    -2.6942  -8.87E-09   625.0254   4.81E+10
0.06555   7599375.       0.00
   58.8000  -1.08E-07    16.1539    -2.0488  -5.13E-09   625.0121   4.81E+10
0.1137   7599375.       0.00
   59.4000  -1.36E-07     4.3576    -1.1227  -3.59E-09   625.0033   4.81E+10
0.1435   7599375.       0.00
   60.0000  -1.59E-07       0.00       0.00  -3.27E-09   625.0000   4.81E+10
0.1683   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 5:

Pile-head deflection             =    23.74714252 inches
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Computed slope at pile head      =    -0.11518975 radians
Maximum bending moment           =      24147317. inch-lbs
Maximum shear force              =       -224571. lbs
Depth of maximum bending moment  =    19.80000000 feet below pile head
Depth of maximum shear force     =    27.00000000 feet below pile head
Number of iterations             =             31
Number of zero deflection points =              5
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Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 6

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 3.503000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 250000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. p	Distrib. Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	3.5030	0.00	26295.	-0.02004	625.0000	4.81E+10	0.00	0.00	0.00
0.6000	3.3587	225394.	26295.	-0.02002	794.0456	4.81E+10	0.00	0.00	0.00
1.2000	3.2147	450727.	26295.	-0.01997	963.0455	4.81E+10	0.00	0.00	0.00
1.8000	3.0711	675939.	26295.	-0.01989	1132.	4.81E+10	0.00	0.00	0.00
2.4000	2.9283	900969.	26295.	-0.01977	1301.	4.81E+10	0.00	0.00	0.00
3.0000	2.7865	1125755.	26295.	-0.01962	1469.	4.81E+10	0.00	0.00	0.00
3.6000	2.6458	1350238.	26295.	-0.01943	1638.	4.81E+10	0.00	0.00	0.00
4.2000	2.5066	1574357.	26295.	-0.01921	1806.	4.81E+10	0.00	0.00	0.00
4.8000	2.3692	1798052.	26295.	-0.01896	1974.	4.81E+10	0.00	0.00	0.00
5.4000	2.2336	2021262.	26295.	-0.01867	2141.	4.81E+10	0.00	0.00	0.00
6.0000	2.1003	2243926.	26295.	-0.01835	2308.	4.81E+10	0.00	0.00	0.00

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    6.6000     1.9693   2465986.     26295.   -0.01800      2474.   4.81E+10
0.00       0.00       0.00
    7.2000     1.8410   2687381.     26295.   -0.01762      2641.   4.81E+10
0.00       0.00       0.00
    7.8000     1.7156   2908051.     26295.   -0.01720      2806.   4.81E+10
0.00       0.00       0.00
    8.4000     1.5934   3127937.     26295.   -0.01674      2971.   4.81E+10
0.00       0.00       0.00
    9.0000     1.4745   3346980.     26295.   -0.01626      3135.   4.81E+10
0.00       0.00       0.00
    9.6000     1.3593   3565120.     26295.   -0.01574      3299.   4.81E+10
0.00       0.00       0.00
   10.2000     1.2478   3782299.     25070.   -0.01519      3462.   4.81E+10
-340.2537      1963.       0.00
   10.8000     1.1405   3980820.     22555.   -0.01461      3611.   4.81E+10
-358.3485      2262.       0.00
   11.4000     1.0374   4159690.     19923.   -0.01400      3745.   4.81E+10
-372.8293      2587.       0.00
   12.0000     0.9389   4318112.     17195.   -0.01337      3864.   4.81E+10
-384.8718      2951.       0.00
   12.6000     0.8450   4455417.     14386.   -0.01271      3967.   4.81E+10
-395.5445      3370.       0.00
   13.2000     0.7559   4571016.     11504.   -0.01203      4053.   4.81E+10
-404.7894      3856.       0.00
   13.8000     0.6717   4664399.      8562.   -0.01134      4123.   4.81E+10
-412.5439      4422.       0.00
   14.4000     0.5926   4735137.      5569.   -0.01064      4176.   4.81E+10
-418.7401      5088.       0.00
   15.0000     0.5185   4782891.      2538.   -0.00992      4212.   4.81E+10
-423.3032      5878.       0.00
   15.6000     0.4497   4807412.  -519.9635   -0.00921      4231.   4.81E+10
-426.1501      6824.       0.00
   16.2000     0.3860   4808544.     -3592.   -0.00849      4231.   4.81E+10
-427.1869      7969.       0.00
   16.8000     0.3275   4786235.     -6665.   -0.00777      4215.   4.81E+10
-426.3054      9373.       0.00
   17.4000     0.2741   4740536.    -10775.   -0.00705      4180.   4.81E+10
-715.4385     18791.       0.00
   18.0000     0.2259   4656470.    -15911.   -0.00635      4117.   4.81E+10
-711.4137     22675.       0.00
   18.6000     0.1827   4534269.    -20976.   -0.00566      4026.   4.81E+10
-695.3030     27402.       0.00
   19.2000     0.1444   4374801.    -25878.   -0.00499      3906.   4.81E+10
-666.5505     33241.       0.00
   19.8000     0.1108   4179600.    -30527.   -0.00435      3760.   4.81E+10
-624.6245     40598.       0.00
   20.4000    0.08169   3950891.    -34823.   -0.00374      3588.   4.81E+10
-568.8774     50142.       0.00
   21.0000    0.05686   3691626.    -38665.   -0.00317      3394.   4.81E+10
-498.2490     63094.       0.00
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   21.6000    0.03601   3405536.    -41936.   -0.00264      3179.   4.81E+10
-410.5397     82086.       0.00
   22.2000    0.01883   3097246.    -44340.   -0.00215      2948.   4.81E+10
-256.9755     98234.       0.00
   22.8000    0.00500   2774799.    -45522.   -0.00171      2706.   4.81E+10
-71.5768    103065.       0.00
   23.4000   -0.00584   2447894.    -45465.   -0.00132      2461.   4.81E+10
87.5414    107897.       0.00
   24.0000   -0.01404   2124866.    -44358.  -9.80E-04      2219.   4.81E+10
219.8751    112728.       0.00
   24.6000   -0.01995   1812664.    -42394.  -6.85E-04      1984.   4.81E+10
325.7981    117559.       0.00
   25.2000   -0.02391   1516863.    -39758.  -4.36E-04      1763.   4.81E+10
406.4208    122390.       0.00
   25.8000   -0.02623   1241722.    -36626.  -2.29E-04      1556.   4.81E+10
463.4451    127221.       0.00
   26.4000   -0.02721    990270.    -33161.  -6.20E-05      1368.   4.81E+10
499.0201    132053.       0.00
   27.0000   -0.02712    764421.    -29509.   6.95E-05      1198.   4.81E+10
515.6058    136884.       0.00
   27.6000   -0.02621    565095.    -25795.   1.69E-04      1049.   4.81E+10
515.8466    141715.       0.00
   28.2000   -0.02469    392358.    -22130.   2.41E-04   919.2685   4.81E+10
502.4585    146546.       0.00
   28.8000   -0.02274    245563.    -18599.   2.89E-04   809.1720   4.81E+10
478.1313    151377.       0.00
   29.4000   -0.02053    123487.    -15275.   3.16E-04   717.6155   4.81E+10
445.4482    156208.       0.00
   30.0000   -0.01819     24471.    -12206.   3.27E-04   643.3531   4.81E+10
406.8207    161040.       0.00
   30.6000   -0.01582    -53463.     -9430.   3.25E-04   665.0970   4.81E+10
364.4410    165871.       0.00
   31.2000   -0.01351   -112489.     -6965.   3.13E-04   709.3669   4.81E+10
320.2486    170702.       0.00
   31.8000   -0.01132   -154884.     -4819.   2.93E-04   741.1628   4.81E+10
275.9117    175533.       0.00
   32.4000   -0.00929   -182933.     -2987.   2.67E-04   762.1999   4.81E+10
232.8198    180364.       0.00
   33.0000   -0.00747   -198864.     -1458.   2.39E-04   774.1480   4.81E+10
192.0873    185196.       0.00
   33.6000   -0.00586   -204783.  -209.7407   2.08E-04   778.5875   4.81E+10
154.5648    190027.       0.00
   34.2000   -0.00447   -202635.   781.7775   1.78E-04   776.9761   4.81E+10
120.8569    194858.       0.00
   34.8000   -0.00329   -194166.      1546.   1.48E-04   770.6248   4.81E+10
91.3438    199689.       0.00
   35.4000   -0.00233   -180910.      2113.   1.20E-04   760.6828   4.81E+10
66.2061    204520.       0.00
   36.0000   -0.00156   -164174.      2515.   9.43E-05   748.1302   4.81E+10
45.4495    209352.       0.00
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```
   36.6000  -9.73E-04   -145036.      2783.   7.12E-05   733.7772   4.81E+10
28.9300    214183.       0.00
   37.2000  -5.38E-04   -124360.      2946.   5.10E-05   718.2702   4.81E+10
16.3760    219014.       0.00
   37.8000  -2.38E-04   -102802.      3031.   3.40E-05   702.1013   4.81E+10
7.4091    223845.       0.00
   38.4000  -4.92E-05    -80831.      3245.   2.02E-05   685.6235   4.81E+10
51.8766   7599375.       0.00
   39.0000   5.28E-05    -56150.      3231.   9.96E-06   667.1124   4.81E+10
-55.7694   7599375.       0.00
   39.6000   9.43E-05    -34344.      2672.   3.18E-06   650.7583   4.81E+10
-99.4987   7599375.       0.00
   40.2000   9.87E-05    -17688.      1939.  -7.15E-07   638.2658   4.81E+10
-104.1328   7599375.       0.00
   40.8000   8.40E-05     -6424.      1245.  -2.52E-06   629.8183   4.81E+10
-88.6326   7599375.       0.00
   41.4000   6.24E-05   245.8715   688.7282  -2.98E-06   625.1844   4.81E+10
-65.8193   7599375.       0.00
   42.0000   4.10E-05      3504.   295.9496  -2.70E-06   627.6280   4.81E+10
-43.2859   7599375.       0.00
   42.6000   2.34E-05      4517.    51.0520  -2.10E-06   628.3880   4.81E+10
-24.7412   7599375.       0.00
   43.2000   1.07E-05      4247.   -78.8354  -1.45E-06   628.1850   4.81E+10
-11.3386   7599375.       0.00
   43.8000   2.62E-06      3387.  -129.6274  -8.74E-07   627.5404   4.81E+10
-2.7702   7599375.       0.00
   44.4000  -1.84E-06      2383.  -132.6079  -4.42E-07   626.7874   4.81E+10
1.9424   7599375.       0.00
   45.0000  -3.73E-06      1479.  -111.4240  -1.52E-07   626.1095   4.81E+10
3.9421   7599375.       0.00
   45.6000  -4.03E-06   779.2858   -81.9044   1.68E-08   625.5845   4.81E+10
4.2578   7599375.       0.00
   46.2000  -3.49E-06   299.8023   -53.3045   9.76E-08   625.2249   4.81E+10
3.6866   7599375.       0.00
   46.8000  -2.63E-06    11.3488   -30.0466   1.21E-07   625.0085   4.81E+10
2.7740   7599375.       0.00
   47.4000  -1.75E-06  -133.3040   -13.4056   1.12E-07   625.1000   4.81E+10
1.8485   7599375.       0.00
   48.0000  -1.02E-06  -182.0943    -2.8818   8.82E-08   625.1366   4.81E+10
1.0748   7599375.       0.00
   48.6000  -4.82E-07  -175.1194     2.8173   6.14E-08   625.1313   4.81E+10
0.5083   7599375.       0.00
   49.2000  -1.34E-07  -141.7462     5.1556   3.77E-08   625.1063   4.81E+10
0.1412   7599375.       0.00
   49.8000   6.12E-08  -101.0149     5.4315   1.95E-08   625.0758   4.81E+10
-0.06456   7599375.       0.00
   50.4000   1.47E-07   -63.6030     4.6399   7.18E-09   625.0477   4.81E+10
-0.1553   7599375.       0.00
   51.0000   1.65E-07   -34.2263     3.4554  -1.46E-10   625.0257   4.81E+10
-0.1737   7599375.       0.00
```

```
   51.6000   1.45E-07   -13.8450     2.2789  -3.75E-09   625.0104   4.81E+10
-0.1531   7599375.       0.00
   52.2000   1.11E-07    -1.3972     1.3073  -4.89E-09   625.0010   4.81E+10
-0.1168   7599375.       0.00
   52.8000   7.47E-08     4.9980     0.6032  -4.62E-09   625.0037   4.81E+10
-0.07882   7599375.       0.00
   53.4000   4.41E-08     7.3057     0.1518  -3.70E-09   625.0055   4.81E+10
-0.04657   7599375.       0.00
   54.0000   2.14E-08     7.1973   -0.09733  -2.61E-09   625.0054   4.81E+10
-0.02264   7599375.       0.00
   54.6000   6.53E-09     5.9135    -0.2036  -1.63E-09   625.0044   4.81E+10
-0.00689   7599375.       0.00
   55.2000  -2.00E-09     4.2708    -0.2208  -8.66E-10   625.0032   4.81E+10
0.00212   7599375.       0.00
   55.8000  -5.94E-09     2.7365    -0.1907  -3.41E-10   625.0021   4.81E+10
0.00626   7599375.       0.00
   56.4000  -6.91E-09     1.5263    -0.1418  -2.17E-11   625.0011   4.81E+10
0.00730   7599375.       0.00
   57.0000  -6.25E-09     0.6940   -0.09184   1.45E-10   625.0005   4.81E+10
0.00659   7599375.       0.00
   57.6000  -4.83E-09     0.2033   -0.04974   2.12E-10   625.0002   4.81E+10
0.00510   7599375.       0.00
   58.2000  -3.20E-09   -0.02297   -0.01922   2.25E-10   625.0000   4.81E+10
0.00338   7599375.       0.00
   58.8000  -1.59E-09   -0.07431   -0.00104   2.18E-10   625.0001   4.81E+10
0.00168   7599375.       0.00
   59.4000  -5.81E-11   -0.03875    0.00521   2.10E-10   625.0000   4.81E+10
6.13E-05   7599375.       0.00
   60.0000   1.43E-09       0.00       0.00   2.07E-10   625.0000   4.81E+10
-0.00151   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 6:

Pile-head deflection             =     3.50300000 inches
Computed slope at pile head      =    -0.02003896 radians
Maximum bending moment           =       4808544. inch-lbs
Maximum shear force              =        -45522. lbs
Depth of maximum bending moment  =    16.20000000 feet below pile head
Depth of maximum shear force     =    22.80000000 feet below pile head
Number of iterations             =             11
Number of zero deflection points =              6


--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------
```

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Load 1	Load Type 2	Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	20000.	M, in-lb	0.00	250000.	2.3841	-0.01410	-32858.	3495841.
2	V, lb	40000.	M, in-lb	0.00	250000.	6.1990	-0.03395	-74981.	7912650.
3	V, lb	60000.	M, in-lb	0.00	250000.	10.7343	-0.05645	-120211.	1.28E+07
4	V, lb	80000.	M, in-lb	0.00	250000.	16.4584	-0.08314	-169138.	1.81E+07
5	V, lb	100000.	M, in-lb	0.00	250000.	23.7471	-0.1152	-224571.	2.41E+07
6	y, in	3.5030	M, in-lb	0.00	250000.	3.5030	-0.02004	-45522.	4808544.

Maximum pile-head deflection = 23.7471425156 inches
Maximum pile-head rotation = -0.1151897506 radians = -6.599887 deg.

The analysis ended normally.

```
================================================================================

                    LPile for Windows, Version 2018-10.007

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Users\keith.coogler\Documents\COOGLERK\2021_10\Bagshaw\Lpile\Lpile\P-y-Springs\

Name of input data file:
LPILE_BS_20 PSC - Trans.lp10

Name of output report file:
LPILE_BS_20 PSC - Trans.lp10

Name of plot output file:
LPILE_BS_20 PSC - Trans.lp10

Name of runtime message file:
LPILE_BS_20 PSC - Trans.lp10



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------
```

Date: October 7, 2021 Time: 8:27:08

Problem Title

Project Name: I-95 over Bagshaw Swamp

Job Number: EN175299

Client: ICE

Engineer: Terracon (J. Cerceo)

Description: 20-inch Sq PSC

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves

```
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - p-y curves computed and reported at user-specified depths
 - Print using wide report formats



--------------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Number of pile sections defined                        =            1
Total length of pile                                   =       60.000 ft
Depth of ground surface below top of pile              =      10.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           20.0000
  2            60.000           20.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is an elastic pile
   Cross-sectional shape                               =     rectangular
   Length of section                                   =    60.000000 ft
   Width of top of section                             =    20.000000 in
   Width of bottom of section                          =    20.000000 in
```

```
   Top Section Depth                                    =    20.000000 in
   Bottom Section Depth                                 =    20.000000 in
   Top Area                                             =   400.000000 sq. in
   Bottom Area                                          =   400.000000 sq. in
   Moment of Inertia at Top                             =       13333. in^4
   Moment of Inertia at Bottom                          =       13333. in^4
   Elastic Modulus                                      =     3605000. psi



-------------------------------------------------------------------------------
                      Ground Slope and Pile Batter Angles
-------------------------------------------------------------------------------

Ground Slope Angle                                      =        0.000 degrees
                                                        =        0.000 radians

Pile Batter Angle                                       =        0.000 degrees
                                                        =        0.000 radians


-------------------------------------------------------------------------------
                      Soil and Rock Layering Information
-------------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer            =    10.000000 ft
   Distance from top of pile to bottom of layer         =    11.000000 ft
   Effective unit weight at top of layer                =   115.000000 pcf
   Effective unit weight at bottom of layer             =   115.000000 pcf
   Undrained cohesion at top of layer                   =        1200. psf
   Undrained cohesion at bottom of layer                =        1200. psf
   Epsilon-50 at top of layer                           =       0.0000
   Epsilon-50 at bottom of layer                        =       0.0000
   Subgrade k at top of layer                           =       0.0000 pci
   Subgrade k at bottom of layer                        =       0.0000 pci

   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer            =    11.000000 ft
   Distance from top of pile to bottom of layer         =    17.000000 ft
   Effective unit weight at top of layer                =    52.600000 pcf
   Effective unit weight at bottom of layer             =    52.600000 pcf
```

```
   Undrained cohesion at top of layer                  =        1200. psf
   Undrained cohesion at bottom of layer               =        1200. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer           =    17.000000 ft
   Distance from top of pile to bottom of layer        =    38.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Friction angle at top of layer                      =    36.000000 deg.
   Friction angle at bottom of layer                   =    36.000000 deg.
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is stiff clay without free water

   Distance from top of pile to top of layer           =    38.000000 ft
   Distance from top of pile to bottom of layer        =    80.000000 ft
   Effective unit weight at top of layer               =    52.600000 pcf
   Effective unit weight at bottom of layer            =    52.600000 pcf
   Undrained cohesion at top of layer                  =        3500. psf
   Undrained cohesion at bottom of layer               =        3500. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 20.000 ft below the pile tip)



--------------------------------------------------------------------------------
                        Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Undrained    Angle of
 E50
Layer           Name             Depth       Unit Wt.    Cohesion     Friction
 or           kpy
 Num.     (p-y Curve Type)        ft           pcf          psf          deg.
 krm          pci
```

1	Stiff Clay w/o Free Water, using k	10.0000	115.0000	1200.	-- default	default	default
		11.0000	115.0000	1200.	-- default	default	default
2	Stiff Clay w/o Free Water, using k	11.0000	52.6000	1200.	-- default	default	default
		17.0000	52.6000	1200.	-- default	default	default
3	Sand (Reese, et al.)	17.0000	57.6000	-- default	36.0000 -- default		
		38.0000	57.6000	-- default	36.0000 -- default		
4	Stiff Clay w/o Free Water	38.0000	52.6000	3500.	-- default	--	
		80.0000	52.6000	3500.	-- default	--	

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	10.000	0.6830	1.0000
2	70.000	0.6830	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 5

Load	Load	Condition	Condition	Axial Thrust

Compute Top y
 No.   Type   1   2   Force, lbs
vs. Pile Length
-----   ----   --------------------   ----------------------   ----------------
----
   1   2   V =   20000. lbs   S =   0.0000 in/in   50000.
    No
   2   2   V =   40000. lbs   S =   0.0000 in/in   50000.
    No
   3   2   V =   60000. lbs   S =   0.0000 in/in   50000.
    No
   4   2   V =   80000. lbs   S =   0.0000 in/in   50000.
    No
   5   2   V =   100000. lbs   S =   0.0000 in/in   50000.
    No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Specified Depths for Output of p-y Curves

Lateral load-transfer (p-y) curves are computed and output at 13 depths.
(Note that load-transfer values are computeded at the specified depths and
may differ from values computed at nodal points)

Depth No.	Depth Below Pile Head ft	Depth Below Ground Surface ft
1	10.500	0.500
2	12.000	2.000
3	14.000	4.000
4	17.000	7.000
5	21.000	11.000
6	25.500	15.500
7	30.500	20.500
8	35.500	25.500
9	40.500	30.500
10	45.500	35.500
11	50.500	40.500

12	55.500	45.500
13	59.500	49.500

Depth of ground surface below top of pile = 10.0000 ft

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

---

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	10.0000	0.00	N.A.	No	0.00	6396.
2	11.0000	1.0000	Yes	No	6396.	53128.
3	17.0000	8.7582	No	No	59524.	1557858.
4	38.0000	37.1217	No	No	1617382.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

---

p-y Curves Reported for Specified Depths

---

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	1	
Depth of top of Layer 1 below pile head	=	10.000	ft
Depth of p-y curve below pile head	=	10.500	ft
Depth of p-y curve below ground surface	=	0.500	ft
Equivalent depth of p-y curve	=	0.500	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	115.000	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	532.986	lb/in
Pcd	=	1500.000	lb/in
Pu	=	532.986	lb/in
y50	=	0.350	in
p-multiplier	=	0.68300	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	0.22665
0.00177	3.62648
0.00896	18.35904
0.02832	58.02363
0.06914	121.34317
0.14336	145.61181
0.26559	169.88044
0.45309	194.14907
0.72576	218.41771
1.10617	242.68634
1.61955	266.95498
2.29376	291.22361
3.15934	315.49225
4.24947	339.76088
5.60000	364.02951
7.00000	364.02951

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

with Option of Defining Initial k

Soil Layer Number	=	2
Depth of top of Layer 2 below pile head	=	11.000 ft
Depth of p-y curve below pile head	=	12.000 ft
Depth of p-y curve below ground surface	=	2.000 ft
Equivalent depth of p-y curve	=	2.000 ft
Pile diameter	=	20.000 in
Undrained cohesion	=	1200.000 psf
Average eff. unit weight	=	83.800 pcf
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
k_py	=	500. pci
Epsilon_50	=	0.00700
Pct	=	623.277 lb/in
Pcd	=	1500.000 lb/in
Pu	=	623.277 lb/in
y50	=	0.350 in
p-multiplier	=	0.68300
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	0.90662
0.00177	14.50591
0.00896	73.43616
0.02832	113.51948
0.06914	141.89935
0.14336	170.27923
0.26559	198.65910
0.45309	227.03897
0.72576	255.41884
1.10617	283.79871
1.61955	312.17858
2.29376	340.55845
3.15934	368.93832
4.24947	397.31819
5.60000	425.69806
7.00000	425.69806

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	2
Depth of top of Layer 2 below pile head	=	11.000 ft
Depth of p-y curve below pile head	=	14.000 ft

Depth of p-y curve below ground surface	=	4.000 ft
Equivalent depth of p-y curve	=	4.000 ft
Pile diameter	=	20.000 in
Undrained cohesion	=	1200.000 psf
Average eff. unit weight	=	68.200 pcf
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
k_py	=	500. pci
Epsilon_50	=	0.00700
Pct	=	737.888 lb/in
Pcd	=	1500.000 lb/in
Pu	=	737.888 lb/in
y50	=	0.350 in
p-multiplier	=	0.68300
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	1.81324
0.00177	29.01182
0.00896	100.79550
0.02832	134.39399
0.06914	167.99249
0.14336	201.59099
0.26559	235.18949
0.45309	268.78799
0.72576	302.38649
1.10617	335.98498
1.61955	369.58348
2.29376	403.18198
3.15934	436.78048
4.24947	470.37898
5.60000	503.97748
7.00000	503.97748

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3
Depth of top of Layer 3 below pile head	=	17.000 ft
Depth of p-y curve below pile head	=	17.000 ft
Depth of p-y curve below ground surface	=	7.000 ft
Equiv. depth of p-y curve below ground surface	=	8.758 ft
Ground slope angle	=	0.000 degrees

Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	61.514	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	1544.286	lb/in
Psd	=	3660.139	lb/in
Ps = Pst (shallow controls)	=	1544.286	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	1505.8703	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	1408.3892	
Yk = [c/(kx)]^(n/(n-1))	=	0.0136	in
Pk	=	110.521	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	772.143	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	1358.972	lb/in
Maximum Es value	=	8112.245	lb/in/in
p-multiplier	=	0.68300	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.01362	75.48559
0.04269	151.15997
0.07175	207.28062
0.10082	254.89297
0.12988	297.33486
0.15895	336.17752
0.18801	372.31585
0.21708	406.31933
0.24614	438.57806
0.27520	469.37364
0.30427	498.91760
0.33333	527.37380
0.54167	727.77585
0.75000	928.17789
0.90000	928.17789
1.05000	928.17789

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	21.000	ft
Depth of p-y curve below ground surface	=	11.000	ft
Equiv. depth of p-y curve below ground surface	=	12.758	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	60.091	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	3026.477	lb/in
Psd	=	5618.560	lb/in
Ps = Pst (shallow controls)	=	3026.477	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	2951.1896	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	2760.1470	
Yk = [c/(kx)]^(n/(n-1))	=	0.0239	in
Pk	=	305.084	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	1513.239	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	2663.300	lb/in
Maximum Es value	=	12747.814	lb/in/in
p-multiplier	=	0.68300	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.02393	208.37209
0.05206	334.23376
0.08019	434.62323

0.10831	521.80338
0.13644	600.43458
0.16457	672.91090
0.19270	740.66368
0.22082	804.63284
0.24895	865.47648
0.27708	923.67760
0.30521	979.60357
0.33333	1033.54190
0.54167	1426.28782
0.75000	1819.03374
0.90000	1819.03374
1.05000	1819.03374

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	25.500	ft
Depth of p-y curve below ground surface	=	15.500	ft
Equiv. depth of p-y curve below ground surface	=	17.258	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	59.368	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	5291.000	lb/in
Psd	=	7821.784	lb/in
Ps = Pst (shallow controls)	=	5291.000	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	5159.3801	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	4825.3924	
Yk = [c/(kx)]^(n/(n-1))	=	0.0415	in
Pk	=	745.229	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	2645.500	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	4656.080	lb/in
Maximum Es value	=	17962.829	lb/in/in

p-multiplier = 0.68300
y-multiplier = 1.00000

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.04149	508.99172
0.06802	687.47437
0.09455	839.88740
0.12108	976.18004
0.14761	1101.14938
0.17414	1217.56319
0.20068	1327.19740
0.22721	1431.27544
0.25374	1530.68429
0.28027	1626.09235
0.30680	1718.01876
0.33333	1806.87666
0.54167	2493.48979
0.75000	3180.10292
0.90000	3180.10292
1.05000	3180.10292

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number = 3
Depth of top of Layer 3 below pile head = 17.000 ft
Depth of p-y curve below pile head = 30.500 ft
Depth of p-y curve below ground surface = 20.500 ft
Equiv. depth of p-y curve below ground surface = 22.258 ft
Ground slope angle = 0.000 degrees
Pile batter angle = 0.000 degrees
Effective slope angle = 0.000 degrees
Pile Diameter = 20.000 in
Angle of Friction = 36.000 degrees
Average Effective Unit Weight = 58.937 pcf
k_py = 96.574 pci
K active = 0.260
K passive = 3.852
K0 = 0.400
Pst = 8547.353 lb/in
Psd = 10269.810 lb/in

Ps = Pst (shallow controls)	=	8547.353	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	8334.7272	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	7795.1863	
Yk = [c/(kx)]^(n/(n-1))	=	0.0691	in
Pk	=	1641.813	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	4273.677	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	7521.671	lb/in
Maximum Es value	=	23757.290	lb/in/in
p-multiplier	=	0.68300	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.06911	1121.35820
0.09313	1344.35397
0.11715	1545.62675
0.14117	1731.22742
0.16519	1904.78457
0.18921	2068.68564
0.21323	2224.60469
0.23725	2373.77158
0.26127	2517.12259
0.28529	2655.39089
0.30931	2789.16389
0.33333	2918.92120
0.54167	4028.11125
0.75000	5137.30131
0.90000	5137.30131
1.05000	5137.30131

The above p-y curve was computed using internal default values of k.

p-y Curve in Sand for Static Loading Conditions Computed Using Reese Criteria

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	35.500	ft
Depth of p-y curve below ground surface	=	25.500	ft

Equiv. depth of p-y curve below ground surface	=	27.258	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile Diameter	=	20.000	in
Angle of Friction	=	36.000	degrees
Average Effective Unit Weight	=	58.675	pcf
k_py	=	96.574	pci
K active	=	0.260	
K passive	=	3.852	
K0	=	0.400	
Pst	=	12582.499	lb/in
Psd	=	12717.837	lb/in
Ps = Pst (shallow controls)	=	12582.499	lb/in
A (static)	=	0.8800	
B (static)	=	0.5000	
C = Pm/(Ym^(1/n))	=	12269.4935	
n = Pm/(m Ym)	=	1.6447	
m = (Pu-Pm)/(Yu-Ym)	=	11475.2392	
Yk = [c/(kx)]^(n/(n-1))	=	0.1062	in
Pk	=	3138.444	lb/in
Ym = b/60	=	0.3333	in
Pm = B ps	=	6291.250	lb/in
Yu = 3b/80	=	0.7500	in
Pu = A Ps	=	11072.599	lb/in
Maximum Es value	=	29551.751	lb/in/in
p-multiplier	=	0.68300	
y-multiplier	=	1.00000	

This p-y curve is computed using the equivalent depth.

This curve has the normal shape where Yk < Ym < Yu.

y, inches	p, lbs/in
0.00000	0.00000
0.10620	2143.55725
0.12685	2388.07449
0.14750	2617.39847
0.16815	2834.43013
0.18879	3041.23178
0.20944	3239.33429
0.23009	3429.91265
0.25074	3613.89297
0.27139	3792.02126
0.29204	3964.90935
0.31268	4133.06678
0.33333	4296.92346
0.54167	5929.75437
0.75000	7562.58528

0.90000	7562.58528
1.05000	7562.58528

The above p-y curve was computed using internal default values of k.

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	4
Depth of p-y curve below pile head	=	40.500 ft
Depth of p-y curve below ground surface	=	30.500 ft
Depth of top of layer 4 below pile head	=	38.000 ft
Equiv. depth of p-y curve below ground surface	=	30.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03362 pci
Average effective unit weight	=	58.089 pcf
Epsilon-50	=	0.00500
Pct	=	7556.155 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68300
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	199.20833
0.00126	398.41667
0.00640	597.62500
0.02023	796.83333
0.04938	996.04167
0.10240	1195.25000
0.18971	1394.45833
0.32363	1593.66667
0.51840	1792.87500
0.79012	1992.08333
1.15682	2191.29167
1.63840	2390.50000
2.25667	2589.70833

3.03534	2788.91667
4.00000	2988.12500
5.00000	2988.12500

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	4
Depth of p-y curve below pile head	=	45.500 ft
Depth of p-y curve below ground surface	=	35.500 ft
Depth of top of layer 4 below pile head	=	38.000 ft
Equiv. depth of p-y curve below ground surface	=	35.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03317 pci
Average effective unit weight	=	57.315 pcf
Epsilon-50	=	0.00500
Pct	=	8320.870 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68300
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	199.20833
0.00126	398.41667
0.00640	597.62500
0.02023	796.83333
0.04938	996.04167
0.10240	1195.25000
0.18971	1394.45833
0.32363	1593.66667
0.51840	1792.87500
0.79012	1992.08333
1.15682	2191.29167
1.63840	2390.50000
2.25667	2589.70833
3.03534	2788.91667
4.00000	2988.12500
5.00000	2988.12500

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	4
Depth of p-y curve below pile head	=	50.500 ft
Depth of p-y curve below ground surface	=	40.500 ft
Depth of top of layer 4 below pile head	=	38.000 ft
Equiv. depth of p-y curve below ground surface	=	40.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03283 pci
Average effective unit weight	=	56.733 pcf
Epsilon-50	=	0.00500
Pct	=	9085.827 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68300
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	199.20833
0.00126	398.41667
0.00640	597.62500
0.02023	796.83333
0.04938	996.04167
0.10240	1195.25000
0.18971	1394.45833
0.32363	1593.66667
0.51840	1792.87500
0.79012	1992.08333
1.15682	2191.29167
1.63840	2390.50000
2.25667	2589.70833
3.03534	2788.91667
4.00000	2988.12500
5.00000	2988.12500

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	4
Depth of p-y curve below pile head	=	55.500 ft
Depth of p-y curve below ground surface	=	45.500 ft

Depth of top of layer 4 below pile head	=	38.000	ft
Equiv. depth of p-y curve below ground surface	=	45.500	ft
Pile diameter	=	20.000	in
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Undrained cohesion	=	24.306	psi
Undrained cohesion	=	3500.000	psf
Average effective unit weight	=	0.03257	pci
Average effective unit weight	=	56.279	pcf
Epsilon-50	=	0.00500	
Pct	=	9850.946	lb/in
Pcd	=	4375.000	lb/in
Pu	=	4375.000	lb/in
y50	=	0.25000	in
p-multiplier	=	0.68300	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	199.20833
0.00126	398.41667
0.00640	597.62500
0.02023	796.83333
0.04938	996.04167
0.10240	1195.25000
0.18971	1394.45833
0.32363	1593.66667
0.51840	1792.87500
0.79012	1992.08333
1.15682	2191.29167
1.63840	2390.50000
2.25667	2589.70833
3.03534	2788.91667
4.00000	2988.12500
5.00000	2988.12500

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	4	
Depth of p-y curve below pile head	=	59.500	ft
Depth of p-y curve below ground surface	=	49.500	ft
Depth of top of layer 4 below pile head	=	38.000	ft
Equiv. depth of p-y curve below ground surface	=	49.500	ft
Pile diameter	=	20.000	in
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees

Effective slope angle	=	0.000	degrees
Undrained cohesion	=	24.306	psi
Undrained cohesion	=	3500.000	psf
Average effective unit weight	=	0.03240	pci
Average effective unit weight	=	55.982	pcf
Epsilon-50	=	0.00500	
Pct	=	10463.125	lb/in
Pcd	=	4375.000	lb/in
Pu	=	4375.000	lb/in
y50	=	0.25000	in
p-multiplier	=	0.68300	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	199.20833
0.00126	398.41667
0.00640	597.62500
0.02023	796.83333
0.04938	996.04167
0.10240	1195.25000
0.18971	1394.45833
0.32363	1593.66667
0.51840	1792.87500
0.79012	1992.08333
1.15682	2191.29167
1.63840	2390.50000
2.25667	2589.70833
3.03534	2788.91667
4.00000	2988.12500
5.00000	2988.12500

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head	=	20000.0	lbs
Rotation of pile head	=	0.000E+00	radians
Axial load at pile head	=	50000.0	lbs

(Zero slope for this load indicates fixed-head conditions)

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil Res.	Soil Spr.	Distrib.
X	y	Moment	Force	S	Stress	Stiffness	p	Es*h	Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	0.5396	-2396878.	20000.	0.00	1923.	4.81E+10	0.00	0.00	0.00
0.6000	0.5383	-2252813.	20000.	-3.48E-04	1815.	4.81E+10	0.00	0.00	0.00
1.2000	0.5346	-2108627.	20000.	-6.75E-04	1706.	4.81E+10	0.00	0.00	0.00
1.8000	0.5286	-1964327.	20000.	-9.80E-04	1598.	4.81E+10	0.00	0.00	0.00
2.4000	0.5205	-1819922.	20000.	-0.00126	1490.	4.81E+10	0.00	0.00	0.00
3.0000	0.5104	-1675418.	20000.	-0.00153	1382.	4.81E+10	0.00	0.00	0.00
3.6000	0.4985	-1530824.	20000.	-0.00177	1273.	4.81E+10	0.00	0.00	0.00
4.2000	0.4850	-1386147.	20000.	-0.00198	1165.	4.81E+10	0.00	0.00	0.00
4.8000	0.4699	-1241395.	20000.	-0.00218	1056.	4.81E+10	0.00	0.00	0.00
5.4000	0.4536	-1096577.	20000.	-0.00236	947.4326	4.81E+10	0.00	0.00	0.00
6.0000	0.4360	-951699.	20000.	-0.00251	838.7744	4.81E+10	0.00	0.00	0.00
6.6000	0.4174	-806770.	20000.	-0.00264	730.0777	4.81E+10	0.00	0.00	0.00
7.2000	0.3980	-661798.	20000.	-0.00275	621.3484	4.81E+10	0.00	0.00	0.00
7.8000	0.3778	-516790.	20000.	-0.00284	512.5923	4.81E+10	0.00	0.00	0.00
8.4000	0.3571	-371754.	20000.	-0.00291	403.8153	4.81E+10	0.00	0.00	0.00
9.0000	0.3360	-226698.	20000.	-0.00295	295.0233	4.81E+10	0.00	0.00	0.00
9.6000	0.3146	-81629.	20000.	-0.00297	186.2221	4.81E+10	0.00	0.00	0.00
10.2000	0.2932	63443.	19396.	-0.00297	172.5824	4.81E+10	-167.6653	4118.	0.00
10.8000	0.2718	199821.	18155.	-0.00296	274.8655	4.81E+10	-177.2102	4694.	0.00
11.4000	0.2506	327001.	16851.	-0.00292	370.2506	4.81E+10	-184.9997	5315.	0.00
12.0000	0.2298	444573.	15495.	-0.00286	458.4297	4.81E+10			

-191.6024	6003.	0.00				
12.6000	0.2095	552188.	14094.	-0.00278	539.1413	4.81E+10
-197.5429	6790.	0.00				
13.2000	0.1897	649533.	12653.	-0.00269	612.1501	4.81E+10
-202.7899	7696.	0.00				
13.8000	0.1707	736331.	11177.	-0.00259	677.2481	4.81E+10
-207.3110	8745.	0.00				
14.4000	0.1524	812342.	9670.	-0.00247	734.2561	4.81E+10
-211.0727	9969.	0.00				
15.0000	0.1351	877366.	8140.	-0.00235	783.0248	4.81E+10
-214.0392	11409.	0.00				
15.6000	0.1186	931248.	6591.	-0.00221	823.4361	4.81E+10
-216.1727	13118.	0.00				
16.2000	0.1032	973873.	5030.	-0.00207	855.4050	4.81E+10
-217.4314	15166.	0.00				
16.8000	0.08886	1005174.	3464.	-0.00192	878.8807	4.81E+10
-217.7690	17646.	0.00				
17.4000	0.07557	1025132.	1847.	-0.00177	893.8490	4.81E+10
-231.3297	22040.	0.00				
18.0000	0.06339	1033042.	176.9721	-0.00161	899.7817	4.81E+10
-232.5245	26410.	0.00				
18.6000	0.05232	1028843.	-1488.	-0.00146	896.6320	4.81E+10
-230.0998	31662.	0.00				
19.2000	0.04237	1012659.	-3123.	-0.00131	884.4945	4.81E+10
-223.8695	38044.	0.00				
19.8000	0.03350	984816.	-4698.	-0.00116	863.6119	4.81E+10
-213.6702	45918.	0.00				
20.4000	0.02570	945843.	-6185.	-0.00101	834.3821	4.81E+10
-199.3331	55840.	0.00				
21.0000	0.01892	896485.	-7495.	-8.75E-04	797.3639	4.81E+10
-164.7293	62689.	0.00				
21.6000	0.01310	838540.	-8522.	-7.45E-04	753.9047	4.81E+10
-120.3214	66108.	0.00				
22.2000	0.00819	774311.	-9240.	-6.24E-04	705.7336	4.81E+10
-79.1231	69527.	0.00				
22.8000	0.00412	705940.	-9675.	-5.13E-04	654.4549	4.81E+10
-41.7212	72947.	0.00				
23.4000	8.04E-04	635367.	-9855.	-4.13E-04	601.5254	4.81E+10
-8.5233	76366.	0.00				
24.0000	-0.00183	564319.	-9813.	-3.23E-04	548.2389	4.81E+10
20.2292	79786.	0.00				
24.6000	-0.00385	494288.	-9580.	-2.44E-04	495.7161	4.81E+10
44.4456	83205.	0.00				
25.2000	-0.00533	426535.	-9189.	-1.75E-04	444.9013	4.81E+10
64.1674	86624.	0.00				
25.8000	-0.00636	362085.	-8672.	-1.16E-04	396.5641	4.81E+10
79.5490	90044.	0.00				
26.4000	-0.00700	301740.	-8059.	-6.59E-05	351.3052	4.81E+10
90.8372	93463.	0.00				
27.0000	-0.00731	246088.	-7378.	-2.48E-05	309.5657	4.81E+10

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98.3515     96882.       0.00
   27.6000   -0.00736    195520.     -6655.   8.25E-06   271.6403   4.81E+10
102.4643    100302.       0.00
   28.2000   -0.00719    150254.     -5913.   3.41E-05   237.6907   4.81E+10
103.5830    103721.       0.00
   28.8000   -0.00686    110350.     -5172.   5.37E-05   207.7624   4.81E+10
102.1339    107141.       0.00
   29.4000   -0.00642     75734.     -4450.   6.76E-05   181.8005   4.81E+10
98.5467    110560.       0.00
   30.0000   -0.00589     46223.     -3759.   7.67E-05   159.6671   4.81E+10
93.2430    113979.       0.00
   30.6000   -0.00531     21543.     -3112.   8.18E-05   141.1571   4.81E+10
86.6254    117399.       0.00
   31.2000   -0.00471      1352.     -2515.   8.35E-05   126.0143   4.81E+10
79.0695    120818.       0.00
   31.8000   -0.00411    -14739.     -1975.   8.25E-05   136.0544   4.81E+10
70.9179    124238.       0.00
   32.4000   -0.00352    -27154.     -1495.   7.94E-05   145.3652   4.81E+10
62.4762    127657.       0.00
   33.0000   -0.00297    -36328.     -1076.   7.46E-05   152.2459   4.81E+10
54.0109    131076.       0.00
   33.6000   -0.00245    -42700.  -716.7506   6.87E-05   157.0251   4.81E+10
45.7485    134496.       0.00
   34.2000   -0.00198    -46698.  -415.7009   6.20E-05   160.0239   4.81E+10
37.8764    137915.       0.00
   34.8000   -0.00156    -48731.  -169.3838   5.49E-05   161.5481   4.81E+10
30.5450    141334.       0.00
   35.4000   -0.00119    -49177.    26.5101   4.75E-05   161.8828   4.81E+10
23.8700    144754.       0.00
   36.0000  -8.72E-04    -48383.   177.0124   4.02E-05   161.2875   4.81E+10
17.9362    148173.       0.00
   36.6000  -6.08E-04    -46657.   287.6670   3.31E-05   159.9928   4.81E+10
12.8012    151593.       0.00
   37.2000  -3.95E-04    -44265.   364.3484   2.63E-05   158.1986   4.81E+10
8.4992    155012.       0.00
   37.8000  -2.29E-04    -41429.   413.1081   1.99E-05   156.0721   4.81E+10
5.0452    158431.       0.00
   38.4000  -1.08E-04    -38330.   722.9842   1.39E-05   153.7477   4.81E+10
81.0315   5378625.       0.00
   39.0000  -2.90E-05    -31028.      1093.   8.71E-06   148.2713   4.81E+10
21.6651   5378625.       0.00
   39.6000   1.70E-05    -22602.      1125.   4.70E-06   141.9514   4.81E+10
-12.7026   5378625.       0.00
   40.2000   3.86E-05    -14832.   975.3301   1.89E-06   136.1243   4.81E+10
-28.8604   5378625.       0.00
   40.8000   4.43E-05     -8558.   752.3870   1.41E-07   131.4188   4.81E+10
-33.0682   5378625.       0.00
   41.4000   4.07E-05     -3998.   523.9712  -7.99E-07   127.9986   4.81E+10
-30.3806   5378625.       0.00
   42.0000   3.28E-05     -1013.   326.5024  -1.17E-06   125.7595   4.81E+10
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-24.4718   5378625.       0.00
   42.6000   2.38E-05   704.2872   174.5141  -1.20E-06   125.5282   4.81E+10
-17.7471   5378625.       0.00
   43.2000   1.55E-05     1501.    68.9009  -1.03E-06   126.1259   4.81E+10
-11.5899   5378625.       0.00
   43.8000   8.89E-06     1697.     3.2658  -7.93E-07   126.2729   4.81E+10
-6.6421   5378625.       0.00
   44.4000   4.10E-06     1549.   -31.6679  -5.50E-07   126.1616   4.81E+10
-3.0617   5378625.       0.00
   45.0000   9.76E-07     1242.   -45.3148  -3.41E-07   125.9312   4.81E+10
-0.7291   5378625.       0.00
   45.6000  -8.07E-07   896.5049   -45.7684  -1.81E-07   125.6724   4.81E+10
0.6031   5378625.       0.00
   46.2000  -1.62E-06   582.6463   -39.2300  -6.98E-08   125.4370   4.81E+10
1.2131   5378625.       0.00
   46.8000  -1.81E-06   331.6433   -29.9897  -1.29E-09   125.2487   4.81E+10
1.3536   5378625.       0.00
   47.4000  -1.64E-06   150.7952   -20.6994   3.48E-08   125.1131   4.81E+10
1.2270   5378625.       0.00
   48.0000  -1.31E-06    33.5461   -12.7584   4.86E-08   125.0252   4.81E+10
0.9788   5378625.       0.00
   48.6000  -9.42E-07   -32.9614    -6.7014   4.87E-08   125.0247   4.81E+10
0.7037   5378625.       0.00
   49.2000  -6.09E-07   -62.9888    -2.5300   4.15E-08   125.0472   4.81E+10
0.4551   5378625.       0.00
   49.8000  -3.44E-07   -69.4227    0.03413   3.16E-08   125.0521   4.81E+10
0.2572   5378625.       0.00
   50.4000  -1.54E-07   -62.5200     1.3749   2.17E-08   125.0469   4.81E+10
0.1153   5378625.       0.00
   51.0000  -3.17E-08   -49.6392     1.8751   1.33E-08   125.0372   4.81E+10
0.02369   5378625.       0.00
   51.6000   3.73E-08   -35.5276     1.8601   6.93E-09   125.0266   4.81E+10
-0.02788   5378625.       0.00
   52.2000   6.80E-08   -22.8594     1.5767   2.55E-09   125.0171   4.81E+10
-0.05083   5378625.       0.00
   52.8000   7.41E-08   -12.8250     1.1944  -1.18E-10   125.0096   4.81E+10
-0.05536   5378625.       0.00
   53.4000   6.63E-08    -5.6596     0.8167  -1.50E-09   125.0042   4.81E+10
-0.04956   5378625.       0.00
   54.0000   5.25E-08    -1.0629     0.4972  -2.01E-09   125.0008   4.81E+10
-0.03919   5378625.       0.00
   54.6000   3.74E-08     1.5020     0.2554  -1.97E-09   125.0011   4.81E+10
-0.02798   5378625.       0.00
   55.2000   2.41E-08     2.6166    0.09003  -1.66E-09   125.0020   4.81E+10
-0.01797   5378625.       0.00
   55.8000   1.35E-08     2.7996   -0.01089  -1.26E-09   125.0021   4.81E+10
-0.01007   5378625.       0.00
   56.4000   5.92E-09     2.4607   -0.06305  -8.65E-10   125.0018   4.81E+10
-0.00442   5378625.       0.00
   57.0000   1.02E-09     1.8924   -0.08170  -5.39E-10   125.0014   4.81E+10
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-7.59E-04   5378625.       0.00
   57.6000  -1.84E-09     1.2846   -0.07947  -3.01E-10   125.0010   4.81E+10
0.00138   5378625.       0.00
   58.2000  -3.32E-09     0.7483   -0.06558  -1.49E-10   125.0006   4.81E+10
0.00248   5378625.       0.00
   58.8000  -3.99E-09     0.3404   -0.04592  -6.74E-11   125.0003   4.81E+10
0.00298   5378625.       0.00
   59.4000  -4.29E-09    0.08712   -0.02364  -3.54E-11   125.0001   4.81E+10
0.00321   5378625.       0.00
   60.0000  -4.50E-09       0.00       0.00  -2.89E-11   125.0000   4.81E+10
0.00336   2689312.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 1:

Pile-head deflection             =     0.53960284 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -2396878. inch-lbs
Maximum shear force              =         20000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     1.80000000 feet below pile head
Number of iterations             =             16
Number of zero deflection points =              5



--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 2
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Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =      40000.0 lbs
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =      50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
lb/inch    lb/inch    lb/inch
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00     1.3917  -5230205.     40000.       0.00      4048.   4.81E+10
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0.00       0.00       0.00
    0.6000     1.3889  -4942064.     40000.  -7.62E-04      3832.   4.81E+10
0.00       0.00       0.00
    1.2000     1.3807  -4653656.     40000.   -0.00148      3615.   4.81E+10
0.00       0.00       0.00
    1.8000     1.3676  -4364998.     40000.   -0.00216      3399.   4.81E+10
0.00       0.00       0.00
    2.4000     1.3497  -4076104.     40000.   -0.00279      3182.   4.81E+10
0.00       0.00       0.00
    3.0000     1.3274  -3786990.     40000.   -0.00338      2965.   4.81E+10
0.00       0.00       0.00
    3.6000     1.3010  -3497672.     40000.   -0.00392      2748.   4.81E+10
0.00       0.00       0.00
    4.2000     1.2709  -3208166.     40000.   -0.00442      2531.   4.81E+10
0.00       0.00       0.00
    4.8000     1.2373  -2918486.     40000.   -0.00488      2314.   4.81E+10
0.00       0.00       0.00
    5.4000     1.2006  -2628650.     40000.   -0.00530      2096.   4.81E+10
0.00       0.00       0.00
    6.0000     1.1610  -2338671.     40000.   -0.00567      1879.   4.81E+10
0.00       0.00       0.00
    6.6000     1.1189  -2048566.     40000.   -0.00600      1661.   4.81E+10
0.00       0.00       0.00
    7.2000     1.0746  -1758351.     40000.   -0.00629      1444.   4.81E+10
0.00       0.00       0.00
    7.8000     1.0284  -1468041.     40000.   -0.00653      1226.   4.81E+10
0.00       0.00       0.00
    8.4000     0.9806  -1177652.     40000.   -0.00672      1008.   4.81E+10
0.00       0.00       0.00
    9.0000     0.9316   -887199.     40000.   -0.00688   790.3994   4.81E+10
0.00       0.00       0.00
    9.6000     0.8816   -596699.     40000.   -0.00699   572.5240   4.81E+10
0.00       0.00       0.00
   10.2000     0.8309   -306166.     39217.   -0.00706   354.6244   4.81E+10
-217.5441      1885.       0.00
   10.8000     0.7799    -26894.     37603.   -0.00708   145.1706   4.81E+10
-230.6433      2129.       0.00
   11.4000     0.7289    240422.     35903.   -0.00707   305.3168   4.81E+10
-241.5921      2386.       0.00
   12.0000     0.6782    495202.     34130.   -0.00701   496.4015   4.81E+10
-251.1256      2666.       0.00
   12.6000     0.6279    736936.     32290.   -0.00692   677.7023   4.81E+10
-259.9311      2980.       0.00
   13.2000     0.5785    965156.     30389.   -0.00679   848.8673   4.81E+10
-267.9720      3335.       0.00
   13.8000     0.5301   1179433.     28434.   -0.00663      1010.   4.81E+10
-275.2106      3738.       0.00
   14.4000     0.4830   1379378.     26429.   -0.00644      1160.   4.81E+10
-281.6081      4198.       0.00
   15.0000     0.4374   1564651.     24382.   -0.00622      1298.   4.81E+10
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-287.1237      4726.       0.00
   15.6000     0.3935   1734955.     22298.   -0.00597      1426.   4.81E+10
-291.7153      5338.       0.00
   16.2000     0.3514   1890043.     20185.   -0.00570      1543.   4.81E+10
-295.3385      6051.       0.00
   16.8000     0.3114   2029718.     18049.   -0.00541      1647.   4.81E+10
-297.9466      6890.       0.00
   17.4000     0.2735   2153839.     15156.   -0.00509      1740.   4.81E+10
-505.6948     13311.       0.00
   18.0000     0.2380   2251628.     11464.   -0.00476      1814.   4.81E+10
-519.7676     15723.       0.00
   18.6000     0.2049   2322351.      7693.   -0.00442      1867.   4.81E+10
-527.7064     18541.       0.00
   19.2000     0.1743   2365592.      3889.   -0.00407      1899.   4.81E+10
-529.0878     21850.       0.00
   19.8000     0.1463   2381278.    99.0929   -0.00371      1911.   4.81E+10
-523.5700     25765.       0.00
   20.4000     0.1209   2369694.     -3625.   -0.00336      1902.   4.81E+10
-510.8865     30438.       0.00
   21.0000    0.09794   2331497.     -7231.   -0.00301      1874.   4.81E+10
-490.8315     36082.       0.00
   21.6000    0.07755   2267730.    -10666.   -0.00266      1826.   4.81E+10
-463.2336     43008.       0.00
   22.2000    0.05960   2179827.    -13874.   -0.00233      1760.   4.81E+10
-427.9042     51690.       0.00
   22.8000    0.04401   2069624.    -16799.   -0.00201      1677.   4.81E+10
-384.5405     62915.       0.00
   23.4000    0.03064   1939374.    -19353.   -0.00171      1580.   4.81E+10
-325.0148     76366.       0.00
   24.0000    0.01937   1792172.    -21296.   -0.00143      1469.   4.81E+10
-214.6558     79786.       0.00
   24.6000    0.01003   1633744.    -22486.   -0.00117      1350.   4.81E+10
-115.9267     83205.       0.00
   25.2000    0.00245   1469219.    -23010.  -9.42E-04      1227.   4.81E+10
-29.5256      86624.       0.00
   25.8000   -0.00354   1303085.    -22957.  -7.35E-04      1102.   4.81E+10
44.2562      90044.       0.00
   26.4000   -0.00813   1139174.    -22417.  -5.52E-04   979.3803   4.81E+10
105.4870      93463.       0.00
   27.0000   -0.01149    980670.    -21481.  -3.93E-04   860.5024   4.81E+10
154.5432      96882.       0.00
   27.6000   -0.01379    830125.    -20234.  -2.57E-04   747.5935   4.81E+10
192.0558     100302.       0.00
   28.2000   -0.01519    689491.    -18754.  -1.44E-04   642.1181   4.81E+10
218.8568     103721.       0.00
   28.8000   -0.01585    560165.    -17117.  -5.00E-05   545.1241   4.81E+10
235.9278     107141.       0.00
   29.4000   -0.01591    443040.    -15388.   2.51E-05   457.2802   4.81E+10
244.3509     110560.       0.00
   30.0000   -0.01549    338558.    -13626.   8.36E-05   378.9188   4.81E+10
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245.2652    113979.       0.00
   30.6000   -0.01471    246773.    -11879.   1.27E-04   310.0796   4.81E+10
239.8273    117399.       0.00
   31.2000   -0.01366    167407.    -10191.   1.58E-04   250.5549   4.81E+10
229.1779    120818.       0.00
   31.8000   -0.01243     99912.     -8594.   1.79E-04   199.9339   4.81E+10
214.4150    124238.       0.00
   32.4000   -0.01109     43527.     -7114.   1.89E-04   157.6453   4.81E+10
196.5719    127657.       0.00
   33.0000   -0.00970     -2670.     -5771.   1.92E-04   127.0024   4.81E+10
176.6022    131076.       0.00
   33.6000   -0.00832    -39711.     -4576.   1.89E-04   154.7836   4.81E+10
155.3696    134496.       0.00
   34.2000   -0.00698    -68697.     -3535.   1.81E-04   176.5225   4.81E+10
133.6435    137915.       0.00
   34.8000   -0.00571    -90750.     -2651.   1.69E-04   193.0625   4.81E+10
112.0986    141334.       0.00
   35.4000   -0.00454   -106987.     -1918.   1.54E-04   205.2405   4.81E+10
91.3186     144754.       0.00
   36.0000   -0.00349   -118485.     -1331.   1.37E-04   213.8637   4.81E+10
71.8034     148173.       0.00
   36.6000   -0.00256   -126254.  -878.2654   1.19E-04   219.6904   4.81E+10
53.9783     151593.       0.00
   37.2000   -0.00177   -131218.  -546.4020   9.98E-05   223.4132   4.81E+10
38.2059     155012.       0.00
   37.8000   -0.00113   -134194.  -319.5877   7.99E-05   225.6454   4.81E+10
24.7980     158431.       0.00
   38.4000  -6.24E-04   -135877.   971.9653   5.97E-05   226.9079   4.81E+10
333.9667    3853104.      0.00
   39.0000  -2.68E-04   -120240.      2894.   4.05E-05   215.1804   4.81E+10
199.9800    5378625.      0.00
   39.6000  -4.10E-05    -94230.      3724.   2.44E-05   195.6727   4.81E+10
30.6439    5378625.      0.00
   40.2000   8.40E-05    -66626.      3609.   1.24E-05   174.9698   4.81E+10
-62.7733    5378625.      0.00
   40.8000   1.37E-04    -42273.      3014.   4.22E-06   156.7049   4.81E+10
-102.5112   5378625.      0.00
   41.4000   1.45E-04    -23232.      2255.  -6.84E-07   142.4238   4.81E+10
-108.1907   5378625.      0.00
   42.0000   1.27E-04     -9798.      1523.  -3.16E-06   132.3483   4.81E+10
-95.1529    5378625.      0.00
   42.6000   9.94E-05     -1296.   913.4173  -3.99E-06   125.9720   4.81E+10
-74.2214    5378625.      0.00
   43.2000   6.99E-05      3358.   458.1360  -3.83E-06   127.5187   4.81E+10
-52.2457    5378625.      0.00
   43.8000   4.41E-05      5304.   151.3391  -3.19E-06   128.9780   4.81E+10
-32.9757    5378625.      0.00
   44.4000   2.41E-05      5540.   -32.0978  -2.37E-06   129.1549   4.81E+10
-17.9790    5378625.      0.00
   45.0000   9.97E-06      4843.  -123.6265  -1.60E-06   128.6326   4.81E+10
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-7.4456   5378625.       0.00
   45.6000   1.09E-06      3761.  -153.3633  -9.51E-07   127.8206   4.81E+10
-0.8146   5378625.       0.00
   46.2000  -3.73E-06      2636.  -146.2642  -4.72E-07   126.9768   4.81E+10
2.7865   5378625.       0.00
   46.8000  -5.71E-06      1655.  -120.8821  -1.51E-07   126.2412   4.81E+10
4.2641   5378625.       0.00
   47.4000  -5.90E-06   895.1372   -89.6618   4.02E-08   125.6714   4.81E+10
4.4082   5378625.       0.00
   48.0000  -5.13E-06   363.7952   -59.9997   1.35E-07   125.2728   4.81E+10
3.8312   5378625.       0.00
   48.6000  -3.96E-06    31.0451   -35.5471   1.64E-07   125.0233   4.81E+10
2.9611   5378625.       0.00
   49.2000  -2.77E-06  -148.2012   -17.4493   1.55E-07   125.1112   4.81E+10
2.0660   5378625.       0.00
   49.8000  -1.73E-06  -220.3370    -5.3665   1.28E-07   125.1653   4.81E+10
1.2903   5378625.       0.00
   50.4000  -9.26E-07  -225.5713     1.7702   9.43E-08   125.1692   4.81E+10
0.6921   5378625.       0.00
   51.0000  -3.69E-07  -194.9143     5.2541   6.28E-08   125.1462   4.81E+10
0.2757   5378625.       0.00
   51.6000  -2.17E-08  -149.9568     6.3050   3.70E-08   125.1125   4.81E+10
0.01624   5378625.       0.00
   52.2000   1.64E-07  -104.1496     5.9229   1.80E-08   125.0781   4.81E+10
-0.1224   5378625.       0.00
   52.8000   2.37E-07   -64.6802     4.8449   5.32E-09   125.0485   4.81E+10
-0.1771   5378625.       0.00
   53.4000   2.40E-07   -34.3862     3.5608  -2.10E-09   125.0258   4.81E+10
-0.1796   5378625.       0.00
   54.0000   2.07E-07   -13.4030     2.3578  -5.67E-09   125.0101   4.81E+10
-0.1545   5378625.       0.00
   54.6000   1.59E-07    -0.4294     1.3746  -6.71E-09   125.0003   4.81E+10
-0.1186   5378625.       0.00
   55.2000   1.10E-07     6.3962     0.6513  -6.26E-09   125.0048   4.81E+10
-0.08233   5378625.       0.00
   55.8000   6.86E-08     8.9534     0.1705  -5.11E-09   125.0067   4.81E+10
-0.05122   5378625.       0.00
   56.4000   3.66E-08     8.8549    -0.1122  -3.78E-09   125.0066   4.81E+10
-0.02732   5378625.       0.00
   57.0000   1.41E-08     7.3399    -0.2486  -2.57E-09   125.0055   4.81E+10
-0.01055   5378625.       0.00
   57.6000  -4.03E-10     5.2775    -0.2855  -1.62E-09   125.0040   4.81E+10
3.01E-04   5378625.       0.00
   58.2000  -9.24E-09     3.2304    -0.2595  -9.85E-10   125.0024   4.81E+10
0.00690   5378625.       0.00
   58.8000  -1.46E-08     1.5410    -0.1954  -6.28E-10   125.0012   4.81E+10
0.01090   5378625.       0.00
   59.4000  -1.83E-08     0.4166    -0.1070  -4.81E-10   125.0003   4.81E+10
0.01366   5378625.       0.00
   60.0000  -2.15E-08       0.00       0.00  -4.50E-10   125.0000   4.81E+10
```

0.01608   2689312.   0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 2:

Pile-head deflection   =   1.39169290 inches
Computed slope at pile head   =   0.000000 radians
Maximum bending moment   =   -5230205. inch-lbs
Maximum shear force   =   40000. lbs
Depth of maximum bending moment =   0.000000 feet below pile head
Depth of maximum shear force   =   0.60000000 feet below pile head
Number of iterations   =   15
Number of zero deflection points =   5

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head   =   60000.0 lbs
Rotation of pile head   =   0.000E+00 radians
Axial load at pile head   =   50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	2.3602	-8193930.	60000.	0.00	6270.	4.81E+10	0.00	0.00	0.00
0.6000	2.3558	-7761709.	60000.	-0.00120	5946.	4.81E+10	0.00	0.00	0.00
1.2000	2.3430	-7329070.	60000.	-0.00233	5622.	4.81E+10	0.00	0.00	0.00
1.8000	2.3223	-6896035.	60000.	-0.00339	5297.	4.81E+10	0.00	0.00	0.00
2.4000	2.2942	-6462628.	60000.	-0.00439	4972.	4.81E+10	0.00	0.00	0.00
3.0000	2.2591	-6028873.	60000.	-0.00533	4647.	4.81E+10			

```
0.00       0.00       0.00
    3.6000     2.2175  -5594793.     60000.   -0.00620      4321.   4.81E+10
0.00       0.00       0.00
    4.2000     2.1699  -5160411.     60000.   -0.00700      3995.   4.81E+10
0.00       0.00       0.00
    4.8000     2.1167  -4725751.     60000.   -0.00774      3669.   4.81E+10
0.00       0.00       0.00
    5.4000     2.0584  -4290836.     60000.   -0.00842      3343.   4.81E+10
0.00       0.00       0.00
    6.0000     1.9954  -3855690.     60000.   -0.00903      3017.   4.81E+10
0.00       0.00       0.00
    6.6000     1.9283  -3420335.     60000.   -0.00957      2690.   4.81E+10
0.00       0.00       0.00
    7.2000     1.8576  -2984797.     60000.   -0.01005      2364.   4.81E+10
0.00       0.00       0.00
    7.8000     1.7836  -2549097.     60000.   -0.01047      2037.   4.81E+10
0.00       0.00       0.00
    8.4000     1.7068  -2113260.     60000.   -0.01082      1710.   4.81E+10
0.00       0.00       0.00
    9.0000     1.6278  -1677309.     60000.   -0.01110      1383.   4.81E+10
0.00       0.00       0.00
    9.6000     1.5470  -1241267.     60000.   -0.01132      1056.   4.81E+10
0.00       0.00       0.00
   10.2000     1.4648   -805159.     59098.   -0.01147   728.8690   4.81E+10
-250.6696      1232.       0.00
   10.8000     1.3818   -382001.     57237.   -0.01156   411.5011   4.81E+10
-266.0934      1387.       0.00
   11.4000     1.2983     27382.     55275.   -0.01159   145.5365   4.81E+10
-279.0980      1548.       0.00
   12.0000     1.2149    422296.     53224.   -0.01155   441.7217   4.81E+10
-290.5298      1722.       0.00
   12.6000     1.1319    802125.     51094.   -0.01146   726.5940   4.81E+10
-301.1837      1916.       0.00
   13.2000     1.0498   1166299.     48890.   -0.01132   999.7239   4.81E+10
-311.0199      2133.       0.00
   13.8000     0.9690   1514286.     46618.   -0.01111      1261.   4.81E+10
-319.9975      2378.       0.00
   14.4000     0.8898   1845602.     44285.   -0.01086      1509.   4.81E+10
-328.0741      2655.       0.00
   15.0000     0.8126   2159812.     41897.   -0.01056      1745.   4.81E+10
-335.2061      2970.       0.00
   15.6000     0.7377   2456528.     39462.   -0.01022      1967.   4.81E+10
-341.3482      3332.       0.00
   16.2000     0.6654   2735416.     36986.   -0.00983      2177.   4.81E+10
-346.4534      3749.       0.00
   16.8000     0.5961   2996197.     34477.   -0.00940      2372.   4.81E+10
-350.4735      4233.       0.00
   17.4000     0.5301   3238648.     30425.   -0.00893      2554.   4.81E+10
-774.9567     10526.       0.00
   18.0000     0.4675   3440750.     24777.   -0.00843      2706.   4.81E+10
```

-794.0119	12228.	0.00				
18.6000	0.4087	3601505.	19014.	-0.00790	2826.	4.81E+10
-806.7950	14214.	0.00				
19.2000	0.3537	3720241.	13180.	-0.00736	2915.	4.81E+10
-813.7602	16565.	0.00				
19.8000	0.3027	3796592.	7318.	-0.00679	2972.	4.81E+10
-814.6426	19375.	0.00				
20.4000	0.2559	3830506.	1483.	-0.00622	2998.	4.81E+10
-806.1092	22683.	0.00				
21.0000	0.2131	3822426.	-4254.	-0.00565	2992.	4.81E+10
-787.4928	26602.	0.00				
21.6000	0.1745	3773316.	-9820.	-0.00508	2955.	4.81E+10
-758.5568	31293.	0.00				
22.2000	0.1400	3684678.	-15139.	-0.00452	2889.	4.81E+10
-719.1280	36987.	0.00				
22.8000	0.1094	3558563.	-20137.	-0.00398	2794.	4.81E+10
-669.0450	44023.	0.00				
23.4000	0.08269	3397572.	-24734.	-0.00346	2673.	4.81E+10
-608.0621	52942.	0.00				
24.0000	0.05963	3204876.	-28852.	-0.00296	2529.	4.81E+10
-535.6588	64677.	0.00				
24.6000	0.04002	2984239.	-32402.	-0.00250	2363.	4.81E+10
-450.6153	81064.	0.00				
25.2000	0.02363	2740080.	-35048.	-0.00207	2180.	4.81E+10
-284.3451	86624.	0.00				
25.8000	0.01020	2481034.	-36531.	-0.00168	1986.	4.81E+10
-127.5642	90044.	0.00				
26.4000	-5.58E-04	2215241.	-36964.	-0.00133	1786.	4.81E+10
7.2420	93463.	0.00				
27.0000	-0.00893	1949704.	-36506.	-0.00102	1587.	4.81E+10
120.1185	96882.	0.00				
27.6000	-0.01519	1690289.	-35311.	-7.44E-04	1393.	4.81E+10
211.6509	100302.	0.00				
28.2000	-0.01964	1441754.	-33531.	-5.09E-04	1206.	4.81E+10
282.8738	103721.	0.00				
28.8000	-0.02252	1207806.	-31306.	-3.11E-04	1031.	4.81E+10
335.1785	107141.	0.00				
29.4000	-0.02411	991169.	-28767.	-1.46E-04	868.3765	4.81E+10
370.2241	110560.	0.00				
30.0000	-0.02463	793670.	-26030.	-1.23E-05	720.2526	4.81E+10
389.8533	113979.	0.00				
30.6000	-0.02429	616339.	-23201.	9.33E-05	587.2541	4.81E+10
396.0163	117399.	0.00				
31.2000	-0.02328	459504.	-20369.	1.74E-04	469.6278	4.81E+10
390.7028	120818.	0.00				
31.8000	-0.02178	322898.	-17609.	2.32E-04	367.1734	4.81E+10
375.8843	124238.	0.00				
32.4000	-0.01994	205760.	-14984.	2.72E-04	279.3203	4.81E+10
353.4670	127657.	0.00				
33.0000	-0.01787	106936.	-12540.	2.95E-04	205.2018	4.81E+10

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325.2546    131076.       0.00
   33.6000   -0.01568     24966.    -10315.   3.05E-04   143.7247   4.81E+10
292.9220    134496.       0.00
   34.2000   -0.01347    -41819.     -8332.   3.04E-04   156.3645   4.81E+10
257.9981    137915.       0.00
   34.8000   -0.01130    -95228.     -6604.   2.94E-04   196.4210   4.81E+10
221.8585    141334.       0.00
   35.4000   -0.00924   -137130.     -5137.   2.76E-04   227.8479   4.81E+10
185.7255    144754.       0.00
   36.0000   -0.00732   -169398.     -3926.   2.53E-04   252.0482   4.81E+10
150.6755    148173.       0.00
   36.6000   -0.00559   -193844.     -2960.   2.26E-04   270.3833   4.81E+10
117.6519    151593.       0.00
   37.2000   -0.00406   -212182.     -2221.   1.96E-04   284.1364   4.81E+10
87.4827     155012.       0.00
   37.8000   -0.00277   -225973.     -1687.   1.63E-04   294.4795   4.81E+10
60.9008     158431.       0.00
   38.4000   -0.00172   -236594.    80.2012   1.28E-04   302.4456   4.81E+10
430.0306   1804690.       0.00
   39.0000  -9.19E-04   -224910.      2953.   9.38E-05   293.6826   4.81E+10
367.8757   2882780.       0.00
   39.6000  -3.65E-04   -194143.      5257.   6.24E-05   270.6075   4.81E+10
272.3069   5378625.       0.00
   40.2000  -1.96E-05   -149250.      6290.   3.67E-05   236.9373   4.81E+10
14.6562    5378625.       0.00
   40.8000   1.64E-04   -103588.      5901.   1.78E-05   202.6912   4.81E+10
-122.7478   5378625.       0.00
   41.4000   2.37E-04    -64284.      4823.   5.21E-06   173.2133   4.81E+10
-176.6933   5378625.       0.00
   42.0000   2.39E-04    -34137.      3543.  -2.16E-06   150.6026   4.81E+10
-178.8466   5378625.       0.00
   42.6000   2.05E-04    -13259.      2347.  -5.71E-06   134.9442   4.81E+10
-153.4966   5378625.       0.00
   43.2000   1.57E-04  -337.5090      1371.  -6.72E-06   125.2531   4.81E+10
-117.4643   5378625.       0.00
   43.8000   1.09E-04      6495.   656.3849  -6.26E-06   129.8709   4.81E+10
-81.1601    5378625.       0.00
   44.4000   6.70E-05      9119.   183.8906  -5.09E-06   131.8392   4.81E+10
-50.0883    5378625.       0.00
   45.0000   3.53E-05      9146.   -91.3360  -3.73E-06   131.8597   4.81E+10
-26.3635    5378625.       0.00
   45.6000   1.34E-05      7806.  -222.2718  -2.46E-06   130.8548   4.81E+10
-10.0076    5378625.       0.00
   46.2000  -7.89E-08      5947.  -258.0869  -1.43E-06   129.4605   4.81E+10
0.05895    5378625.       0.00
   46.8000  -7.14E-06      4091.  -238.6727  -6.74E-07   128.0682   4.81E+10
5.3339     5378625.       0.00
   47.4000  -9.79E-06      2511.  -193.1445  -1.80E-07   126.8832   4.81E+10
7.3128     5378625.       0.00
   48.0000  -9.73E-06      1310.  -140.6508   1.06E-07   125.9824   4.81E+10
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7.2688   5378625.       0.00
   48.6000  -8.26E-06   485.4594   -92.2731   2.41E-07   125.3641   4.81E+10
6.1695   5378625.       0.00
   49.2000  -6.26E-06   -19.0938   -53.2185   2.76E-07   125.0143   4.81E+10
4.6790   5378625.       0.00
   49.8000  -4.29E-06  -281.0852   -24.8397   2.53E-07   125.2108   4.81E+10
3.2040   5378625.       0.00
   50.4000  -2.62E-06  -376.9675    -6.2660   2.04E-07   125.2827   4.81E+10
1.9554   5378625.       0.00
   51.0000  -1.35E-06  -371.4626     4.4112   1.48E-07   125.2786   4.81E+10
1.0105   5378625.       0.00
   51.6000  -4.88E-07  -313.5532     9.3626   9.65E-08   125.2352   4.81E+10
0.3649   5378625.       0.00
   52.2000   3.76E-08  -236.7106    10.5751   5.53E-08   125.1775   4.81E+10
-0.02808   5378625.       0.00
   52.8000   3.08E-07  -161.3110     9.6448   2.55E-08   125.1210   4.81E+10
-0.2303   5378625.       0.00
   53.4000   4.05E-07   -97.8438     7.7260   6.11E-09   125.0734   4.81E+10
-0.3027   5378625.       0.00
   54.0000   3.96E-07   -50.0608     5.5704  -4.96E-09   125.0375   4.81E+10
-0.2961   5378625.       0.00
   54.6000   3.34E-07   -17.6262     3.6070  -1.00E-08   125.0132   4.81E+10
-0.2493   5378625.       0.00
   55.2000   2.52E-07     1.8874     2.0321  -1.12E-08   125.0014   4.81E+10
-0.1882   5378625.       0.00
   55.8000   1.72E-07    11.6445     0.8914  -1.02E-08   125.0087   4.81E+10
-0.1287   5378625.       0.00
   56.4000   1.05E-07    14.7309     0.1456  -8.22E-09   125.0110   4.81E+10
-0.07851   5378625.       0.00
   57.0000   5.38E-08    13.7469    -0.2818  -6.09E-09   125.0103   4.81E+10
-0.04022   5378625.       0.00
   57.6000   1.74E-08    10.6773    -0.4734  -4.26E-09   125.0080   4.81E+10
-0.01300   5378625.       0.00
   58.2000  -7.51E-09     6.9331    -0.5000  -2.94E-09   125.0052   4.81E+10
0.00561   5378625.       0.00
   58.8000  -2.49E-08     3.4794    -0.4127  -2.16E-09   125.0026   4.81E+10
0.01864   5378625.       0.00
   59.4000  -3.86E-08     0.9917    -0.2417  -1.83E-09   125.0007   4.81E+10
0.02886   5378625.       0.00
   60.0000  -5.12E-08       0.00       0.00  -1.75E-09   125.0000   4.81E+10
0.03828   2689312.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 3:

Pile-head deflection             =     2.36023077 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -8193930. inch-lbs
```

```
Maximum shear force              =         60000. lbs
Depth of maximum bending moment  =      0.000000 feet below pile head
Depth of maximum shear force     =    1.20000000 feet below pile head
Number of iterations             =            15
Number of zero deflection points =             5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 80000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	3.3919	-1.12E+07	80000.	0.00	8543.	4.81E+10	0.00	0.00	0.00
0.6000	3.3858	-1.06E+07	80000.	-0.00164	8110.	4.81E+10	0.00	0.00	0.00
1.2000	3.3683	-1.01E+07	80000.	-0.00319	7678.	4.81E+10	0.00	0.00	0.00
1.8000	3.3399	-9492764.	80000.	-0.00465	7245.	4.81E+10	0.00	0.00	0.00
2.4000	3.3013	-8914833.	80000.	-0.00603	6811.	4.81E+10	0.00	0.00	0.00
3.0000	3.2530	-8336420.	80000.	-0.00733	6377.	4.81E+10	0.00	0.00	0.00
3.6000	3.1958	-7757558.	80000.	-0.00853	5943.	4.81E+10	0.00	0.00	0.00
4.2000	3.1302	-7178278.	80000.	-0.00965	5509.	4.81E+10	0.00	0.00	0.00
4.8000	3.0568	-6598611.	80000.	-0.01068	5074.	4.81E+10	0.00	0.00	0.00
5.4000	2.9763	-6018587.	80000.	-0.01163	4639.	4.81E+10	0.00	0.00	0.00
6.0000	2.8894	-5438240.	80000.	-0.01248	4204.	4.81E+10			

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0.00       0.00       0.00
    6.6000     2.7966  -4857599.     80000.   -0.01326      3768.   4.81E+10
0.00       0.00       0.00
    7.2000     2.6985  -4276696.     80000.   -0.01394      3333.   4.81E+10
0.00       0.00       0.00
    7.8000     2.5958  -3695562.     80000.   -0.01454      2897.   4.81E+10
0.00       0.00       0.00
    8.4000     2.4892  -3114229.     80000.   -0.01505      2461.   4.81E+10
0.00       0.00       0.00
    9.0000     2.3792  -2532728.     80000.   -0.01547      2025.   4.81E+10
0.00       0.00       0.00
    9.6000     2.2664  -1951091.     80000.   -0.01581      1588.   4.81E+10
0.00       0.00       0.00
   10.2000     2.1516  -1369348.     79007.   -0.01605      1152.   4.81E+10
-275.9594   923.4707       0.00
   10.8000     2.0352   -801838.     76958.   -0.01622   726.3782   4.81E+10
-293.1426      1037.       0.00
   11.4000     1.9180   -249480.     74795.   -0.01630   312.1101   4.81E+10
-307.6989      1155.       0.00
   12.0000     1.8006    286940.     72533.   -0.01629   340.2047   4.81E+10
-320.5596      1282.       0.00
   12.6000     1.6834    806726.     70182.   -0.01621   730.0446   4.81E+10
-332.6020      1423.       0.00
   13.2000     1.5671   1309227.     67747.   -0.01605      1107.   4.81E+10
-343.7838      1579.       0.00
   13.8000     1.4523   1793836.     65234.   -0.01582      1470.   4.81E+10
-354.0615      1755.       0.00
   14.4000     1.3393   2259993.     62652.   -0.01552      1820.   4.81E+10
-363.3905      1954.       0.00
   15.0000     1.2288   2707190.     60005.   -0.01514      2155.   4.81E+10
-371.7246      2178.       0.00
   15.6000     1.1213   3134971.     57302.   -0.01471      2476.   4.81E+10
-379.0164      2434.       0.00
   16.2000     1.0171   3542935.     54551.   -0.01421      2782.   4.81E+10
-385.2169      2727.       0.00
   16.8000     0.9167   3930738.     51759.   -0.01365      3073.   4.81E+10
-390.2764      3065.       0.00
   17.4000     0.8205   4298097.     46741.   -0.01303      3349.   4.81E+10
-1004.      8807.       0.00
   18.0000     0.7290   4613192.     39174.   -0.01236      3585.   4.81E+10
-1098.     10847.       0.00
   18.6000     0.6425   4871102.     31226.   -0.01165      3778.   4.81E+10
-1109.     12431.       0.00
   19.2000     0.5612   5071240.     23234.   -0.01091      3928.   4.81E+10
-1111.     14250.       0.00
   19.8000     0.4854   5213521.     15263.   -0.01014      4035.   4.81E+10
-1103.     16366.       0.00
   20.4000     0.4153   5298322.      7373.   -0.00935      4099.   4.81E+10
-1088.     18868.       0.00
   21.0000     0.3508   5326424.  -383.8012   -0.00855      4120.   4.81E+10
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-1066.     21889.       0.00
   21.6000     0.2921   5298954.     -7958.   -0.00776      4099.   4.81E+10
-1037.     25574.       0.00
   22.2000     0.2391   5217421.    -15277.   -0.00697      4038.   4.81E+10
-995.6584     29987.       0.00
   22.8000     0.1917   5083990.    -22248.   -0.00620      3938.   4.81E+10
-940.7624     35338.       0.00
   23.4000     0.1498   4901517.    -28776.   -0.00545      3801.   4.81E+10
-872.5626     41945.       0.00
   24.0000     0.1132   4673545.    -34764.   -0.00473      3630.   4.81E+10
-790.8009     50312.       0.00
   24.6000    0.08160   4404327.    -40112.   -0.00405      3428.   4.81E+10
-694.8641     61313.       0.00
   25.2000    0.05478   4098849.    -44713.   -0.00342      3199.   4.81E+10
-583.2490     76664.       0.00
   25.8000    0.03238   3762914.    -48271.   -0.00283      2947.   4.81E+10
-404.9056     90044.       0.00
   26.4000    0.01403   3405787.    -50384.   -0.00229      2679.   4.81E+10
-182.1861     93463.       0.00
   27.0000  -6.34E-04   3039031.    -51009.   -0.00181      2404.   4.81E+10
8.5296     96882.       0.00
   27.6000   -0.01203   2672553.    -50376.   -0.00138      2129.   4.81E+10
167.5185    100302.       0.00
   28.2000   -0.02053   2314616.    -48708.   -0.00101      1861.   4.81E+10
295.8045    103721.       0.00
   28.8000   -0.02655   1971888.    -46221.  -6.87E-04      1604.   4.81E+10
395.0256    107141.       0.00
   29.4000   -0.03043   1649532.    -43116.  -4.16E-04      1362.   4.81E+10
467.3012    110560.       0.00
   30.0000   -0.03254   1351312.    -39580.  -1.91E-04      1138.   4.81E+10
515.1047    113979.       0.00
   30.6000   -0.03319   1079722.    -35777.  -9.32E-06   934.7912   4.81E+10
541.1460    117399.       0.00
   31.2000   -0.03267    836126.    -31855.   1.34E-04   752.0948   4.81E+10
548.2637    120818.       0.00
   31.8000   -0.03126    620908.    -27940.   2.43E-04   590.6811   4.81E+10
539.3320    124238.       0.00
   32.4000   -0.02917    433615.    -24137.   3.22E-04   450.2115   4.81E+10
517.1815    127657.       0.00
   33.0000   -0.02662    273110.    -20530.   3.75E-04   329.8323   4.81E+10
484.5356    131076.       0.00
   33.6000   -0.02377    137708.    -17188.   4.06E-04   228.2809   4.81E+10
443.9613    134496.       0.00
   34.2000   -0.02077     25313.    -14157.   4.18E-04   143.9851   4.81E+10
397.8365    137915.       0.00
   34.8000   -0.01774    -66458.    -11471.   4.15E-04   174.8438   4.81E+10
348.3289    141334.       0.00
   35.4000   -0.01479   -140169.     -9147.   4.00E-04   230.1270   4.81E+10
297.3894    144754.       0.00
   36.0000   -0.01199   -198456.     -7188.   3.74E-04   273.8421   4.81E+10
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246.7563    148173.       0.00
   36.6000   -0.00940   -243940.     -5587.   3.41E-04   307.9552   4.81E+10
197.9685    151593.       0.00
   37.2000   -0.00708   -279149.     -4325.   3.02E-04   334.3614   4.81E+10
152.3871    155012.       0.00
   37.8000   -0.00505   -306442.     -3376.   2.58E-04   354.8316   4.81E+10
111.2223    158431.       0.00
   38.4000   -0.00336   -327953.     -1144.   2.11E-04   370.9650   4.81E+10
508.7772   1089737.       0.00
   39.0000   -0.00202   -323072.      2300.   1.62E-04   367.3039   4.81E+10
448.0781   1595359.       0.00
   39.6000   -0.00103   -294945.      5277.   1.16E-04   346.2085   4.81E+10
378.6630   2643554.       0.00
   40.2000  -3.59E-04   -247172.      7604.   7.49E-05   310.3787   4.81E+10
267.8397   5378625.       0.00
   40.8000   4.77E-05   -185500.      8440.   4.25E-05   264.1253   4.81E+10
-35.6157   5378625.       0.00
   41.4000   2.54E-04   -125666.      7629.   1.92E-05   219.2492   4.81E+10
-189.6180   5378625.       0.00
   42.0000   3.24E-04    -75654.      6074.   4.14E-06   181.7403   4.81E+10
-242.3747   5378625.       0.00
   42.6000   3.13E-04    -38203.      4358.  -4.38E-06   153.6519   4.81E+10
-234.1792   5378625.       0.00
   43.2000   2.61E-04    -12889.      2813.  -8.21E-06   134.6668   4.81E+10
-195.2048   5378625.       0.00
   43.8000   1.95E-04      2306.      1585.  -9.00E-06   126.7292   4.81E+10
-145.8461   5378625.       0.00
   44.4000   1.32E-04      9940.   705.7834  -8.09E-06   132.4547   4.81E+10
-98.3449   5378625.       0.00
   45.0000   7.88E-05     12475.   139.8750  -6.41E-06   134.3561   4.81E+10
-58.8518   5378625.       0.00
   45.6000   3.94E-05     11958.  -177.8653  -4.58E-06   133.9688   4.81E+10
-29.4093   5378625.       0.00
   46.2000   1.29E-05      9917.  -318.3038  -2.94E-06   132.4376   4.81E+10
-9.6014   5378625.       0.00
   46.8000  -2.97E-06      7377.  -344.8879  -1.64E-06   130.5327   4.81E+10
2.2169   5378625.       0.00
   47.4000  -1.08E-05      4952.  -307.7767  -7.21E-07   128.7137   4.81E+10
8.0918   5378625.       0.00
   48.0000  -1.34E-05      2945.  -242.7281  -1.30E-07   127.2091   4.81E+10
9.9773   5378625.       0.00
   48.6000  -1.27E-05      1456.  -172.6468   2.00E-07   126.0923   4.81E+10
9.4897   5378625.       0.00
   49.2000  -1.05E-05   459.1882  -110.3000   3.43E-07   125.3444   4.81E+10
7.8288   5378625.       0.00
   49.8000  -7.76E-06  -132.1848   -61.2437   3.68E-07   125.0991   4.81E+10
5.7979   5378625.       0.00
   50.4000  -5.19E-06  -422.9856   -26.4263   3.26E-07   125.3172   4.81E+10
3.8736   5378625.       0.00
   51.0000  -3.07E-06  -512.9585    -4.2377   2.56E-07   125.3847   4.81E+10
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2.2900   5378625.       0.00
   51.6000  -1.50E-06  -484.1921     8.0369   1.81E-07   125.3631   4.81E+10
1.1196   5378625.       0.00
   52.2000  -4.54E-07  -397.3571    13.2896   1.15E-07   125.2980   4.81E+10
0.3394   5378625.       0.00
   52.8000   1.61E-07  -292.9045    14.0773   6.36E-08   125.2197   4.81E+10
-0.1206   5378625.       0.00
   53.4000   4.61E-07  -194.6900    12.4020   2.71E-08   125.1460   4.81E+10
-0.3447   5378625.       0.00
   54.0000   5.51E-07  -114.3356     9.6779   3.94E-09   125.0858   4.81E+10
-0.4120   5378625.       0.00
   54.6000   5.18E-07   -55.3310     6.8014  -8.77E-09   125.0415   4.81E+10
-0.3871   5378625.       0.00
   55.2000   4.25E-07   -16.3890     4.2646  -1.41E-08   125.0123   4.81E+10
-0.3176   5378625.       0.00
   55.8000   3.14E-07     6.0892     2.2754  -1.49E-08   125.0046   4.81E+10
-0.2349   5378625.       0.00
   56.4000   2.10E-07    16.3881     0.8639  -1.32E-08   125.0123   4.81E+10
-0.1572   5378625.       0.00
   57.0000   1.24E-07    18.5383   -0.03534  -1.06E-08   125.0139   4.81E+10
-0.09261   5378625.       0.00
   57.6000   5.75E-08    15.8867    -0.5235  -8.04E-09   125.0119   4.81E+10
-0.04298   5378625.       0.00
   58.2000   8.25E-09    11.0059    -0.7004  -6.02E-09   125.0083   4.81E+10
-0.00616   5378625.       0.00
   58.8000  -2.92E-08     5.8052    -0.6441  -4.76E-09   125.0044   4.81E+10
0.02180   5378625.       0.00
   59.4000  -6.03E-08     1.7342    -0.4034  -4.20E-09   125.0013   4.81E+10
0.04508   5378625.       0.00
   60.0000  -8.96E-08       0.00       0.00  -4.07E-09   125.0000   4.81E+10
0.06696   2689312.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 4:

Pile-head deflection             =     3.39186803 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =     -11223363. inch-lbs
Maximum shear force              =         80000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     0.60000000 feet below pile head
Number of iterations             =             15
Number of zero deflection points =              5


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                 Computed Values of Pile Loading and Deflection
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for Lateral Loading for Load Case Number 5

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 100000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	4.5507	-1.44E+07	100000.	0.00	10912.	4.81E+10	0.00	0.00	0.00
0.6000	4.5429	-1.37E+07	100000.	-0.00210	10371.	4.81E+10	0.00	0.00	0.00
1.2000	4.5204	-1.29E+07	100000.	-0.00409	9831.	4.81E+10	0.00	0.00	0.00
1.8000	4.4840	-1.22E+07	100000.	-0.00598	9289.	4.81E+10	0.00	0.00	0.00
2.4000	4.4344	-1.15E+07	100000.	-0.00775	8747.	4.81E+10	0.00	0.00	0.00
3.0000	4.3723	-1.08E+07	100000.	-0.00942	8205.	4.81E+10	0.00	0.00	0.00
3.6000	4.2987	-1.00E+07	100000.	-0.01098	7662.	4.81E+10	0.00	0.00	0.00
4.2000	4.2142	-9325481.	100000.	-0.01243	7119.	4.81E+10	0.00	0.00	0.00
4.8000	4.1197	-8600754.	100000.	-0.01377	6576.	4.81E+10	0.00	0.00	0.00
5.4000	4.0159	-7875563.	100000.	-0.01501	6032.	4.81E+10	0.00	0.00	0.00
6.0000	3.9036	-7149948.	100000.	-0.01613	5487.	4.81E+10	0.00	0.00	0.00
6.6000	3.7835	-6423947.	100000.	-0.01715	4943.	4.81E+10	0.00	0.00	0.00
7.2000	3.6566	-5697599.	100000.	-0.01806	4398.	4.81E+10	0.00	0.00	0.00
7.8000	3.5235	-4970944.	100000.	-0.01886	3853.	4.81E+10	0.00	0.00	0.00
8.4000	3.3850	-4244022.	100000.	-0.01955	3308.	4.81E+10	0.00	0.00	0.00
9.0000	3.2420	-3516870.	100000.	-0.02013	2763.	4.81E+10			

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0.00       0.00       0.00
    9.6000     3.0952  -2789529.    100000.   -0.02060      2217.   4.81E+10
0.00       0.00       0.00
   10.2000     2.9453  -2062037.     98925.   -0.02096      1672.   4.81E+10
-298.4975   729.6869       0.00
   10.8000     2.7933  -1349909.     96709.   -0.02122      1137.   4.81E+10
-317.2884   817.8441       0.00
   11.4000     2.6398   -654155.     94367.   -0.02137   615.6164   4.81E+10
-333.2754   909.0092       0.00
   12.0000     2.4856     24356.     91916.   -0.02142   143.2673   4.81E+10
-347.4655      1007.       0.00
   12.6000     2.3314    684854.     89366.   -0.02136   638.6405   4.81E+10
-360.8103      1114.       0.00
   13.2000     2.1779   1326610.     86723.   -0.02121      1120.   4.81E+10
-373.2659      1234.       0.00
   13.8000     2.0259   1948945.     83994.   -0.02097      1587.   4.81E+10
-384.7873      1368.       0.00
   14.4000     1.8760   2551227.     81186.   -0.02063      2038.   4.81E+10
-395.3280      1517.       0.00
   15.0000     1.7288   3132878.     78305.   -0.02021      2475.   4.81E+10
-404.8405      1686.       0.00
   15.6000     1.5850   3693373.     75360.   -0.01969      2895.   4.81E+10
-413.2754      1877.       0.00
   16.2000     1.4452   4232245.     72358.   -0.01910      3299.   4.81E+10
-420.5822      2095.       0.00
   16.8000     1.3100   4749085.     69308.   -0.01843      3687.   4.81E+10
-426.7092      2345.       0.00
   17.4000     1.1798   5243549.     64159.   -0.01768      4058.   4.81E+10
-1004.      6125.       0.00
   18.0000     1.0554   5685697.     56503.   -0.01686      4389.   4.81E+10
-1123.      7659.       0.00
   18.6000     0.9370   6069338.     47967.   -0.01598      4677.   4.81E+10
-1248.      9593.       0.00
   19.2000     0.8253   6387934.     38502.   -0.01505      4916.   4.81E+10
-1381.     12048.       0.00
   19.8000     0.7204   6634597.     28226.   -0.01407      5101.   4.81E+10
-1474.     14728.       0.00
   20.4000     0.6226   6804517.     17715.   -0.01307      5228.   4.81E+10
-1446.     16725.       0.00
   21.0000     0.5322   6899094.      7438.   -0.01204      5299.   4.81E+10
-1408.     19054.       0.00
   21.6000     0.4492   6920286.     -2536.   -0.01100      5315.   4.81E+10
-1362.     21827.       0.00
   22.2000     0.3737   6870505.    -12149.   -0.00997      5278.   4.81E+10
-1309.     25208.       0.00
   22.8000     0.3057   6752520.    -21357.   -0.00895      5189.   4.81E+10
-1249.     29431.       0.00
   23.4000     0.2448   6569404.    -30090.   -0.00795      5052.   4.81E+10
-1176.     34595.       0.00
   24.0000     0.1911   6324946.    -38241.   -0.00699      4869.   4.81E+10
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-1088.     40969.       0.00
   24.6000     0.1442   6023771.    -45692.   -0.00606      4643.   4.81E+10
-982.4026     49045.       0.00
   25.2000     0.1038   5671343.    -52326.   -0.00519      4379.   4.81E+10
-860.3547     59668.       0.00
   25.8000    0.06953   5274008.    -58014.   -0.00437      4081.   4.81E+10
-719.5570     74513.       0.00
   26.4000    0.04093   4839087.    -62517.   -0.00361      3754.   4.81E+10
-531.3056     93463.       0.00
   27.0000    0.01755   4376363.    -65280.   -0.00292      3407.   4.81E+10
-236.1334     96882.       0.00
   27.6000   -0.00111   3901161.    -66074.   -0.00230      3051.   4.81E+10
15.4943    100302.       0.00
   28.2000   -0.01557   3426552.    -65211.   -0.00175      2695.   4.81E+10
224.2359    103721.       0.00
   28.8000   -0.02632   2963382.    -62994.   -0.00127      2348.   4.81E+10
391.7138    107141.       0.00
   29.4000   -0.03389   2520359.    -59710.  -8.62E-04      2015.   4.81E+10
520.3334    110560.       0.00
   30.0000   -0.03873   2104175.    -55630.  -5.15E-04      1703.   4.81E+10
613.1050    113979.       0.00
   30.6000   -0.04130   1719660.    -50998.  -2.29E-04      1415.   4.81E+10
673.4746    117399.       0.00
   31.2000   -0.04202   1369966.    -46035.   2.64E-06      1152.   4.81E+10
705.1677    120818.       0.00
   31.8000   -0.04127   1056753.    -40933.   1.84E-04   917.5648   4.81E+10
712.0497    124238.       0.00
   32.4000   -0.03937    780396.    -35857.   3.22E-04   710.2971   4.81E+10
698.0047    127657.       0.00
   33.0000   -0.03663    540182.    -30943.   4.21E-04   530.1364   4.81E+10
666.8350    131076.       0.00
   33.6000   -0.03331    334507.    -26303.   4.86E-04   375.8803   4.81E+10
622.1809    134496.       0.00
   34.2000   -0.02962    161068.    -22020.   5.24E-04   245.8011   4.81E+10
567.4612    137915.       0.00
   34.8000   -0.02577     17038.    -18156.   5.37E-04   137.7783   4.81E+10
505.8339    141334.       0.00
   35.4000   -0.02189   -100771.    -14751.   5.31E-04   200.5784   4.81E+10
440.1745    144754.       0.00
   36.0000   -0.01813   -195756.    -11823.   5.08E-04   271.8170   4.81E+10
373.0714    148173.       0.00
   36.6000   -0.01457   -271390.     -9375.   4.73E-04   328.5427   4.81E+10
306.8365    151593.       0.00
   37.2000   -0.01131   -331104.     -7394.   4.28E-04   373.3277   4.81E+10
243.5268    155012.       0.00
   37.8000   -0.00841   -378175.     -5852.   3.75E-04   408.6309   4.81E+10
184.9762    158431.       0.00
   38.4000   -0.00591   -415636.     -3077.   3.16E-04   436.7269   4.81E+10
585.8317    713798.       0.00
   39.0000   -0.00386   -422705.   928.4184   2.53E-04   442.0290   4.81E+10
```

```
526.6830    982324.       0.00
   39.6000   -0.00227   -402449.      4484.   1.91E-04   426.8366   4.81E+10
461.0806   1464150.       0.00
   40.2000   -0.00111   -358268.      7532.   1.34E-04   393.7010   4.81E+10
385.5502   2504380.       0.00
   40.8000  -3.36E-04   -294081.      9824.   8.53E-05   345.5608   4.81E+10
250.9285   5378625.       0.00
   41.4000   1.19E-04   -216870.     10406.   4.70E-05   287.6526   4.81E+10
-89.2507   5378625.       0.00
   42.0000   3.41E-04   -144274.      9167.   2.00E-05   233.2057   4.81E+10
-254.7030   5378625.       0.00
   42.6000   4.07E-04    -84874.      7170.   2.79E-06   188.6558   4.81E+10
-300.0769   5310659.       0.00
   43.2000   3.81E-04    -41026.      5065.  -6.64E-06   155.7695   4.81E+10
-284.7503   5378625.       0.00
   43.8000   3.11E-04    -11937.      3203.  -1.06E-05   133.9526   4.81E+10
-232.5298   5378625.       0.00
   44.4000   2.28E-04      5099.      1751.  -1.11E-05   128.8241   4.81E+10
-170.6921   5378625.       0.00
   45.0000   1.51E-04     13285.   729.8203  -9.74E-06   134.9640   4.81E+10
-112.9624   5378625.       0.00
   45.6000   8.83E-05     15615.    85.7850  -7.57E-06   136.7114   4.81E+10
-65.9363   5378625.       0.00
   46.2000   4.22E-05     14526.  -264.9533  -5.32E-06   135.8946   4.81E+10
-31.4910   5378625.       0.00
   46.8000   1.17E-05     11804.  -409.8173  -3.34E-06   133.8528   4.81E+10
-8.7490   5378625.       0.00
   47.4000  -6.00E-06      8627.  -425.1744  -1.81E-06   131.4703   4.81E+10
4.4831   5378625.       0.00
   48.0000  -1.44E-05      5682.  -370.2828  -7.42E-07   129.2619   4.81E+10
10.7646   5378625.       0.00
   48.6000  -1.67E-05      3296.  -286.6465  -6.98E-08   127.4717   4.81E+10
12.4678   5378625.       0.00
   49.2000  -1.54E-05      1555.  -200.3055   2.93E-07   126.1661   4.81E+10
11.5158   5378625.       0.00
   49.8000  -1.25E-05   410.9633  -125.3283   4.41E-07   125.3082   4.81E+10
9.3112   5378625.       0.00
   50.4000  -9.07E-06  -250.2240   -67.4163   4.53E-07   125.1877   4.81E+10
6.7755   5378625.       0.00
   51.0000  -5.95E-06  -560.1580   -27.0359   3.92E-07   125.4201   4.81E+10
4.4413   5378625.       0.00
   51.6000  -3.42E-06  -639.8231    -1.8365   3.02E-07   125.4799   4.81E+10
2.5585   5378625.       0.00
   52.2000  -1.59E-06  -586.8208    11.6623   2.10E-07   125.4401   4.81E+10
1.1912   5378625.       0.00
   52.8000  -3.97E-07  -472.0367    17.0184   1.31E-07   125.3540   4.81E+10
0.2966   5378625.       0.00
   53.4000   2.91E-07  -341.8504    17.3028   7.00E-08   125.2564   4.81E+10
-0.2176   5378625.       0.00
   54.0000   6.11E-07  -222.9273    14.8761   2.77E-08   125.1672   4.81E+10
```

```
-0.4564   5378625.       0.00
   54.6000   6.90E-07  -127.6544    11.3765   1.45E-09   125.0957   4.81E+10
-0.5157   5378625.       0.00
   55.2000   6.32E-07   -59.1064     7.8209  -1.25E-08   125.0443   4.81E+10
-0.4720   5378625.       0.00
   55.8000   5.10E-07   -15.0250     4.7508  -1.81E-08   125.0113   4.81E+10
-0.3808   5378625.       0.00
   56.4000   3.71E-07     9.3178     2.3813  -1.85E-08   125.0070   4.81E+10
-0.2774   5378625.       0.00
   57.0000   2.43E-07    19.2789     0.7290  -1.64E-08   125.0145   4.81E+10
-0.1816   5378625.       0.00
   57.6000   1.36E-07    19.8268    -0.2891  -1.34E-08   125.0149   4.81E+10
-0.1012   5378625.       0.00
   58.2000   4.94E-08    15.1251    -0.7864  -1.08E-08   125.0113   4.81E+10
-0.03690   5378625.       0.00
   58.8000  -2.04E-08     8.5098    -0.8643  -9.06E-09   125.0064   4.81E+10
0.01526   5378625.       0.00
   59.4000  -8.11E-08     2.6851    -0.5914  -8.22E-09   125.0020   4.81E+10
0.06056   5378625.       0.00
   60.0000  -1.39E-07       0.00       0.00  -8.02E-09   125.0000   4.81E+10
0.1037   2689312.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 5:

Pile-head deflection             =     4.55068315 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =     -14382304. inch-lbs
Maximum shear force              =        100000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     8.40000000 feet below pile head
Number of iterations             =             17
Number of zero deflection points =              5


--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians
```

```
Load Load                Load                  Axial    Pile-head  Pile-head  Max
Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in
Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs
     in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ----------
---------- ----------
  1  V, lb     20000.   S, rad         0.00     50000.     0.5396       0.00
20000.  -2396878.
  2  V, lb     40000.   S, rad         0.00     50000.     1.3917       0.00
40000.  -5230205.
  3  V, lb     60000.   S, rad         0.00     50000.     2.3602       0.00
60000.  -8193930.
  4  V, lb     80000.   S, rad         0.00     50000.     3.3919       0.00
80000.  -1.12E+07
  5  V, lb    100000.   S, rad         0.00     50000.     4.5507       0.00
100000.  -1.44E+07


Maximum pile-head deflection = 4.5506831548 inches
Maximum pile-head rotation   = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.
```

```
================================================================================

                    LPile for Windows, Version 2018-10.007

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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================================================================================

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Projects\18-42 I-95 Bridge Replacements Jasper
Co\Structures\Seismic\Rev1-Analysis\Lpile\Liquified-LPile\p-y Springs\

Name of input data file:
LPILE_BS_IB3_20 PSC Longitudinal.lp10

Name of output report file:
LPILE_BS_IB3_20 PSC Longitudinal.lp10

Name of plot output file:
LPILE_BS_IB3_20 PSC Longitudinal.lp10

Name of runtime message file:
LPILE_BS_IB3_20 PSC Longitudinal.lp10



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------
```

Date: October 19, 2021 Time: 8:37:46

Problem Title

Project Name: I-95 BRO SC 46 and Bagshaw Swamp (Bagshaw Swamp)

Job Number: EN175299

Client: ICE

Engineer: Terracon (A. Fekrat)

Description: HP 14x89 Steel Pile (Weak Axis)

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
- Static loading specified

```
 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - p-y curves computed and reported at user-specified depths
 - Print using wide report formats



--------------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Number of pile sections defined                        =            1
Total length of pile                                   =       60.000 ft
Depth of ground surface below top of pile              =      10.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           20.0000
  2            60.000           20.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is an elastic pile
   Cross-sectional shape                               =     rectangular
   Length of section                                   =    60.000000 ft
   Width of top of section                             =    20.000000 in
```

```
   Width of bottom of section                          =    20.000000 in
   Top Section Depth                                   =    20.000000 in
   Bottom Section Depth                                =    20.000000 in
   Top Area                                            =   400.000000 sq. in
   Bottom Area                                         =   400.000000 sq. in
   Moment of Inertia at Top                            =       13333. in^4
   Moment of Inertia at Bottom                         =       13333. in^4
   Elastic Modulus                                     =     3605000. psi



---------------------------------------------------------------------------
                        Ground Slope and Pile Batter Angles
---------------------------------------------------------------------------

Ground Slope Angle                                     =        0.000 degrees
                                                       =        0.000 radians

Pile Batter Angle                                      =        0.000 degrees
                                                       =        0.000 radians


---------------------------------------------------------------------------
                        Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 6 layers

Layer 1 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer           =    10.000000 ft
   Distance from top of pile to bottom of layer        =    15.000000 ft
   Effective unit weight at top of layer               =   115.000000 pcf
   Effective unit weight at bottom of layer            =    52.600000 pcf
   Undrained cohesion at top of layer                  =        1200. psf
   Undrained cohesion at bottom of layer               =        1200. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer           =    15.000000 ft
   Distance from top of pile to bottom of layer        =    18.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
```

```
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =   125.000000 psf
   Undrained cohesion at bottom of layer               =   125.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.


Layer 3 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer           =    18.000000 ft
   Distance from top of pile to bottom of layer        =    22.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =   200.000000 psf
   Undrained cohesion at bottom of layer               =   200.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.


Layer 4 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer           =    22.000000 ft
   Distance from top of pile to bottom of layer        =    26.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =   125.000000 psf
   Undrained cohesion at bottom of layer               =   125.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.


Layer 5 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer           =    26.000000 ft
   Distance from top of pile to bottom of layer        =    36.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =        1300. psf
   Undrained cohesion at bottom of layer               =        1300. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci
```

```
   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer          =    36.000000 ft
   Distance from top of pile to bottom of layer       =   102.000000 ft
   Effective unit weight at top of layer              =    52.600000 pcf
   Effective unit weight at bottom of layer           =    52.600000 pcf
   Undrained cohesion at top of layer                 =        3500. psf
   Undrained cohesion at bottom of layer              =        3500. psf
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 42.000 ft below the pile tip)



--------------------------------------------------------------------------------
                        Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Undrained       E50

Layer           Name             Depth       Unit Wt.    Cohesion        or
 kpy
 Num.     (p-y Curve Type)        ft           pcf          psf          krm
 pci
-----   -------------------   ----------   ----------   ----------   ----------
----------
  1       Stiff Clay w/o         10.0000     115.0000        1200.     default
default
        Free Water, using k      15.0000      52.6000        1200.     default
default
  2            Soft              15.0000      57.6000     125.0000     default
 --
               Clay              18.0000      57.6000     125.0000     default
 --
  3            Soft              18.0000      57.6000     200.0000     default
 --
               Clay              22.0000      57.6000     200.0000     default
 --
  4            Soft              22.0000      57.6000     125.0000     default
 --
               Clay              26.0000      57.6000     125.0000     default
 --
  5       Stiff Clay w/o         26.0000      57.6000        1300.     default
default
```

```
        Free Water, using k      36.0000      57.6000        1300.     default
default
  6         Stiff Clay           36.0000      52.6000        3500.     default
 --
          w/o Free Water        102.0000      52.6000        3500.     default
 --
```

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	10.000	0.9650	1.0000
2	72.000	0.9650	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 5

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 15000. lbs	M = 0.0000 in-lbs	50000.	No
2	1	V = 30000. lbs	M = 0.0000 in-lbs	50000.	No
3	1	V = 45000. lbs	M = 0.0000 in-lbs	50000.	No
4	1	V = 60000. lbs	M = 0.0000 in-lbs	50000.	

	No					
5	1	V =	75000. lbs	M =	0.0000 in-lbs	50000.
	No					

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Specified Depths for Output of p-y Curves

Lateral load-transfer (p-y) curves are computed and output at 13 depths.
(Note that load-transfer values are computeded at the specified depths and may differ from values computed at nodal points)

Depth No.	Depth Below Pile Head ft	Depth Below Ground Surface ft
1	10.500	0.500
2	12.000	2.000
3	14.000	4.000
4	17.000	7.000
5	21.000	11.000
6	25.500	15.500
7	30.500	20.500
8	35.500	25.500
9	40.500	30.500
10	45.500	35.500
11	50.500	40.500
12	55.500	45.500
13	59.500	49.500

Depth of ground surface below top of pile = 10.0000 ft

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

---
Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	10.0000	0.00	N.A.	No	0.00	39395.
2	15.0000	23.0719	No	No	39395.	5711.
3	18.0000	18.0212	Yes	No	45107.	11985.
4	22.0000	32.8070	Yes	No	57092.	7625.
5	26.0000	7.0511	No	No	64717.	156465.
6	36.0000	8.6629	No	No	221182.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

---
p-y Curves Reported for Specified Depths
---

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water with Option of Defining Initial k

Soil Layer Number	=	1
Depth of top of Layer 1 below pile head	=	10.000 ft
Depth of p-y curve below pile head	=	10.500 ft
Depth of p-y curve below ground surface	=	0.500 ft
Equivalent depth of p-y curve	=	0.500 ft
Pile diameter	=	20.000 in

Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	111.880	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	532.769	lb/in
Pcd	=	1500.000	lb/in
Pu	=	532.769	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	0.32024
0.00177	5.12379
0.00896	25.93920
0.02832	81.98068
0.06914	171.37417
0.14336	205.64901
0.26559	239.92384
0.45309	274.19867
0.72576	308.47351
1.10617	342.74834
1.61955	377.02318
2.29376	411.29801
3.15934	445.57285
4.24947	479.84768
5.60000	514.12251
7.00000	514.12251

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	1	
Depth of top of Layer 1 below pile head	=	10.000	ft
Depth of p-y curve below pile head	=	12.000	ft
Depth of p-y curve below ground surface	=	2.000	ft
Equivalent depth of p-y curve	=	2.000	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	102.520	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees

k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	628.478	lb/in
Pcd	=	1500.000	lb/in
Pu	=	628.478	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	1.28095
0.00177	20.49517
0.00896	103.75680
0.02832	161.72828
0.06914	202.16035
0.14336	242.59242
0.26559	283.02449
0.45309	323.45656
0.72576	363.88863
1.10617	404.32070
1.61955	444.75277
2.29376	485.18484
3.15934	525.61691
4.24947	566.04899
5.60000	606.48106
7.00000	606.48106

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	1	
Depth of top of Layer 1 below pile head	=	10.000	ft
Depth of p-y curve below pile head	=	14.000	ft
Depth of p-y curve below ground surface	=	4.000	ft
Equivalent depth of p-y curve	=	4.000	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	90.040	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	750.022	lb/in
Pcd	=	1500.000	lb/in
Pu	=	750.022	lb/in

y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	2.56190
0.00177	40.99034
0.00896	144.75429
0.02832	193.00572
0.06914	241.25715
0.14336	289.50858
0.26559	337.76001
0.45309	386.01144
0.72576	434.26287
1.10617	482.51430
1.61955	530.76573
2.29376	579.01716
3.15934	627.26859
4.24947	675.52001
5.60000	723.77144
7.00000	723.77144

p-y Curve Computed Using the Soft Clay Criteria for Static Loading

Soil Layer Number	=	2	
Depth of top of Layer 2 below pile head	=	15.000	ft
Depth of p-y curve below pile head	=	17.000	ft
Depth of p-y curve below ground surface	=	7.000	ft
Equiv. depth of p-y curve below ground surface	=	25.072	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile diameter	=	20.000	in
Average effective unit weight	=	0.04416	pci
Average effective unit weight	=	76.314	pcf
Undrained cohesion	=	0.868	psi
Undrained cohesion	=	125.000	psf
Epsilon_50	=	0.0200	
J (default value)	=	0.5000	
Transition depth Xr	=	6.590	ft
Static pu_s for flat ground	=	448.408	lb/in
Static pu_d for flat ground	=	156.250	lb/in
y_50	=	1.00000	in

p-multiplier	=	0.965	
y-multiplier	=	1.000	
Positive-y Sloping Ground Factor	=	1.000	
Negative-y Sloping Ground Factor	=	1.000	
Sloping Ground Factor	=	1.000	
Positive-y, static pu	=	156.250	lb/in

y, inches	p, lbs/in
0.00000	0.00000
0.00237	10.05208
0.01896	20.10417
0.06400	30.15625
0.15170	40.20833
0.29630	50.26042
0.51200	60.31250
0.81304	70.36458
1.21363	80.41667
1.72800	90.46875
2.37037	100.52083
3.15496	110.57292
4.09600	120.62500
5.20770	130.67708
6.50430	140.72917
8.00000	150.78125
8.50000	150.78125

p-y Curve Computed Using the Soft Clay Criteria for Static Loading

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	18.000	ft
Depth of p-y curve below pile head	=	21.000	ft
Depth of p-y curve below ground surface	=	11.000	ft
Equiv. depth of p-y curve below ground surface	=	21.021	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile diameter	=	20.000	in
Average effective unit weight	=	0.04023	pci
Average effective unit weight	=	69.509	pcf
Undrained cohesion	=	1.389	psi
Undrained cohesion	=	200.000	psf
Epsilon_50	=	0.0200	
J (default value)	=	0.5000	
Transition depth Xr	=	9.266	ft
Static pu_s for flat ground	=	461.449	lb/in

Static pu_d for flat ground	=	250.000	lb/in
y_50	=	1.00000	in
p-multiplier	=	0.965	
y-multiplier	=	1.000	
Positive-y Sloping Ground Factor	=	1.000	
Negative-y Sloping Ground Factor	=	1.000	
Sloping Ground Factor	=	1.000	
Positive-y, static pu	=	250.000	lb/in

y, inches	p, lbs/in
0.00000	0.00000
0.00237	16.08333
0.01896	32.16667
0.06400	48.25000
0.15170	64.33333
0.29630	80.41667
0.51200	96.50000
0.81304	112.58333
1.21363	128.66667
1.72800	144.75000
2.37037	160.83333
3.15496	176.91667
4.09600	193.00000
5.20770	209.08333
6.50430	225.16667
8.00000	241.25000
8.50000	241.25000

p-y Curve Computed Using the Soft Clay Criteria for Static Loading

Soil Layer Number	=	4	
Depth of top of Layer 4 below pile head	=	22.000	ft
Depth of p-y curve below pile head	=	25.500	ft
Depth of p-y curve below ground surface	=	15.500	ft
Equiv. depth of p-y curve below ground surface	=	36.307	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile diameter	=	20.000	in
Average effective unit weight	=	0.03822	pci
Average effective unit weight	=	66.052	pcf
Undrained cohesion	=	0.868	psi
Undrained cohesion	=	125.000	psf
Epsilon_50	=	0.0200	
J (default value)	=	0.5000	

Transition depth Xr	=	7.243 ft
Static pu_s for flat ground	=	574.256 lb/in
Static pu_d for flat ground	=	156.250 lb/in
y_50	=	1.00000 in
p-multiplier	=	0.965
y-multiplier	=	1.000
Positive-y Sloping Ground Factor	=	1.000
Negative-y Sloping Ground Factor	=	1.000
Sloping Ground Factor	=	1.000
Positive-y, static pu	=	156.250 lb/in

y, inches	p, lbs/in
0.00000	0.00000
0.00237	10.05208
0.01896	20.10417
0.06400	30.15625
0.15170	40.20833
0.29630	50.26042
0.51200	60.31250
0.81304	70.36458
1.21363	80.41667
1.72800	90.46875
2.37037	100.52083
3.15496	110.57292
4.09600	120.62500
5.20770	130.67708
6.50430	140.72917
8.00000	150.78125
8.50000	150.78125

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	5
Depth of top of Layer 5 below pile head	=	26.000 ft
Depth of p-y curve below pile head	=	30.500 ft
Depth of p-y curve below ground surface	=	20.500 ft
Equivalent depth of p-y curve	=	11.551 ft
Pile diameter	=	20.000 in
Undrained cohesion	=	1300.000 psf
Average eff. unit weight	=	63.990 pcf
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
k_py	=	500. pci

Epsilon_50	=	0.00700	
Pct	=	1270.014	lb/in
Pcd	=	1625.000	lb/in
Pu	=	1270.014	lb/in
y50	=	0.350	in
p-multiplier	=	0.96500	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	13.12972
0.00177	163.40845
0.00896	245.11268
0.02832	326.81690
0.06914	408.52113
0.14336	490.22535
0.26559	571.92958
0.45309	653.63380
0.72576	735.33803
1.10617	817.04225
1.61955	898.74648
2.29376	980.45070
3.15934	1062.15493
4.24947	1143.85915
5.60000	1225.56338
7.00000	1225.56338

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	5	
Depth of top of Layer 5 below pile head	=	26.000	ft
Depth of p-y curve below pile head	=	35.500	ft
Depth of p-y curve below ground surface	=	25.500	ft
Equivalent depth of p-y curve	=	16.551	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1300.000	psf
Average eff. unit weight	=	62.737	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	1582.405	lb/in
Pcd	=	1625.000	lb/in
Pu	=	1582.405	lb/in
y50	=	0.350	in

p-multiplier = 0.96500
y-multiplier = 1.00000
Sloping Ground Factor = 1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	16.33209
0.00177	203.60272
0.00896	305.40407
0.02832	407.20543
0.06914	509.00679
0.14336	610.80815
0.26559	712.60951
0.45309	814.41087
0.72576	916.21222
1.10617	1018.01358
1.61955	1119.81494
2.29376	1221.61630
3.15934	1323.41766
4.24947	1425.21902
5.60000	1527.02037
7.00000	1527.02037

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number = 6
Depth of p-y curve below pile head = 40.500 ft
Depth of p-y curve below ground surface = 30.500 ft
Depth of top of layer 6 below pile head = 36.000 ft
Equiv. depth of p-y curve below ground surface = 13.163 ft
Pile diameter = 20.000 in
Ground slope angle = 0.000 degrees
Pile batter angle = 0.000 degrees
Effective slope angle = 0.000 degrees
Undrained cohesion = 24.306 psi
Undrained cohesion = 3500.000 psf
Average effective unit weight = 0.03539 pci
Average effective unit weight = 61.157 pcf
Epsilon-50 = 0.00500
Pct = 3489.723 lb/in
Pcd = 4375.000 lb/in
Pu = 3489.723 lb/in
y50 = 0.25000 in
p-multiplier = 0.96500
y-multiplier = 1.00000

Sloping Ground Factor = 1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	224.50550
0.00126	449.01099
0.00640	673.51649
0.02023	898.02198
0.04938	1122.52748
0.10240	1347.03298
0.18971	1571.53847
0.32363	1796.04397
0.51840	2020.54946
0.79012	2245.05496
1.15682	2469.56045
1.63840	2694.06595
2.25667	2918.57145
3.03534	3143.07694
4.00000	3367.58244
5.00000	3367.58244

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	45.500 ft
Depth of p-y curve below ground surface	=	35.500 ft
Depth of top of layer 6 below pile head	=	36.000 ft
Equiv. depth of p-y curve below ground surface	=	18.163 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03469 pci
Average effective unit weight	=	59.952 pcf
Epsilon-50	=	0.00500
Pct	=	4258.319 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4258.319 lb/in
y50	=	0.25000 in
p-multiplier	=	0.96500
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000

0.00007901	273.95188
0.00126	547.90376
0.00640	821.85564
0.02023	1095.80752
0.04938	1369.75940
0.10240	1643.71128
0.18971	1917.66316
0.32363	2191.61504
0.51840	2465.56692
0.79012	2739.51880
1.15682	3013.47068
1.63840	3287.42256
2.25667	3561.37444
3.03534	3835.32632
4.00000	4109.27820
5.00000	4109.27820

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	50.500 ft
Depth of p-y curve below ground surface	=	40.500 ft
Depth of top of layer 6 below pile head	=	36.000 ft
Equiv. depth of p-y curve below ground surface	=	40.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03417 pci
Average effective unit weight	=	59.044 pcf
Epsilon-50	=	0.00500
Pct	=	5026.199 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.96500
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	281.45833
0.00126	562.91667
0.00640	844.37500
0.02023	1125.83333
0.04938	1407.29167

0.10240	1688.75000
0.18971	1970.20833
0.32363	2251.66667
0.51840	2533.12500
0.79012	2814.58333
1.15682	3096.04167
1.63840	3377.50000
2.25667	3658.95833
3.03534	3940.41667
4.00000	4221.87500
5.00000	4221.87500

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	55.500 ft
Depth of p-y curve below ground surface	=	45.500 ft
Depth of top of layer 6 below pile head	=	36.000 ft
Equiv. depth of p-y curve below ground surface	=	45.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03376 pci
Average effective unit weight	=	58.336 pcf
Epsilon-50	=	0.00500
Pct	=	5793.599 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.96500
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	281.45833
0.00126	562.91667
0.00640	844.37500
0.02023	1125.83333
0.04938	1407.29167
0.10240	1688.75000
0.18971	1970.20833
0.32363	2251.66667
0.51840	2533.12500
0.79012	2814.58333

1.15682	3096.04167
1.63840	3377.50000
2.25667	3658.95833
3.03534	3940.41667
4.00000	4221.87500
5.00000	4221.87500

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	59.500 ft
Depth of p-y curve below ground surface	=	49.500 ft
Depth of top of layer 6 below pile head	=	36.000 ft
Equiv. depth of p-y curve below ground surface	=	49.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03349 pci
Average effective unit weight	=	57.873 pcf
Epsilon-50	=	0.00500
Pct	=	6407.271 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.96500
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	281.45833
0.00126	562.91667
0.00640	844.37500
0.02023	1125.83333
0.04938	1407.29167
0.10240	1688.75000
0.18971	1970.20833
0.32363	2251.66667
0.51840	2533.12500
0.79012	2814.58333
1.15682	3096.04167
1.63840	3377.50000
2.25667	3658.95833
3.03534	3940.41667
4.00000	4221.87500

5.00000 4221.87500

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 15000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 50000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	1.7857	-2.06E-06	15000.	-0.00983	125.0000	4.81E+10	0.00	0.00	0.00
0.6000	1.7149	111540.	15000.	-0.00982	208.6549	4.81E+10	0.00	0.00	0.00
1.2000	1.6443	223074.	15000.	-0.00980	292.3052	4.81E+10	0.00	0.00	0.00
1.8000	1.5738	334595.	15000.	-0.00976	375.9465	4.81E+10	0.00	0.00	0.00
2.4000	1.5038	446099.	15000.	-0.00970	459.5743	4.81E+10	0.00	0.00	0.00
3.0000	1.4342	557579.	15000.	-0.00962	543.1841	4.81E+10	0.00	0.00	0.00
3.6000	1.3652	669028.	15000.	-0.00953	626.7713	4.81E+10	0.00	0.00	0.00
4.2000	1.2969	780442.	15000.	-0.00942	710.3314	4.81E+10	0.00	0.00	0.00
4.8000	1.2295	891813.	15000.	-0.00930	793.8600	4.81E+10	0.00	0.00	0.00
5.4000	1.1630	1003137.	15000.	-0.00916	877.3525	4.81E+10	0.00	0.00	0.00
6.0000	1.0976	1114406.	15000.	-0.00900	960.8045	4.81E+10	0.00	0.00	0.00
6.6000	1.0334	1225615.	15000.	-0.00882	1044.	4.81E+10	0.00	0.00	0.00
7.2000	0.9706	1336758.	15000.	-0.00863	1128.	4.81E+10			

```
0.00       0.00       0.00
    7.8000     0.9092   1447829.     15000.   -0.00842      1211.   4.81E+10
0.00       0.00       0.00
    8.4000     0.8493   1558822.     15000.   -0.00820      1294.   4.81E+10
0.00       0.00       0.00
    9.0000     0.7911   1669731.     15000.   -0.00796      1377.   4.81E+10
0.00       0.00       0.00
    9.6000     0.7347   1780550.     15000.   -0.00770      1460.   4.81E+10
0.00       0.00       0.00
   10.2000     0.6803   1891273.     13948.   -0.00742      1543.   4.81E+10
-292.3536      3094.       0.00
   10.8000     0.6279   1986738.     11785.   -0.00713      1615.   4.81E+10
-308.3649      3536.       0.00
   11.4000     0.5776   2066110.      9512.   -0.00683      1675.   4.81E+10
-323.0194      4027.       0.00
   12.0000     0.5296   2128626.      7138.   -0.00651      1721.   4.81E+10
-336.3181      4573.       0.00
   12.6000     0.4838   2173592.      4674.   -0.00619      1755.   4.81E+10
-348.2641      5183.       0.00
   13.2000     0.4404   2200387.      2128.   -0.00586      1775.   4.81E+10
-358.8624      5867.       0.00
   13.8000     0.3994   2208460.  -488.9417   -0.00553      1781.   4.81E+10
-368.1190      6637.       0.00
   14.4000     0.3607   2197330.     -3168.   -0.00520      1773.   4.81E+10
-376.0405      7506.       0.00
   15.0000     0.3244   2166588.     -5767.   -0.00488      1750.   4.81E+10
-345.9252      7677.       0.00
   15.6000     0.2905   2117797.     -7192.   -0.00456      1713.   4.81E+10
-49.9304      1238.       0.00
   16.2000     0.2588   2066303.     -7545.   -0.00424      1675.   4.81E+10
-48.0463      1337.       0.00
   16.8000     0.2294   2012206.     -7884.   -0.00394      1634.   4.81E+10
-46.1515      1449.       0.00
   17.4000     0.2021   1955609.     -8209.   -0.00364      1592.   4.81E+10
-44.2457      1576.       0.00
   18.0000     0.1770   1896613.     -8567.   -0.00335      1547.   4.81E+10
-55.0274      2239.       0.00
   18.6000     0.1539   1834661.     -8998.   -0.00307      1501.   4.81E+10
-64.6403      3024.       0.00
   19.2000     0.1328   1769260.     -9452.   -0.00280      1452.   4.81E+10
-61.5352      3337.       0.00
   19.8000     0.1135   1700574.     -9884.   -0.00254      1400.   4.81E+10
-58.4096      3704.       0.00
   20.4000    0.09615   1628767.    -10293.   -0.00229      1347.   4.81E+10
-55.2616      4138.       0.00
   21.0000    0.08052   1554008.    -10679.   -0.00205      1291.   4.81E+10
-52.0887      4658.       0.00
   21.6000    0.06657   1476466.    -11043.   -0.00183      1232.   4.81E+10
-48.8873      5288.       0.00
   22.2000    0.05421   1396309.    -11321.   -0.00161      1172.   4.81E+10
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-28.5326      3790.       0.00
   22.8000    0.04335   1314597.    -11520.   -0.00141      1111.   4.81E+10
-26.4846      4399.       0.00
   23.4000    0.03391   1231442.    -11703.   -0.00122      1049.   4.81E+10
-24.4037      5181.       0.00
   24.0000    0.02581   1146956.    -11871.   -0.00104   985.2167   4.81E+10
-22.2793      6216.       0.00
   24.6000    0.01893   1061252.    -12023.  -8.75E-04   920.9391   4.81E+10
-20.0947      7641.       0.00
   25.2000    0.01321    974450.    -12160.  -7.22E-04   855.8373   4.81E+10
-17.8213      9715.       0.00
   25.8000    0.00853    886671.    -12279.  -5.83E-04   790.0032   4.81E+10
-15.4055     13002.       0.00
   26.4000    0.00481    798046.    -12938.  -4.57E-04   723.5343   4.81E+10
-167.4003    250521.       0.00
   27.0000    0.00195    700699.    -14039.  -3.45E-04   650.5246   4.81E+10
-138.5816    511179.       0.00
   27.6000  -1.52E-04    596131.    -14482.  -2.48E-04   572.0985   4.81E+10
15.4418    733709.       0.00
   28.2000   -0.00161    492331.    -13917.  -1.66E-04   494.2486   4.81E+10
141.5131    632040.       0.00
   28.8000   -0.00254    395841.    -12818.  -9.95E-05   421.8809   4.81E+10
163.8797    464243.       0.00
   29.4000   -0.00304    307825.    -11591.  -4.68E-05   355.8688   4.81E+10
176.9826    418581.       0.00
   30.0000   -0.00321    228967.    -10288.  -6.55E-06   296.7253   4.81E+10
185.0240    414371.       0.00
   30.6000   -0.00314    159688.     -8939.   2.26E-05   244.7664   4.81E+10
189.4913    434691.       0.00
   31.2000   -0.00289    100224.     -7569.   4.20E-05   200.1683   4.81E+10
191.0823    476032.       0.00
   31.8000   -0.00253     50661.     -6197.   5.33E-05   162.9955   4.81E+10
190.1737    540454.       0.00
   32.4000   -0.00212     10953.     -4839.   5.79E-05   133.2147   4.81E+10
186.9860    634366.       0.00
   33.0000   -0.00170    -19062.     -3512.   5.73E-05   139.2967   4.81E+10
181.6520    769704.       0.00
   33.6000   -0.00130    -39659.     -2231.   5.29E-05   154.7446   4.81E+10
174.2431    967480.       0.00
   34.2000  -9.37E-04    -51222.     -1131.   4.61E-05   163.4163   4.81E+10
131.2900   1008850.       0.00
   34.8000  -6.33E-04    -55975.  -331.1256   3.81E-05   166.9814   4.81E+10
90.8240   1033862.       0.00
   35.4000  -3.88E-04    -56017.   201.4752   2.97E-05   167.0131   4.81E+10
57.1207   1058875.       0.00
   36.0000  -2.05E-04    -53095.   752.3073   2.15E-05   164.8215   4.81E+10
95.8882   3372647.       0.00
   36.6000  -7.83E-05    -45200.      1294.   1.42E-05   158.8998   4.81E+10
54.5608   5018992.       0.00
   37.2000  -5.84E-07    -34473.      1492.   8.21E-06   150.8548   4.81E+10
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0.4203   5179499.       0.00
   37.8000   3.99E-05    -23723.      1387.   3.85E-06   142.7921   4.81E+10
-29.6089   5339966.       0.00
   38.4000   5.48E-05    -14506.      1129.   9.86E-07   135.8797   4.81E+10
-41.8977   5500397.       0.00
   39.0000   5.41E-05     -7461.   825.3392  -6.59E-07   130.5957   4.81E+10
-42.5506   5660794.       0.00
   39.6000   4.54E-05     -2621.   540.1610  -1.41E-06   126.9657   4.81E+10
-36.6655   5821158.       0.00
   40.2000   3.38E-05   318.4487   307.2168  -1.59E-06   125.2388   4.81E+10
-28.0412   5981492.       0.00
   40.8000   2.25E-05      1804.   137.1723  -1.43E-06   126.3531   4.81E+10
-19.1934   6141798.       0.00
   41.4000   1.32E-05      2295.    26.5054  -1.12E-06   126.7211   4.81E+10
-11.5475   6302076.       0.00
   42.0000   6.36E-06      2187.   -35.6160  -7.85E-07   126.6400   4.81E+10
-5.7085   6462330.       0.00
   42.6000   1.89E-06      1782.   -62.4108  -4.88E-07   126.3368   4.81E+10
-1.7345   6622559.       0.00
   43.2000  -6.66E-07      1288.   -66.3956  -2.58E-07   125.9662   4.81E+10
0.6276   6782765.       0.00
   43.8000  -1.83E-06   826.5425   -57.7874  -9.96E-08   125.6199   4.81E+10
1.7635   6942950.       0.00
   44.4000  -2.10E-06   456.1971   -43.9806  -3.49E-09   125.3421   4.81E+10
2.0717   7103115.       0.00
   45.0000  -1.88E-06   193.2244   -29.6982   4.51E-08   125.1449   4.81E+10
1.8956   7263260.       0.00
   45.6000  -1.45E-06    28.5102   -17.4926   6.18E-08   125.0214   4.81E+10
1.4948   7423387.       0.00
   46.2000  -9.90E-07   -58.7128    -8.3578   5.95E-08   125.0440   4.81E+10
1.0426   7583497.       0.00
   46.8000  -5.93E-07   -91.8850    -2.3506   4.82E-08   125.0689   4.81E+10
0.6261   7599375.       0.00
   47.4000  -2.96E-07   -92.5955     1.0266   3.44E-08   125.0694   4.81E+10
0.3120   7599375.       0.00
   48.0000  -9.79E-08   -77.1266     2.5218   2.17E-08   125.0578   4.81E+10
0.1033   7599375.       0.00
   48.6000   1.66E-08   -56.2969     2.8306   1.17E-08   125.0422   4.81E+10
-0.01756   7599375.       0.00
   49.2000   7.04E-08   -36.3742     2.4997   4.75E-09   125.0273   4.81E+10
-0.07436   7599375.       0.00
   49.8000   8.50E-08   -20.3042     1.9089   5.05E-10   125.0152   4.81E+10
-0.08975   7599375.       0.00
   50.4000   7.77E-08    -8.8857     1.2905  -1.68E-09   125.0067   4.81E+10
-0.08203   7599375.       0.00
   51.0000   6.08E-08    -1.7193     0.7641  -2.48E-09   125.0013   4.81E+10
-0.06420   7599375.       0.00
   51.6000   4.21E-08     2.1191     0.3731  -2.45E-09   125.0016   4.81E+10
-0.04441   7599375.       0.00
   52.2000   2.56E-08     3.6553     0.1159  -2.01E-09   125.0027   4.81E+10
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-0.02703   7599375.       0.00
   52.8000   1.31E-08     3.7900   -0.03110  -1.46E-09   125.0028   4.81E+10
-0.01381   7599375.       0.00
   53.4000   4.65E-09     3.2084   -0.09851  -9.31E-10   125.0024   4.81E+10
-0.00491   7599375.       0.00
   54.0000  -3.22E-10     2.3721    -0.1150  -5.13E-10   125.0018   4.81E+10
3.40E-04   7599375.       0.00
   54.6000  -2.74E-09     1.5533    -0.1033  -2.19E-10   125.0012   4.81E+10
0.00289   7599375.       0.00
   55.2000  -3.48E-09     0.8843   -0.07970  -3.67E-11   125.0007   4.81E+10
0.00367   7599375.       0.00
   55.8000  -3.27E-09     0.4057   -0.05406   5.99E-11   125.0003   4.81E+10
0.00345   7599375.       0.00
   56.4000  -2.62E-09     0.1058   -0.03170   9.82E-11   125.0001   4.81E+10
0.00276   7599375.       0.00
   57.0000  -1.85E-09   -0.05083   -0.01471   1.02E-10   125.0000   4.81E+10
0.00196   7599375.       0.00
   57.6000  -1.14E-09    -0.1061   -0.00333   9.06E-11   125.0001   4.81E+10
0.00121   7599375.       0.00
   58.2000  -5.49E-10   -0.09879    0.00310   7.52E-11   125.0001   4.81E+10
5.79E-04   7599375.       0.00
   58.8000  -6.01E-11   -0.06145    0.00542   6.32E-11   125.0000   4.81E+10
6.35E-05   7599375.       0.00
   59.4000   3.62E-10   -0.02082    0.00427   5.71E-11   125.0000   4.81E+10
-3.82E-04   7599375.       0.00
   60.0000   7.62E-10       0.00       0.00   5.55E-11   125.0000   4.81E+10
-8.04E-04   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 1:

Pile-head deflection             =     1.78573765 inches
Computed slope at pile head      =    -0.00983282 radians
Maximum bending moment           =       2208460. inch-lbs
Maximum shear force              =         15000. lbs
Depth of maximum bending moment  =    13.80000000 feet below pile head
Depth of maximum shear force     =     9.00000000 feet below pile head
Number of iterations             =             25
Number of zero deflection points =              6



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                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 2
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Pile-head conditions are Shear and Moment (Loading Type 1)
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Shear force at pile head = 30000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 50000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	5.9363	4.94E-06	30000.	-0.02734	125.0000	4.81E+10	0.00	0.00	0.00
0.6000	5.7394	225842.	30000.	-0.02732	294.3814	4.81E+10	0.00	0.00	0.00
1.2000	5.5428	451671.	30000.	-0.02727	463.7536	4.81E+10	0.00	0.00	0.00
1.8000	5.3467	677477.	30000.	-0.02719	633.1076	4.81E+10	0.00	0.00	0.00
2.4000	5.1514	903246.	30000.	-0.02707	802.4342	4.81E+10	0.00	0.00	0.00
3.0000	4.9570	1128966.	30000.	-0.02692	971.7242	4.81E+10	0.00	0.00	0.00
3.6000	4.7638	1354625.	30000.	-0.02673	1141.	4.81E+10	0.00	0.00	0.00
4.2000	4.5721	1580211.	30000.	-0.02651	1310.	4.81E+10	0.00	0.00	0.00
4.8000	4.3820	1805712.	30000.	-0.02626	1479.	4.81E+10	0.00	0.00	0.00
5.4000	4.1940	2031115.	30000.	-0.02597	1648.	4.81E+10	0.00	0.00	0.00
6.0000	4.0081	2256409.	30000.	-0.02565	1817.	4.81E+10	0.00	0.00	0.00
6.6000	3.8246	2481582.	30000.	-0.02529	1986.	4.81E+10	0.00	0.00	0.00
7.2000	3.6439	2706620.	30000.	-0.02490	2155.	4.81E+10	0.00	0.00	0.00
7.8000	3.4660	2931513.	30000.	-0.02448	2324.	4.81E+10	0.00	0.00	0.00
8.4000	3.2913	3156247.	30000.	-0.02403	2492.	4.81E+10	0.00	0.00	0.00
9.0000	3.1200	3380812.	30000.	-0.02354	2661.	4.81E+10	0.00	0.00	0.00
9.6000	2.9524	3605194.	30000.	-0.02301	2829.	4.81E+10	0.00	0.00	0.00
10.2000	2.7886	3829381.	28502.	-0.02246	2997.	4.81E+10	-415.9893	1074.	0.00
10.8000	2.6290	4031797.	25417.	-0.02187	3149.	4.81E+10			

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-441.1075      1208.       0.00
   11.4000     2.4738   4211129.     22156.   -0.02125      3283.   4.81E+10
-464.6860      1352.       0.00
   12.0000     2.3230   4366144.     18731.   -0.02061      3400.   4.81E+10
-486.7259      1509.       0.00
   12.6000     2.1770   4495692.     15153.   -0.01994      3497.   4.81E+10
-507.2292      1678.       0.00
   13.2000     2.0358   4598703.     11432.   -0.01926      3574.   4.81E+10
-526.1987      1861.       0.00
   13.8000     1.8996   4674188.      7581.   -0.01857      3631.   4.81E+10
-543.6379      2061.       0.00
   14.4000     1.7684   4721238.      3609.   -0.01786      3666.   4.81E+10
-559.5498      2278.       0.00
   15.0000     1.6424   4739027.  -543.1648   -0.01716      3679.   4.81E+10
-593.9640      2604.       0.00
   15.6000     1.5214   4725769.     -2994.   -0.01645      3669.   4.81E+10
-86.7092   410.3531       0.00
   16.2000     1.4055   4707762.     -3610.   -0.01574      3656.   4.81E+10
-84.4495   432.6076       0.00
   16.8000     1.2947   4685122.     -4210.   -0.01504      3639.   4.81E+10
-82.1694   456.9488       0.00
   17.4000     1.1890   4657971.     -4793.   -0.01434      3618.   4.81E+10
-79.8686   483.6552       0.00
   18.0000     1.0883   4626427.     -5443.   -0.01364      3595.   4.81E+10
-100.8105   666.9713       0.00
   18.6000     0.9925   4589409.     -6239.   -0.01295      3567.   4.81E+10
-120.3241   872.8573       0.00
   19.2000     0.9017   4545905.     -7092.   -0.01227      3534.   4.81E+10
-116.5379   930.4973       0.00
   19.8000     0.8159   4496114.     -7917.   -0.01159      3497.   4.81E+10
-112.7143   994.6978       0.00
   20.4000     0.7348   4440238.     -8715.   -0.01092      3455.   4.81E+10
-108.8521      1067.       0.00
   21.0000     0.6586   4378480.     -9485.   -0.01026      3409.   4.81E+10
-104.9494      1147.       0.00
   21.6000     0.5871   4311045.    -10226.   -0.00961      3358.   4.81E+10
-101.0042      1239.       0.00
   22.2000     0.5202   4238142.    -10808.   -0.00897      3304.   4.81E+10
-60.6337   839.1944       0.00
   22.8000     0.4579   4161867.    -11236.   -0.00834      3246.   4.81E+10
-58.1098   913.6769       0.00
   23.4000     0.4001   4082354.    -11645.   -0.00772      3187.   4.81E+10
-55.5538   999.6895       0.00
   24.0000     0.3467   3999742.    -12035.   -0.00712      3125.   4.81E+10
-52.9632      1100.       0.00
   24.6000     0.2976   3914169.    -12407.   -0.00653      3061.   4.81E+10
-50.3352      1218.       0.00
   25.2000     0.2527   3825775.    -12760.   -0.00595      2994.   4.81E+10
-47.6667      1358.       0.00
   25.8000     0.2120   3734704.    -13094.   -0.00538      2926.   4.81E+10
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-44.9539      1527.       0.00
   26.4000     0.1753   3641101.    -14736.   -0.00483      2856.   4.81E+10
-411.2376     16892.       0.00
   27.0000     0.1425   3525983.    -17674.   -0.00429      2769.   4.81E+10
-404.9994     20464.       0.00
   27.6000     0.1135   3389680.    -20559.   -0.00377      2667.   4.81E+10
-396.3161     25139.       0.00
   28.2000    0.08818   3232648.    -23372.   -0.00328      2549.   4.81E+10
-384.9261     31431.       0.00
   28.8000    0.06633   3055489.    -26091.   -0.00281      2417.   4.81E+10
-370.4523     40210.       0.00
   29.4000    0.04778   2858960.    -28693.   -0.00236      2269.   4.81E+10
-352.3089     53086.       0.00
   30.0000    0.03232   2644013.    -31147.   -0.00195      2108.   4.81E+10
-329.4884     73405.       0.00
   30.6000    0.01970   2411843.    -33413.   -0.00157      1934.   4.81E+10
-299.9808    109616.       0.00
   31.2000    0.00969   2163991.    -35424.   -0.00123      1748.   4.81E+10
-258.6196    192142.       0.00
   31.8000    0.00201   1902617.    -37002.  -9.24E-04      1552.   4.81E+10
-179.6454    642849.       0.00
   32.4000   -0.00361   1631827.    -36880.  -6.59E-04      1349.   4.81E+10
213.5545    425339.       0.00
   33.0000   -0.00748   1372019.    -35164.  -4.34E-04      1154.   4.81E+10
263.1079    253189.       0.00
   33.6000   -0.00987   1125777.    -33175.  -2.47E-04   969.3330   4.81E+10
289.3916    211118.       0.00
   34.2000   -0.01104    894477.    -31034.  -9.60E-05   795.8576   4.81E+10
305.2581    199033.       0.00
   34.8000   -0.01125    678953.    -28804.   2.19E-05   634.2144   4.81E+10
314.3456    201160.       0.00
   35.4000   -0.01073    479687.    -26527.   1.09E-04   484.7656   4.81E+10
318.1849    213557.       0.00
   36.0000   -0.00969    296891.    -23885.   1.67E-04   347.6684   4.81E+10
415.6226    308936.       0.00
   36.6000   -0.00833    135625.    -20245.   1.99E-04   226.7185   4.81E+10
595.5285    515042.       0.00
   37.2000   -0.00682      5223.    -15996.   2.10E-04   128.9174   4.81E+10
584.6334    617424.       0.00
   37.8000   -0.00530    -94871.    -11854.   2.03E-04   196.1535   4.81E+10
566.0901    768383.       0.00
   38.4000   -0.00389   -165615.     -7873.   1.84E-04   249.2109   4.81E+10
539.7186    998041.       0.00
   39.0000   -0.00266   -208370.     -4111.   1.56E-04   281.2773   4.81E+10
505.0527   1366358.       0.00
   39.6000   -0.00165   -224932.  -633.2654   1.23E-04   293.6989   4.81E+10
461.1196   2007465.       0.00
   40.2000  -8.89E-04   -217577.      2487.   8.99E-05   288.1831   4.81E+10
405.6966   3285954.       0.00
   40.8000  -3.59E-04   -189180.      5049.   5.95E-05   266.8849   4.81E+10
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305.9635   6141798.       0.00
   41.4000  -3.25E-05   -144911.      6253.   3.45E-05   233.6833   4.81E+10
28.4033   6302076.       0.00
   42.0000   1.37E-04    -99162.      5911.   1.62E-05   199.3715   4.81E+10
-123.4056   6462330.       0.00
   42.6000   2.00E-04    -59805.      4803.   4.27E-06   169.8537   4.81E+10
-184.4092   6622559.       0.00
   43.2000   1.99E-04    -30004.      3464.  -2.46E-06   147.5032   4.81E+10
-187.4538   6782765.       0.00
   43.8000   1.65E-04     -9920.      2216.  -5.45E-06   132.4398   4.81E+10
-159.2264   6942950.       0.00
   44.4000   1.21E-04      1911.      1215.  -6.05E-06   126.4333   4.81E+10
-118.9374   7103115.       0.00
   45.0000   7.81E-05      7576.   503.0267  -5.34E-06   130.6820   4.81E+10
-78.7448   7263260.       0.00
   45.6000   4.37E-05      9158.    57.2367  -4.08E-06   131.8689   4.81E+10
-45.0857   7423387.       0.00
   46.2000   1.93E-05      8403.  -178.1635  -2.77E-06   131.3024   4.81E+10
-20.3032   7583497.       0.00
   46.8000   3.89E-06      6595.  -266.0237  -1.64E-06   129.9462   4.81E+10
-4.1024   7599375.       0.00
   47.4000  -4.39E-06      4574.  -264.1106  -8.07E-07   128.4302   4.81E+10
4.6338   7599375.       0.00
   48.0000  -7.73E-06      2792.  -218.0395  -2.55E-07   127.0942   4.81E+10
8.1637   7599375.       0.00
   48.6000  -8.07E-06      1434.  -157.9957   6.12E-08   126.0755   4.81E+10
8.5151   7599375.       0.00
   49.2000  -6.85E-06   517.1144  -101.2986   2.07E-07   125.3878   4.81E+10
7.2341   7599375.       0.00
   49.8000  -5.08E-06   -24.8167   -55.9440   2.44E-07   125.0186   4.81E+10
5.3644   7599375.       0.00
   50.4000  -3.34E-06  -288.6544   -23.9491   2.21E-07   125.2165   4.81E+10
3.5230   7599375.       0.00
   51.0000  -1.90E-06  -369.8432    -4.0296   1.71E-07   125.2774   4.81E+10
2.0102   7599375.       0.00
   51.6000  -8.70E-07  -346.8037     6.5132   1.18E-07   125.2601   4.81E+10
0.9184   7599375.       0.00
   52.2000  -2.10E-07  -276.1376    10.6161   7.10E-08   125.2071   4.81E+10
0.2213   7599375.       0.00
   52.8000   1.53E-07  -193.9835    10.8318   3.58E-08   125.1455   4.81E+10
-0.1614   7599375.       0.00
   53.4000   3.06E-07  -120.1860     9.0868   1.23E-08   125.0901   4.81E+10
-0.3233   7599375.       0.00
   54.0000   3.30E-07   -63.1420     6.6687  -1.43E-09   125.0474   4.81E+10
-0.3484   7599375.       0.00
   54.6000   2.86E-07   -24.1551     4.3288  -7.97E-09   125.0181   4.81E+10
-0.3016   7599375.       0.00
   55.2000   2.15E-07    -0.8020     2.4246  -9.84E-09   125.0006   4.81E+10
-0.2273   7599375.       0.00
   55.8000   1.44E-07    10.7669     1.0587  -9.09E-09   125.0081   4.81E+10
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-0.1521   7599375.       0.00
   56.4000   8.45E-08    14.4492     0.1900  -7.20E-09   125.0108   4.81E+10
-0.08918   7599375.       0.00
   57.0000   4.04E-08    13.5074    -0.2848  -5.11E-09   125.0101   4.81E+10
-0.04269   7599375.       0.00
   57.6000   1.10E-08    10.3519    -0.4801  -3.32E-09   125.0078   4.81E+10
-0.01157   7599375.       0.00
   58.2000  -7.35E-09     6.5958    -0.4939  -2.05E-09   125.0049   4.81E+10
0.00776   7599375.       0.00
   58.8000  -1.86E-08     3.2415    -0.3954  -1.31E-09   125.0024   4.81E+10
0.01958   7599375.       0.00
   59.4000  -2.63E-08     0.9023    -0.2252  -1.00E-09   125.0007   4.81E+10
0.02772   7599375.       0.00
   60.0000  -3.30E-08       0.00       0.00  -9.35E-10   125.0000   4.81E+10
0.03483   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 2:

Pile-head deflection             =     5.93626866 inches
Computed slope at pile head      =    -0.02733843 radians
Maximum bending moment           =       4739027. inch-lbs
Maximum shear force              =        -37002. lbs
Depth of maximum bending moment  =    15.00000000 feet below pile head
Depth of maximum shear force     =    31.80000000 feet below pile head
Number of iterations             =             31
Number of zero deflection points =              5



--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 3
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Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head                                =      45000.0 lbs
Applied moment at pile head                             =          0.0 in-lbs
Axial thrust load on pile head                          =      50000.0 lbs

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
lb/inch    lb/inch    lb/inch
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      0.00   11.9613   1.15E-05   45000.   -0.04996   125.0000   4.81E+10
0.00   0.00   0.00
    0.6000   11.6015   341986.   45000.   -0.04994   381.4894   4.81E+10
0.00   0.00   0.00
    1.2000   11.2422   683953.   45000.   -0.04986   637.9649   4.81E+10
0.00   0.00   0.00
    1.8000   10.8836   1025884.   45000.   -0.04973   894.4128   4.81E+10
0.00   0.00   0.00
    2.4000   10.5261   1367759.   45000.   -0.04955   1151.   4.81E+10
0.00   0.00   0.00
    3.0000   10.1700   1709560.   45000.   -0.04932   1407.   4.81E+10
0.00   0.00   0.00
    3.6000   9.8159   2051270.   45000.   -0.04904   1663.   4.81E+10
0.00   0.00   0.00
    4.2000   9.4639   2392868.   45000.   -0.04871   1920.   4.81E+10
0.00   0.00   0.00
    4.8000   9.1145   2734338.   45000.   -0.04832   2176.   4.81E+10
0.00   0.00   0.00
    5.4000   8.7681   3075660.   45000.   -0.04789   2432.   4.81E+10
0.00   0.00   0.00
    6.0000   8.4249   3416816.   45000.   -0.04740   2688.   4.81E+10
0.00   0.00   0.00
    6.6000   8.0855   3757788.   45000.   -0.04686   2943.   4.81E+10
0.00   0.00   0.00
    7.2000   7.7501   4098558.   45000.   -0.04627   3199.   4.81E+10
0.00   0.00   0.00
    7.8000   7.4191   4439106.   45000.   -0.04564   3454.   4.81E+10
0.00   0.00   0.00
    8.4000   7.0930   4779415.   45000.   -0.04494   3710.   4.81E+10
0.00   0.00   0.00
    9.0000   6.7719   5119466.   45000.   -0.04420   3965.   4.81E+10
0.00   0.00   0.00
    9.6000   6.4564   5459242.   45000.   -0.04341   4219.   4.81E+10
0.00   0.00   0.00
   10.2000   6.1468   5798722.   43217.   -0.04257   4474.   4.81E+10
-495.1997   580.0472   0.00
   10.8000   5.8434   6112219.   39516.   -0.04168   4709.   4.81E+10
-532.8958   656.6077   0.00
   11.4000   5.5467   6397761.   35551.   -0.04074   4923.   4.81E+10
-568.6279   738.1219   0.00
   12.0000   5.2568   6653481.   31355.   -0.03976   5115.   4.81E+10
-596.9679   817.6394   0.00
   12.6000   4.9741   6877895.   26960.   -0.03875   5283.   4.81E+10
-623.6169   902.6828   0.00
   13.2000   4.6988   7069609.   22381.   -0.03770   5427.   4.81E+10
-648.5770   993.8118   0.00
   13.8000   4.4312   7227320.   17627.   -0.03663   5545.   4.81E+10
-671.8505   1092.   0.00
   14.4000   4.1713   7349813.   12712.   -0.03554   5637.   4.81E+10

-693.4401	1197.	0.00				
15.0000	3.9194	7435961.	7358.	-0.03443	5702.	4.81E+10
-793.7367	1458.	0.00				
15.6000	3.6755	7480561.	4082.	-0.03332	5735.	4.81E+10
-116.3471	227.9157	0.00				
16.2000	3.4396	7518727.	3253.	-0.03219	5764.	4.81E+10
-113.8034	238.2183	0.00				
16.8000	3.2119	7550587.	2443.	-0.03106	5788.	4.81E+10
-111.2343	249.3496	0.00				
17.4000	2.9923	7576274.	1652.	-0.02993	5807.	4.81E+10
-108.6392	261.4041	0.00				
18.0000	2.7809	7595920.	764.2932	-0.02879	5822.	4.81E+10
-137.8233	356.8379	0.00				
18.6000	2.5777	7608012.	-327.2800	-0.02766	5831.	4.81E+10
-165.3915	461.9760	0.00				
19.2000	2.3826	7611120.	-1503.	-0.02652	5833.	4.81E+10
-161.1106	486.8530	0.00				
19.8000	2.1958	7605465.	-2647.	-0.02538	5829.	4.81E+10
-156.7848	514.0889	0.00				
20.4000	2.0172	7591272.	-3760.	-0.02424	5818.	4.81E+10
-152.4130	544.0040	0.00				
21.0000	1.8468	7568769.	-4842.	-0.02310	5802.	4.81E+10
-147.9939	576.9769	0.00				
21.6000	1.6845	7538186.	-5891.	-0.02197	5779.	4.81E+10
-143.5261	613.4575	0.00				
22.2000	1.5304	7499756.	-6721.	-0.02085	5750.	4.81E+10
-86.8800	408.7401	0.00				
22.8000	1.3844	7456418.	-7336.	-0.01973	5717.	4.81E+10
-84.0235	437.0037	0.00				
23.4000	1.2464	7408322.	-7930.	-0.01861	5681.	4.81E+10
-81.1332	468.6938	0.00				
24.0000	1.1163	7355620.	-8504.	-0.01751	5642.	4.81E+10
-78.2080	504.4116	0.00				
24.6000	0.9943	7298468.	-9057.	-0.01641	5599.	4.81E+10
-75.2464	544.8982	0.00				
25.2000	0.8801	7237021.	-9587.	-0.01532	5553.	4.81E+10
-72.2474	591.0749	0.00				
25.8000	0.7737	7171439.	-10097.	-0.01424	5504.	4.81E+10
-69.2099	644.0969	0.00				
26.4000	0.6750	7101882.	-12420.	-0.01317	5451.	4.81E+10
-576.0734	6145.	0.00				
27.0000	0.5840	7002078.	-16568.	-0.01212	5377.	4.81E+10
-576.2357	7104.	0.00				
27.6000	0.5005	6872025.	-20710.	-0.01108	5279.	4.81E+10
-574.2968	8261.	0.00				
28.2000	0.4245	6711829.	-24830.	-0.01006	5159.	4.81E+10
-570.1593	9671.	0.00				
28.8000	0.3557	6521715.	-28912.	-0.00907	5016.	4.81E+10
-563.7091	11411.	0.00				
29.4000	0.2939	6302026.	-32939.	-0.00811	4852.	4.81E+10

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-554.8085     13591.       0.00
   30.0000     0.2389   6053236.    -36892.   -0.00718      4665.   4.81E+10
-543.2861     16372.       0.00
   30.6000     0.1905   5775956.    -40752.   -0.00630      4457.   4.81E+10
-528.9208     19992.       0.00
   31.2000     0.1483   5470945.    -44497.   -0.00545      4228.   4.81E+10
-511.4135     24835.       0.00
   31.8000     0.1119   5139127.    -48103.   -0.00466      3979.   4.81E+10
-490.3365     31536.       0.00
   32.4000    0.08118   4781614.    -51543.   -0.00392      3711.   4.81E+10
-465.0330     41247.       0.00
   33.0000    0.05556   4399735.    -54780.   -0.00323      3425.   4.81E+10
-434.3946     56295.       0.00
   33.6000    0.03469   3995099.    -57771.   -0.00260      3121.   4.81E+10
-396.2820     82260.       0.00
   34.2000    0.01812   3569705.    -60441.   -0.00203      2802.   4.81E+10
-345.5458    137290.       0.00
   34.8000    0.00541   3126206.    -62628.   -0.00153      2470.   4.81E+10
-261.8002    348552.       0.00
   35.4000   -0.00393   2668966.    -62679.   -0.00110      2127.   4.81E+10
247.5702    453091.       0.00
   36.0000   -0.01040   2224416.    -60265.  -7.31E-04      1793.   4.81E+10
423.0436    292941.       0.00
   36.6000   -0.01446   1801677.    -56281.  -4.30E-04      1476.   4.81E+10
683.7019    340379.       0.00
   37.2000   -0.01658   1414284.    -51191.  -1.89E-04      1186.   4.81E+10
730.1364    316997.       0.00
   37.8000   -0.01718   1064665.    -45828.  -3.06E-06   923.4986   4.81E+10
759.4366    318277.       0.00
   38.4000   -0.01663    754357.    -40301.   1.33E-04   690.7681   4.81E+10
775.8931    335970.       0.00
   39.0000   -0.01526    484232.    -34694.   2.26E-04   488.1738   4.81E+10
781.5934    368723.       0.00
   39.6000   -0.01337    254598.    -29081.   2.81E-04   315.9482   4.81E+10
777.6360    418642.       0.00
   40.2000   -0.01121     65263.    -23529.   3.05E-04   173.9469   4.81E+10
764.5875    491011.       0.00
   40.8000   -0.00898    -84440.    -18103.   3.04E-04   188.3300   4.81E+10
742.6761    595548.       0.00
   41.4000   -0.00684   -195638.    -12867.   2.83E-04   271.7281   4.81E+10
711.8658    749672.       0.00
   42.0000   -0.00491   -269921.     -7885.   2.48E-04   327.4410   4.81E+10
671.8484    985983.       0.00
   42.6000   -0.00327   -309362.     -3228.   2.05E-04   357.0216   4.81E+10
621.9262   1370907.       0.00
   43.2000   -0.00196   -316545.      1030.   1.58E-04   362.4091   4.81E+10
560.6364   2059185.       0.00
   43.8000  -9.96E-04   -294648.      4792.   1.12E-04   345.9863   4.81E+10
484.4585   3503502.       0.00
   44.4000  -3.49E-04   -247621.      7775.   7.13E-05   310.7158   4.81E+10
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344.0134   7103115.       0.00
   45.0000   3.11E-05   -182747.      8900.   3.91E-05   262.0601   4.81E+10
-31.4066   7263260.       0.00
   45.6000   2.14E-04   -119491.      7993.   1.64E-05   214.6181   4.81E+10
-220.5148   7423387.       0.00
   46.2000   2.68E-04    -67660.      6184.   2.42E-06   175.7448   4.81E+10
-282.0154   7583497.       0.00
   46.8000   2.49E-04    -30445.      4224.  -4.93E-06   147.8336   4.81E+10
-262.4504   7599375.       0.00
   47.4000   1.97E-04     -6834.      2531.  -7.72E-06   130.1252   4.81E+10
-207.6388   7599375.       0.00
   48.0000   1.37E-04      6014.      1262.  -7.79E-06   129.5105   4.81E+10
-145.0484   7599375.       0.00
   48.6000   8.46E-05     11342.   418.1281  -6.49E-06   133.5064   4.81E+10
-89.3038   7599375.       0.00
   49.2000   4.40E-05     12040.   -70.6570  -4.73E-06   134.0297   4.81E+10
-46.4699   7599375.       0.00
   49.8000   1.64E-05     10328.  -300.3763  -3.06E-06   132.7459   4.81E+10
-17.3410   7599375.       0.00
   50.4000  -2.98E-08      7716.  -362.6910  -1.71E-06   130.7873   4.81E+10
0.03140   7599375.       0.00
   51.0000  -8.17E-06      5106.  -331.5459  -7.48E-07   128.8297   4.81E+10
8.6200   7599375.       0.00
   51.6000  -1.08E-05      2943.  -259.4882  -1.45E-07   127.2070   4.81E+10
11.3960   7599375.       0.00
   52.2000  -1.03E-05      1370.  -179.5025   1.78E-07   126.0273   4.81E+10
10.8222   7599375.       0.00
   52.8000  -8.23E-06   357.7570  -109.2613   3.07E-07   125.2683   4.81E+10
8.6892   7599375.       0.00
   53.4000  -5.83E-06  -203.8202   -55.8439   3.19E-07   125.1529   4.81E+10
6.1490   7599375.       0.00
   54.0000  -3.64E-06  -446.6244   -19.8810   2.70E-07   125.3350   4.81E+10
3.8407   7599375.       0.00
   54.6000  -1.93E-06  -490.3019     1.2927   2.00E-07   125.3677   4.81E+10
2.0409   7599375.       0.00
   55.2000  -7.57E-07  -428.1542    11.5168   1.31E-07   125.3211   4.81E+10
0.7992   7599375.       0.00
   55.8000  -4.25E-08  -324.5553    14.5550   7.50E-08   125.2434   4.81E+10
0.04481   7599375.       0.00
   56.4000   3.22E-07  -218.6157    13.4921   3.43E-08   125.1640   4.81E+10
-0.3401   7599375.       0.00
   57.0000   4.51E-07  -130.2938    10.5538   8.14E-09   125.0977   4.81E+10
-0.4761   7599375.       0.00
   57.6000   4.39E-07   -66.6465     7.1700  -6.61E-09   125.0500   4.81E+10
-0.4638   7599375.       0.00
   58.2000   3.56E-07   -27.0405     4.1478  -1.36E-08   125.0203   4.81E+10
-0.3757   7599375.       0.00
   58.8000   2.43E-07    -6.9082     1.8711  -1.62E-08   125.0052   4.81E+10
-0.2568   7599375.       0.00
   59.4000   1.23E-07   -0.08556     0.4789  -1.67E-08   125.0001   4.81E+10
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-0.1300   7599375.       0.00
   60.0000   2.91E-09       0.00       0.00  -1.67E-08   125.0000   4.81E+10
-0.00307   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 3:

Pile-head deflection             =    11.96125439 inches
Computed slope at pile head      =    -0.04996066 radians
Maximum bending moment           =       7611120. inch-lbs
Maximum shear force              =        -62679. lbs
Depth of maximum bending moment  =    19.20000000 feet below pile head
Depth of maximum shear force     =    35.40000000 feet below pile head
Number of iterations             =             37
Number of zero deflection points =              5



---------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 4
---------------------------------------------------------------------------

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head                              =      60000.0 lbs
Applied moment at pile head                           =          0.0 in-lbs
Axial thrust load on pile head                        =      50000.0 lbs

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
lb/inch    lb/inch    lb/inch
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    21.4713   7.58E-05     60000.   -0.08191   125.0000   4.81E+10
0.00       0.00       0.00
    0.6000    20.8815    461488.     60000.   -0.08188   471.1158   4.81E+10
0.00       0.00       0.00
    1.2000    20.2923    922950.     60000.   -0.08177   817.2129   4.81E+10
0.00       0.00       0.00
    1.8000    19.7040   1384364.     60000.   -0.08160      1163.   4.81E+10
0.00       0.00       0.00
    2.4000    19.1172   1845702.     60000.   -0.08136      1509.   4.81E+10
0.00       0.00       0.00
    3.0000    18.5325   2306941.     60000.   -0.08105      1855.   4.81E+10
```

```
0.00       0.00       0.00
    3.6000    17.9502   2768055.     60000.   -0.08067      2201.   4.81E+10
0.00       0.00       0.00
    4.2000    17.3709   3229020.     60000.   -0.08022      2547.   4.81E+10
0.00       0.00       0.00
    4.8000    16.7950   3689811.     60000.   -0.07970      2892.   4.81E+10
0.00       0.00       0.00
    5.4000    16.2232   4150403.     60000.   -0.07911      3238.   4.81E+10
0.00       0.00       0.00
    6.0000    15.6558   4610772.     60000.   -0.07846      3583.   4.81E+10
0.00       0.00       0.00
    6.6000    15.0934   5070891.     60000.   -0.07773      3928.   4.81E+10
0.00       0.00       0.00
    7.2000    14.5365   5530738.     60000.   -0.07694      4273.   4.81E+10
0.00       0.00       0.00
    7.8000    13.9856   5990286.     60000.   -0.07607      4618.   4.81E+10
0.00       0.00       0.00
    8.4000    13.4411   6449510.     60000.   -0.07514      4962.   4.81E+10
0.00       0.00       0.00
    9.0000    12.9035   6908388.     60000.   -0.07414      5306.   4.81E+10
0.00       0.00       0.00
    9.6000    12.3734   7366892.     60000.   -0.07307      5650.   4.81E+10
0.00       0.00       0.00
   10.2000    11.8513   7824999.     58217.   -0.07193      5994.   4.81E+10
-495.1995   300.8482       0.00
   10.8000    11.3376   8257014.     54516.   -0.07073      6318.   4.81E+10
-532.8956   338.4189       0.00
   11.4000    10.8328   8660957.     50546.   -0.06946      6621.   4.81E+10
-569.9896   378.8436       0.00
   12.0000    10.3373   9034886.     46310.   -0.06814      6901.   4.81E+10
-606.4814   422.4181       0.00
   12.6000     9.8516   9376887.     41815.   -0.06676      7158.   4.81E+10
-642.3711   469.4746       0.00
   13.2000     9.3760   9685082.     37062.   -0.06533      7389.   4.81E+10
-677.6586   520.3870       0.00
   13.8000     8.9108   9957625.     32058.   -0.06386      7593.   4.81E+10
-712.3440   575.5779       0.00
   14.4000     8.4564   1.02E+07     26807.   -0.06235      7770.   4.81E+10
-746.4272   635.5269       0.00
   15.0000     8.0130   1.04E+07     21243.   -0.06081      7916.   4.81E+10
-799.1412   718.0617       0.00
   15.6000     7.5808   1.05E+07     17833.   -0.05924      8032.   4.81E+10
-148.1000   140.6614       0.00
   16.2000     7.1599   1.07E+07     16777.   -0.05765      8141.   4.81E+10
-145.3071   146.1207       0.00
   16.8000     6.7506   1.08E+07     15740.   -0.05604      8244.   4.81E+10
-142.4835   151.9693       0.00
   17.4000     6.3529   1.10E+07     14725.   -0.05441      8341.   4.81E+10
-139.6290   158.2464       0.00
   18.0000     5.9671   1.11E+07     13582.   -0.05276      8433.   4.81E+10
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-177.7660   214.4954       0.00
   18.6000     5.5932   1.12E+07     12171.   -0.05109      8516.   4.81E+10
-214.1203   275.6318       0.00
   19.2000     5.2314   1.13E+07     10647.   -0.04941      8592.   4.81E+10
-209.3999   288.1988       0.00
   19.8000     4.8817   1.14E+07      9156.   -0.04771      8658.   4.81E+10
-204.6268   301.8008       0.00
   20.4000     4.5444   1.15E+07      7700.   -0.04600      8716.   4.81E+10
-199.7999   316.5591       0.00
   21.0000     4.2193   1.15E+07      6279.   -0.04428      8766.   4.81E+10
-194.9182   332.6139       0.00
   21.6000     3.9067   1.16E+07      4894.   -0.04255      8808.   4.81E+10
-189.9806   350.1279       0.00
   22.2000     3.6066   1.16E+07      3794.   -0.04081      8842.   4.81E+10
-115.6161   230.8069       0.00
   22.8000     3.3191   1.17E+07      2973.   -0.03907      8871.   4.81E+10
-112.4577   243.9534       0.00
   23.4000     3.0441   1.17E+07      2174.   -0.03732      8895.   4.81E+10
-109.2619   258.4330       0.00
   24.0000     2.7817   1.17E+07      1399.   -0.03556      8915.   4.81E+10
-106.0278   274.4392       0.00
   24.6000     2.5319   1.17E+07   647.6600   -0.03381      8929.   4.81E+10
-102.7546   292.2019       0.00
   25.2000     2.2948   1.18E+07   -80.2467   -0.03205      8940.   4.81E+10
-99.4417   311.9959       0.00
   25.8000     2.0704   1.18E+07  -784.1551   -0.03029      8946.   4.81E+10
-96.0884   334.1517       0.00
   26.4000     1.8587   1.18E+07     -3802.   -0.02853      8948.   4.81E+10
-742.0869      2875.       0.00
   27.0000     1.6597   1.17E+07     -9167.   -0.02677      8920.   4.81E+10
-748.1761      3246.       0.00
   27.6000     1.4733   1.17E+07    -14568.   -0.02502      8863.   4.81E+10
-752.2265      3676.       0.00
   28.2000     1.2994   1.15E+07    -19991.   -0.02328      8776.   4.81E+10
-754.1694      4179.       0.00
   28.8000     1.1381   1.14E+07    -25420.   -0.02156      8660.   4.81E+10
-753.9287      4770.       0.00
   29.4000     0.9889   1.12E+07    -30839.   -0.01987      8514.   4.81E+10
-751.4189      5471.       0.00
   30.0000     0.8519   1.10E+07    -36232.   -0.01821      8338.   4.81E+10
-746.5430      6310.       0.00
   30.6000     0.7267   1.07E+07    -41581.   -0.01659      8132.   4.81E+10
-739.1886      7324.       0.00
   31.2000     0.6129   1.04E+07    -46867.   -0.01502      7897.   4.81E+10
-729.2230      8566.       0.00
   31.8000     0.5104   1.00E+07    -52072.   -0.01349      7634.   4.81E+10
-716.4855     10108.       0.00
   32.4000     0.4186   9623075.    -57174.   -0.01202      7342.   4.81E+10
-700.7758     12053.       0.00
   33.0000     0.3373   9197329.    -62151.   -0.01061      7023.   4.81E+10
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-681.8356     14557.       0.00
   33.6000     0.2658   8735740.    -66979.   -0.00927      6677.   4.81E+10
-659.3171     17860.       0.00
   34.2000     0.2038   8239502.    -71631.   -0.00800      6305.   4.81E+10
-632.7282     22357.       0.00
   34.8000     0.1506   7710019.    -76073.   -0.00680      5908.   4.81E+10
-601.3262     28745.       0.00
   35.4000     0.1058   7148947.    -80268.   -0.00569      5487.   4.81E+10
-563.8919     38378.       0.00
   36.0000    0.06867   6558257.    -84740.   -0.00466      5044.   4.81E+10
-678.2330     71113.       0.00
   36.6000    0.03862   5932055.    -90328.   -0.00373      4574.   4.81E+10
-874.0678    162948.       0.00
   37.2000    0.01497   5260220.    -96037.   -0.00289      4070.   4.81E+10
-711.7694    342297.       0.00
   37.8000   -0.00300   4551204.    -96832.   -0.00216      3538.   4.81E+10
491.0332   1176533.       0.00
   38.4000   -0.01607   3867398.    -92294.   -0.00153      3026.   4.81E+10
769.3326    344626.       0.00
   39.0000   -0.02497   3223265.    -86342.  -9.94E-04      2542.   4.81E+10
883.9653    254886.       0.00
   39.6000   -0.03039   2624783.    -79723.  -5.56E-04      2094.   4.81E+10
954.7741    226198.       0.00
   40.2000   -0.03298   2075656.    -72681.  -2.04E-04      1682.   4.81E+10
1001.    218601.       0.00
   40.8000   -0.03333   1578325.    -65365.   6.94E-05      1309.   4.81E+10
1031.    222683.       0.00
   41.4000   -0.03198   1134352.    -57885.   2.73E-04   975.7641   4.81E+10
1047.    235695.       0.00
   42.0000   -0.02941    744590.    -50331.   4.13E-04   683.4428   4.81E+10
1051.    257389.       0.00
   42.6000   -0.02603    409286.    -42785.   5.00E-04   431.9644   4.81E+10
1045.    289043.       0.00
   43.2000   -0.02221    128130.    -35320.   5.40E-04   221.0976   4.81E+10
1029.    333441.       0.00
   43.8000   -0.01825    -99708.    -28008.   5.42E-04   199.7813   4.81E+10
1003.    395423.       0.00
   44.4000   -0.01440   -275571.    -20919.   5.14E-04   331.6783   4.81E+10
966.6823    483179.       0.00
   45.0000   -0.01085   -401306.    -14123.   4.63E-04   425.9795   4.81E+10
920.9228    610969.       0.00
   45.6000   -0.00773   -479279.     -7695.   3.97E-04   484.4590   4.81E+10
864.7697    805133.       0.00
   46.2000   -0.00513   -512396.     -1711.   3.23E-04   509.2969   4.81E+10
797.3026   1118836.       0.00
   46.8000   -0.00308   -504153.      3691.   2.47E-04   503.1149   4.81E+10
703.3255   1643597.       0.00
   47.4000   -0.00157   -459423.      8364.   1.75E-04   469.5672   4.81E+10
594.6950   2718771.       0.00
   48.0000  -5.64E-04   -383839.     12161.   1.12E-04   412.8793   4.81E+10
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460.0966   5870606.       0.00
   48.6000   3.24E-05   -284383.     13695.   6.16E-05   338.2872   4.81E+10
-34.1580   7599375.       0.00
   49.2000   3.22E-04   -186682.     12347.   2.63E-05   265.0117   4.81E+10
-340.1812   7599375.       0.00
   49.8000   4.11E-04   -106606.      9592.   4.32E-06   204.9549   4.81E+10
-425.0357   7447571.       0.00
   50.4000   3.85E-04    -48559.      6601.  -7.30E-06   161.4191   4.81E+10
-405.8643   7599375.       0.00
   51.0000   3.06E-04    -11549.      3978.  -1.18E-05   133.6614   4.81E+10
-322.7537   7599375.       0.00
   51.6000   2.15E-04      8731.      2001.  -1.20E-05   131.5481   4.81E+10
-226.4970   7599375.       0.00
   52.2000   1.33E-04     17268.   680.5179  -1.01E-05   137.9510   4.81E+10
-140.1788   7599375.       0.00
   52.8000   6.97E-05     18537.   -88.7875  -7.38E-06   138.9031   4.81E+10
-73.5171   7599375.       0.00
   53.4000   2.65E-05     15995.  -454.0948  -4.80E-06   136.9961   4.81E+10
-27.9571   7599375.       0.00
   54.0000   5.73E-07     12002.  -556.9162  -2.70E-06   134.0014   4.81E+10
-0.6044   7599375.       0.00
   54.6000  -1.24E-05      7977.  -511.9812  -1.20E-06   130.9828   4.81E+10
13.0863   7599375.       0.00
   55.2000  -1.68E-05      4630.  -401.1635  -2.60E-07   128.4727   4.81E+10
17.6964   7599375.       0.00
   55.8000  -1.61E-05      2201.  -276.1277   2.52E-07   126.6504   4.81E+10
17.0358   7599375.       0.00
   56.4000  -1.31E-05   653.8492  -164.8664   4.66E-07   125.4904   4.81E+10
13.8702   7599375.       0.00
   57.0000  -9.44E-06  -173.8590   -79.0767   5.01E-07   125.1304   4.81E+10
9.9603   7599375.       0.00
   57.6000  -5.92E-06  -485.2165   -20.7258   4.52E-07   125.3639   4.81E+10
6.2483   7599375.       0.00
   58.2000  -2.93E-06  -472.6354    12.8874   3.80E-07   125.3545   4.81E+10
3.0887   7599375.       0.00
   58.8000  -4.42E-07  -299.9121    25.6880   3.23E-07   125.2249   4.81E+10
0.4670   7599375.       0.00
   59.4000   1.72E-06  -102.9610    20.8418   2.92E-07   125.0772   4.81E+10
-1.8132   7599375.       0.00
   60.0000   3.77E-06       0.00       0.00   2.85E-07   125.0000   4.81E+10
-3.9762   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 4:

Pile-head deflection             =    21.47126784 inches
Computed slope at pile head      =    -0.08191023 radians
Maximum bending moment           =      11763619. inch-lbs
```

```
Maximum shear force              =        -96832. lbs
Depth of maximum bending moment  =    26.40000000 feet below pile head
Depth of maximum shear force     =    37.80000000 feet below pile head
Number of iterations             =             42
Number of zero deflection points =              4
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 5

Pile-head conditions are Shear and Moment (Loading Type 1)

```
Shear force at pile head                              =      75000.0 lbs
Applied moment at pile head                           =          0.0 in-lbs
Axial thrust load on pile head                        =      50000.0 lbs
```

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	33.3582	2.64E-05	75000.	-0.1195	125.0000	4.81E+10	0.00	0.00	0.00
0.6000	32.4978	583019.	75000.	-0.1195	562.2645	4.81E+10	0.00	0.00	0.00
1.2000	31.6380	1166007.	75000.	-0.1193	999.5054	4.81E+10	0.00	0.00	0.00
1.8000	30.7795	1748932.	75000.	-0.1191	1437.	4.81E+10	0.00	0.00	0.00
2.4000	29.9229	2331763.	75000.	-0.1188	1874.	4.81E+10	0.00	0.00	0.00
3.0000	29.0688	2914468.	75000.	-0.1184	2311.	4.81E+10	0.00	0.00	0.00
3.6000	28.2178	3497016.	75000.	-0.1179	2748.	4.81E+10	0.00	0.00	0.00
4.2000	27.3707	4079375.	75000.	-0.1174	3185.	4.81E+10	0.00	0.00	0.00
4.8000	26.5279	4661514.	75000.	-0.1167	3621.	4.81E+10	0.00	0.00	0.00
5.4000	25.6901	5243402.	75000.	-0.1160	4058.	4.81E+10	0.00	0.00	0.00
6.0000	24.8580	5825007.	75000.	-0.1151	4494.	4.81E+10	0.00	0.00	0.00
6.6000	24.0322	6406298.	75000.	-0.1142	4930.	4.81E+10			

```
0.00       0.00       0.00
    7.2000    23.2133   6987244.     75000.    -0.1132      5365.   4.81E+10
0.00       0.00       0.00
    7.8000    22.4019   7567812.     75000.    -0.1121      5801.   4.81E+10
0.00       0.00       0.00
    8.4000    21.5987   8147973.     75000.    -0.1109      6236.   4.81E+10
0.00       0.00       0.00
    9.0000    20.8043   8727694.     75000.    -0.1097      6671.   4.81E+10
0.00       0.00       0.00
    9.6000    20.0193   9306945.     75000.    -0.1083      7105.   4.81E+10
0.00       0.00       0.00
   10.2000    19.2443   9885694.     73217.    -0.1069      7539.   4.81E+10
-495.1994   185.2724       0.00
   10.8000    18.4800   1.04E+07     69516.    -0.1054      7954.   4.81E+10
-532.8955   207.6219       0.00
   11.4000    17.7269   1.10E+07     65546.    -0.1038      8347.   4.81E+10
-569.9895   231.5081       0.00
   12.0000    16.9857   1.15E+07     61310.    -0.1021      8718.   4.81E+10
-606.4813   257.0792       0.00
   12.6000    16.2568   1.19E+07     56815.    -0.1003      9064.   4.81E+10
-642.3709   284.5006       0.00
   13.2000    15.5408   1.23E+07     52062.   -0.09852      9385.   4.81E+10
-677.6584   313.9572       0.00
   13.8000    14.8381   1.27E+07     47058.   -0.09664      9680.   4.81E+10
-712.3438   345.6563       0.00
   14.4000    14.1491   1.31E+07     41807.   -0.09471      9946.   4.81E+10
-746.4269   379.8311       0.00
   15.0000    13.4743   1.34E+07     36243.   -0.09272     10182.   4.81E+10
-799.1410   427.0224       0.00
   15.6000    12.8139   1.37E+07     32823.   -0.09069     10387.   4.81E+10
-150.7813    84.7226       0.00
   16.2000    12.1683   1.39E+07     31738.   -0.08863     10586.   4.81E+10
-150.7813    89.2178       0.00
   16.8000    11.5377   1.42E+07     30652.   -0.08652     10778.   4.81E+10
-150.7813    94.0939       0.00
   17.4000    10.9224   1.45E+07     29566.   -0.08437     10964.   4.81E+10
-150.7813    99.3942       0.00
   18.0000    10.3227   1.47E+07     28318.   -0.08219     11143.   4.81E+10
-196.0157   136.7188       0.00
   18.6000     9.7389   1.49E+07     26744.   -0.07997     11314.   4.81E+10
-241.2501   178.3567       0.00
   19.2000     9.1712   1.51E+07     25007.   -0.07772     11475.   4.81E+10
-241.2501   189.3979       0.00
   19.8000     8.6198   1.53E+07     23270.   -0.07544     11626.   4.81E+10
-241.2501   201.5141       0.00
   20.4000     8.0849   1.55E+07     21533.   -0.07313     11767.   4.81E+10
-241.2501   214.8459       0.00
   21.0000     7.5667   1.57E+07     19812.   -0.07079     11898.   4.81E+10
-236.8137   225.3364       0.00
   21.6000     7.0655   1.59E+07     18126.   -0.06843     12019.   4.81E+10
```

```
-231.4650   235.8708       0.00
   22.2000     6.5814   1.60E+07     16784.   -0.06604     12131.   4.81E+10
-141.2831   154.5626       0.00
   22.8000     6.1146   1.61E+07     15779.   -0.06363     12236.   4.81E+10
-137.8603   162.3330       0.00
   23.4000     5.6651   1.63E+07     14799.   -0.06120     12335.   4.81E+10
-134.3963   170.8088       0.00
   24.0000     5.2333   1.64E+07     13844.   -0.05875     12429.   4.81E+10
-130.8905   180.0813       0.00
   24.6000     4.8191   1.65E+07     12914.   -0.05629     12517.   4.81E+10
-127.3422   190.2570       0.00
   25.2000     4.4227   1.66E+07     12010.   -0.05380     12599.   4.81E+10
-123.7506   201.4608       0.00
   25.8000     4.0443   1.67E+07     11132.   -0.05131     12675.   4.81E+10
-120.1154   213.8395       0.00
   26.4000     3.6839   1.68E+07      7530.   -0.04879     12747.   4.81E+10
-880.5009      1721.       0.00
   27.0000     3.3417   1.69E+07      1152.   -0.04627     12783.   4.81E+10
-891.2316      1920.       0.00
   27.6000     3.0177   1.69E+07     -5296.   -0.04374     12784.   4.81E+10
-899.9037      2147.       0.00
   28.2000     2.7119   1.68E+07    -11799.   -0.04121     12749.   4.81E+10
-906.4548      2407.       0.00
   28.8000     2.4242   1.67E+07    -18341.   -0.03870     12679.   4.81E+10
-910.8164      2705.       0.00
   29.4000     2.1546   1.66E+07    -24907.   -0.03620     12572.   4.81E+10
-912.9135      3051.       0.00
   30.0000     1.9029   1.64E+07    -31479.   -0.03373     12429.   4.81E+10
-912.6628      3453.       0.00
   30.6000     1.6689   1.62E+07    -38040.   -0.03129     12251.   4.81E+10
-909.9708      3926.       0.00
   31.2000     1.4523   1.59E+07    -44573.   -0.02889     12036.   4.81E+10
-904.7311      4485.       0.00
   31.8000     1.2528   1.55E+07    -51059.   -0.02654     11785.   4.81E+10
-896.8209      5154.       0.00
   32.4000     1.0701   1.52E+07    -57477.   -0.02424     11498.   4.81E+10
-886.0961      5962.       0.00
   33.0000     0.9038   1.47E+07    -63808.   -0.02200     11177.   4.81E+10
-872.3835      6950.       0.00
   33.6000     0.7534   1.43E+07    -70028.   -0.01983     10821.   4.81E+10
-855.4702      8176.       0.00
   34.2000     0.6183   1.37E+07    -76114.   -0.01773     10431.   4.81E+10
-835.0871      9725.       0.00
   34.8000     0.4981   1.32E+07    -82040.   -0.01571     10009.   4.81E+10
-810.8814     11722.       0.00
   35.4000     0.3920   1.26E+07    -87775.   -0.01378      9554.   4.81E+10
-782.3716     14369.       0.00
   36.0000     0.2996   1.19E+07    -94120.   -0.01195      9068.   4.81E+10
-980.1849     23559.       0.00
   36.6000     0.2200   1.12E+07   -102510.   -0.01022      8544.   4.81E+10
```

```
-1350.     44198.       0.00
   37.2000     0.1525   1.05E+07   -111948.   -0.00859      7967.   4.81E+10
-1271.     60044.       0.00
   37.8000    0.09624   9619301.   -120731.   -0.00709      7339.   4.81E+10
-1168.     87414.       0.00
   38.4000    0.05039   8722042.   -128623.   -0.00571      6667.   4.81E+10
-1024.    146286.       0.00
   39.0000    0.01395   7771241.   -135060.   -0.00448      5953.   4.81E+10
-764.2197    394573.       0.00
   39.6000   -0.01412   6780404.   -134974.   -0.00339      5210.   4.81E+10
788.1852    402025.       0.00
   40.2000   -0.03486   5830061.   -128481.   -0.00245      4498.   4.81E+10
1015.    209682.       0.00
   40.8000   -0.04932   4932039.   -120732.   -0.00164      3824.   4.81E+10
1137.    165973.       0.00
   41.4000   -0.05847   4092694.   -112257.  -9.63E-04      3195.   4.81E+10
1217.    149915.       0.00
   42.0000   -0.06319   3316236.   -103292.  -4.08E-04      2612.   4.81E+10
1273.    145019.       0.00
   42.6000   -0.06434   2605582.    -93993.   3.53E-05      2079.   4.81E+10
1310.    146617.       0.00
   43.2000   -0.06269   1962713.    -84476.   3.77E-04      1597.   4.81E+10
1333.    153135.       0.00
   43.8000   -0.05891   1388852.    -74839.   6.28E-04      1167.   4.81E+10
1344.    164229.       0.00
   44.4000   -0.05364    884574.    -65168.   7.99E-04   788.4307   4.81E+10
1343.    180262.       0.00
   45.0000   -0.04741    449861.    -55541.   8.99E-04   462.3957   4.81E+10
1331.    202204.       0.00
   45.6000   -0.04069     84142.    -46032.   9.39E-04   188.1067   4.81E+10
1310.    231737.       0.00
   46.2000   -0.03389   -213683.    -36716.   9.29E-04   285.2619   4.81E+10
1278.    271554.       0.00
   46.8000   -0.02732   -445234.    -27745.   8.80E-04   458.9255   4.81E+10
1214.    319888.       0.00
   47.4000   -0.02122   -613845.    -19274.   8.00E-04   585.3841   4.81E+10
1139.    386551.       0.00
   48.0000   -0.01579   -723355.    -11362.   7.00E-04   667.5163   4.81E+10
1058.    482486.       0.00
   48.6000   -0.01114   -777965.     -4061.   5.88E-04   708.4734   4.81E+10
969.8879    626783.       0.00
   49.2000   -0.00733   -782253.      2575.   4.71E-04   711.6899   4.81E+10
873.4790    858071.       0.00
   49.8000   -0.00436   -741218.      8482.   3.57E-04   680.9138   4.81E+10
767.1511   1266587.       0.00
   50.4000   -0.00219   -660375.     13569.   2.52E-04   620.2810   4.81E+10
645.9416   2121743.       0.00
   51.0000  -7.35E-04   -546010.     17664.   1.61E-04   534.5072   4.81E+10
491.5694   4813955.       0.00
   51.6000   1.33E-04   -406132.     18929.   9.01E-05   429.5991   4.81E+10
```

```
-140.0144   7599375.       0.00
   52.2000   5.63E-04   -273491.     16770.   3.92E-05   330.1183   4.81E+10
-459.7538   5884697.       0.00
   52.8000   6.97E-04   -164669.     13369.   6.40E-06   248.5017   4.81E+10
-485.1341   5008467.       0.00
   53.4000   6.55E-04    -80987.      9903.  -1.20E-05   185.7405   4.81E+10
-477.5306   5251485.       0.00
   54.0000   5.25E-04    -22057.      6557.  -1.97E-05   141.5424   4.81E+10
-451.8134   6200187.       0.00
   54.6000   3.71E-04     13453.      3522.  -2.04E-05   135.0901   4.81E+10
-391.4095   7599375.       0.00
   55.2000   2.32E-04     28672.      1233.  -1.72E-05   146.5041   4.81E+10
-244.3599   7599375.       0.00
   55.8000   1.23E-04     31222.  -114.4773  -1.27E-05   148.4162   4.81E+10
-129.9485   7599375.       0.00
   56.4000   4.84E-05     27033.  -766.1704  -8.35E-06   145.2746   4.81E+10
-51.0774   7599375.       0.00
   57.0000   2.82E-06     20195.  -960.7709  -4.82E-06   140.1460   4.81E+10
-2.9783   7599375.       0.00
   57.6000  -2.10E-05     13201.  -891.8157  -2.32E-06   134.9009   4.81E+10
22.1326   7599375.       0.00
   58.2000  -3.05E-05      7354.  -696.1600  -7.76E-07   130.5157   4.81E+10
32.2162   7599375.       0.00
   58.8000  -3.21E-05      3177.  -458.0392   1.26E-08   127.3828   4.81E+10
33.9284   7599375.       0.00
   59.4000  -3.03E-05   758.4585  -220.6101   3.07E-07   125.5688   4.81E+10
32.0241   7599375.       0.00
   60.0000  -2.77E-05       0.00       0.00   3.64E-07   125.0000   4.81E+10
29.2565   3799688.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 5:

Pile-head deflection             =    33.35816094 inches
Computed slope at pile head      =    -0.11949814 radians
Maximum bending moment           =      16878783. inch-lbs
Maximum shear force              =       -135060. lbs
Depth of maximum bending moment  =    27.60000000 feet below pile head
Depth of maximum shear force     =    39.00000000 feet below pile head
Number of iterations             =             44
Number of zero deflection points =              3


--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:
```

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Load Pile-head 1		Load Type	Load Pile-head 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	15000.	M, in-lb		0.00	50000.	1.7857	-0.00983	15000.	2208460.
2	V, lb	30000.	M, in-lb		0.00	50000.	5.9363	-0.02734	-37002.	4739027.
3	V, lb	45000.	M, in-lb		0.00	50000.	11.9613	-0.04996	-62679.	7611120.
4	V, lb	60000.	M, in-lb		0.00	50000.	21.4713	-0.08191	-96832.	1.18E+07
5	V, lb	75000.	M, in-lb		0.00	50000.	33.3582	-0.1195	-135060.	1.69E+07

Maximum pile-head deflection = 33.3581609413 inches
Maximum pile-head rotation = -0.1194981401 radians = -6.846739 deg.

The analysis ended normally.

```
=============================================================================

                    LPile for Windows, Version 2018-10.007

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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=============================================================================

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-----------------------------------------------------------------------------
                            Files Used for Analysis
-----------------------------------------------------------------------------

Path to file locations:
\Projects\18-42 I-95 Bridge Replacements Jasper
Co\Structures\Seismic\Rev1-Analysis\Lpile\Liquified-LPile\p-y Springs\

Name of input data file:
LPILE_BS_IB3_20 PSC Transverse.lp10

Name of output report file:
LPILE_BS_IB3_20 PSC Transverse.lp10

Name of plot output file:
LPILE_BS_IB3_20 PSC Transverse.lp10

Name of runtime message file:
LPILE_BS_IB3_20 PSC Transverse.lp10



-----------------------------------------------------------------------------
                          Date and Time of Analysis
-----------------------------------------------------------------------------
```

Date: October 19, 2021 Time: 8:38:10

Problem Title

Project Name: I-95 BRO SC 46 and Bagshaw Swamp (Bagshaw Swamp)

Job Number: EN175299

Client: ICE

Engineer: Terracon (A. Fekrat)

Description: HP 14x89 Steel Pile (Weak Axis)

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
- Static loading specified

```
 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - p-y curves computed and reported at user-specified depths
 - Print using wide report formats



--------------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Number of pile sections defined                        =            1
Total length of pile                                   =       60.000 ft
Depth of ground surface below top of pile              =      10.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

            Depth Below           Pile
Point        Pile Head          Diameter
 No.            feet             inches
-----      -------------     -------------
  1             0.000           20.0000
  2            60.000           20.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is an elastic pile
   Cross-sectional shape                               =     rectangular
   Length of section                                   =    60.000000 ft
   Width of top of section                             =    20.000000 in
```

```
   Width of bottom of section                          =    20.000000 in
   Top Section Depth                                   =    20.000000 in
   Bottom Section Depth                                =    20.000000 in
   Top Area                                            =   400.000000 sq. in
   Bottom Area                                         =   400.000000 sq. in
   Moment of Inertia at Top                            =       13333. in^4
   Moment of Inertia at Bottom                         =       13333. in^4
   Elastic Modulus                                     =     3605000. psi



--------------------------------------------------------------------------------
                        Ground Slope and Pile Batter Angles
--------------------------------------------------------------------------------

Ground Slope Angle                                     =        0.000 degrees
                                                       =        0.000 radians

Pile Batter Angle                                      =        0.000 degrees
                                                       =        0.000 radians


--------------------------------------------------------------------------------
                        Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using 6 layers

Layer 1 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer           =    10.000000 ft
   Distance from top of pile to bottom of layer        =    17.000000 ft
   Effective unit weight at top of layer               =   115.000000 pcf
   Effective unit weight at bottom of layer            =    52.600000 pcf
   Undrained cohesion at top of layer                  =        1200. psf
   Undrained cohesion at bottom of layer               =        1200. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci

   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer           =    17.000000 ft
   Distance from top of pile to bottom of layer        =    20.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
```

```
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =   125.000000 psf
   Undrained cohesion at bottom of layer               =   125.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.


Layer 3 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer           =    20.000000 ft
   Distance from top of pile to bottom of layer        =    24.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =   200.000000 psf
   Undrained cohesion at bottom of layer               =   200.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.


Layer 4 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer           =    24.000000 ft
   Distance from top of pile to bottom of layer        =    28.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =   125.000000 psf
   Undrained cohesion at bottom of layer               =   125.000000 psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.


Layer 5 is stiff clay with user-defined k-value

   Distance from top of pile to top of layer           =    28.000000 ft
   Distance from top of pile to bottom of layer        =    38.000000 ft
   Effective unit weight at top of layer               =    57.600000 pcf
   Effective unit weight at bottom of layer            =    57.600000 pcf
   Undrained cohesion at top of layer                  =        1300. psf
   Undrained cohesion at bottom of layer               =        1300. psf
   Epsilon-50 at top of layer                          =       0.0000
   Epsilon-50 at bottom of layer                       =       0.0000
   Subgrade k at top of layer                          =       0.0000 pci
   Subgrade k at bottom of layer                       =       0.0000 pci
```

```
   NOTE: Default values for Epsilon-50 will be computed for this layer.
   NOTE: Default values for subgrade k will be computed for this layer.

Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer          =    38.000000 ft
   Distance from top of pile to bottom of layer       =   104.000000 ft
   Effective unit weight at top of layer              =    52.600000 pcf
   Effective unit weight at bottom of layer           =    52.600000 pcf
   Undrained cohesion at top of layer                 =        3500. psf
   Undrained cohesion at bottom of layer              =        3500. psf
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000

   NOTE: Default values for Epsilon-50 will be computed for this layer.

 (Depth of the lowest soil layer extends 44.000 ft below the pile tip)



--------------------------------------------------------------------------------
                        Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Undrained       E50

Layer           Name             Depth       Unit Wt.    Cohesion        or
 kpy
 Num.     (p-y Curve Type)        ft           pcf          psf          krm
 pci
-----   -------------------   ----------   ----------   ----------   ----------
----------
  1       Stiff Clay w/o         10.0000     115.0000        1200.     default
default
        Free Water, using k      17.0000      52.6000        1200.     default
default
  2            Soft              17.0000      57.6000     125.0000     default
 --
               Clay              20.0000      57.6000     125.0000     default
 --
  3            Soft              20.0000      57.6000     200.0000     default
 --
               Clay              24.0000      57.6000     200.0000     default
 --
  4            Soft              24.0000      57.6000     125.0000     default
 --
               Clay              28.0000      57.6000     125.0000     default
 --
  5       Stiff Clay w/o         28.0000      57.6000        1300.     default
default
```

Free Water, using k	38.0000	57.6000	1300.	default	default
6 Stiff Clay	38.0000	52.6000	3500.	default	--
w/o Free Water	104.0000	52.6000	3500.	default	--

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	10.000	0.6800	1.0000
2	64.000	0.6800	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 10

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	2	V = 15000. lbs	S = 0.0000 in/in	50000.	No
2	2	V = 30000. lbs	S = 0.0000 in/in	50000.	No
3	2	V = 45000. lbs	S = 0.0000 in/in	50000.	No
4	2	V = 60000. lbs	S = 0.0000 in/in	50000.	

No 5	2	V =	75000. lbs	S =	0.0000 in/in	50000.
No 6	2	V =	5000. lbs	S =	0.0000 in/in	50000.
No 7	2	V =	10000. lbs	S =	0.0000 in/in	50000.
No 8	2	V =	20000. lbs	S =	0.0000 in/in	50000.
No 9	2	V =	25000. lbs	S =	0.0000 in/in	50000.
No 10	2	V =	35000. lbs	S =	0.0000 in/in	50000.
No						

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Specified Depths for Output of p-y Curves

Lateral load-transfer (p-y) curves are computed and output at 13 depths.
(Note that load-transfer values are computeded at the specified depths and may differ from values computed at nodal points)

Depth No.	Depth Below Pile Head ft	Depth Below Ground Surface ft
1	10.500	0.500
2	12.000	2.000
3	14.000	4.000
4	17.000	7.000
5	21.000	11.000
6	25.500	15.500
7	30.500	20.500
8	35.500	25.500
9	40.500	30.500
10	45.500	35.500
11	50.500	40.500
12	55.500	45.500
13	59.500	49.500

Depth of ground surface below top of pile = 10.0000 ft

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

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Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	10.0000	0.00	N.A.	No	0.00	60440.
2	17.0000	34.2956	No	No	60440.	5711.
3	20.0000	24.9929	Yes	No	66151.	11985.
4	24.0000	43.9832	Yes	No	78136.	7625.
5	28.0000	8.7256	No	No	85761.	168644.
6	38.0000	9.6237	No	No	254406.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

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p-y Curves Reported for Specified Depths

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p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	1	
Depth of top of Layer 1 below pile head	=	10.000	ft
Depth of p-y curve below pile head	=	10.500	ft
Depth of p-y curve below ground surface	=	0.500	ft
Equivalent depth of p-y curve	=	0.500	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	112.771	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	532.831	lb/in
Pcd	=	1500.000	lb/in
Pu	=	532.831	lb/in
y50	=	0.350	in
p-multiplier	=	0.68000	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	0.22566
0.00177	3.61055
0.00896	18.27840
0.02832	57.76877
0.06914	120.77511
0.14336	144.93013
0.26559	169.08515
0.45309	193.24017
0.72576	217.39519
1.10617	241.55021
1.61955	265.70523
2.29376	289.86025
3.15934	314.01528
4.24947	338.17030
5.60000	362.32532
7.00000	362.32532

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	1

Depth of top of Layer 1 below pile head	=	10.000	ft
Depth of p-y curve below pile head	=	12.000	ft
Depth of p-y curve below ground surface	=	2.000	ft
Equivalent depth of p-y curve	=	2.000	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	106.086	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	629.468	lb/in
Pcd	=	1500.000	lb/in
Pu	=	629.468	lb/in
y50	=	0.350	in
p-multiplier	=	0.68000	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	0.90264
0.00177	14.44219
0.00896	73.11360
0.02832	114.14358
0.06914	142.67947
0.14336	171.21537
0.26559	199.75126
0.45309	228.28715
0.72576	256.82305
1.10617	285.35894
1.61955	313.89484
2.29376	342.43073
3.15934	370.96662
4.24947	399.50252
5.60000	428.03841
7.00000	428.03841

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	1	
Depth of top of Layer 1 below pile head	=	10.000	ft
Depth of p-y curve below pile head	=	14.000	ft
Depth of p-y curve below ground surface	=	4.000	ft
Equivalent depth of p-y curve	=	4.000	ft
Pile diameter	=	20.000	in

Undrained cohesion	=	1200.000	psf
Average eff. unit weight	=	97.171	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	753.984	lb/in
Pcd	=	1500.000	lb/in
Pu	=	753.984	lb/in
y50	=	0.350	in
p-multiplier	=	0.68000	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	1.80527
0.00177	28.88439
0.00896	102.54184
0.02832	136.72246
0.06914	170.90307
0.14336	205.08368
0.26559	239.26430
0.45309	273.44491
0.72576	307.62552
1.10617	341.80614
1.61955	375.98675
2.29376	410.16737
3.15934	444.34798
4.24947	478.52859
5.60000	512.70921
7.00000	512.70921

p-y Curve Computed Using the Soft Clay Criteria for Static Loading

Soil Layer Number	=	2	
Depth of top of Layer 2 below pile head	=	17.000	ft
Depth of p-y curve below pile head	=	17.000	ft
Depth of p-y curve below ground surface	=	7.000	ft
Equiv. depth of p-y curve below ground surface	=	34.296	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile diameter	=	20.000	in

Average effective unit weight	=	0.04850	pci
Average effective unit weight	=	83.800	pcf
Undrained cohesion	=	4.601	psi
Undrained cohesion	=	662.500	psf
Epsilon_50	=	0.0100	
J (default value)	=	0.5000	
Transition depth Xr	=	14.068	ft
Static pu_s for flat ground	=	1621.907	lb/in
Static pu_d for flat ground	=	828.125	lb/in
y_50	=	0.50000	in
p-multiplier	=	0.680	
y-multiplier	=	1.000	
Positive-y Sloping Ground Factor	=	1.000	
Negative-y Sloping Ground Factor	=	1.000	
Sloping Ground Factor	=	1.000	
Positive-y, static pu	=	828.125	lb/in

y, inches	p, lbs/in
0.00000	0.00000
0.00119	37.54167
0.00948	75.08333
0.03200	112.62500
0.07585	150.16667
0.14815	187.70833
0.25600	225.25000
0.40652	262.79167
0.60681	300.33333
0.86400	337.87500
1.18519	375.41667
1.57748	412.95833
2.04800	450.50000
2.60385	488.04167
3.25215	525.58333
4.00000	563.12500
4.25000	563.12500

p-y Curve Computed Using the Soft Clay Criteria for Static Loading

Soil Layer Number	=	3	
Depth of top of Layer 3 below pile head	=	20.000	ft
Depth of p-y curve below pile head	=	21.000	ft
Depth of p-y curve below ground surface	=	11.000	ft
Equiv. depth of p-y curve below ground surface	=	25.993	ft
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees

Effective slope angle	=	0.000	degrees
Pile diameter	=	20.000	in
Average effective unit weight	=	0.04298	pci
Average effective unit weight	=	74.273	pcf
Undrained cohesion	=	1.389	psi
Undrained cohesion	=	200.000	psf
Epsilon_50	=	0.0200	
J (default value)	=	0.5000	
Transition depth Xr	=	8.937	ft
Static pu_s for flat ground	=	568.074	lb/in
Static pu_d for flat ground	=	250.000	lb/in
y_50	=	1.00000	in
p-multiplier	=	0.680	
y-multiplier	=	1.000	
Positive-y Sloping Ground Factor	=	1.000	
Negative-y Sloping Ground Factor	=	1.000	
Sloping Ground Factor	=	1.000	
Positive-y, static pu	=	250.000	lb/in

y, inches	p, lbs/in
0.00000	0.00000
0.00237	11.33333
0.01896	22.66667
0.06400	34.00000
0.15170	45.33333
0.29630	56.66667
0.51200	68.00000
0.81304	79.33333
1.21363	90.66667
1.72800	102.00000
2.37037	113.33333
3.15496	124.66667
4.09600	136.00000
5.20770	147.33333
6.50430	158.66667
8.00000	170.00000
8.50000	170.00000

p-y Curve Computed Using the Soft Clay Criteria for Static Loading

Soil Layer Number	=	4	
Depth of top of Layer 4 below pile head	=	24.000	ft
Depth of p-y curve below pile head	=	25.500	ft
Depth of p-y curve below ground surface	=	15.500	ft
Equiv. depth of p-y curve below ground surface	=	45.483	ft

Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Pile diameter	=	20.000	in
Average effective unit weight	=	0.04018	pci
Average effective unit weight	=	69.432	pcf
Undrained cohesion	=	0.868	psi
Undrained cohesion	=	125.000	psf
Epsilon_50	=	0.0200	
J (default value)	=	0.5000	
Transition depth Xr	=	7.014	ft
Static pu_s for flat ground	=	727.586	lb/in
Static pu_d for flat ground	=	156.250	lb/in
y_50	=	1.00000	in
p-multiplier	=	0.680	
y-multiplier	=	1.000	
Positive-y Sloping Ground Factor	=	1.000	
Negative-y Sloping Ground Factor	=	1.000	
Sloping Ground Factor	=	1.000	
Positive-y, static pu	=	156.250	lb/in

y, inches	p, lbs/in
0.00000	0.00000
0.00237	7.08333
0.01896	14.16667
0.06400	21.25000
0.15170	28.33333
0.29630	35.41667
0.51200	42.50000
0.81304	49.58333
1.21363	56.66667
1.72800	63.75000
2.37037	70.83333
3.15496	77.91667
4.09600	85.00000
5.20770	92.08333
6.50430	99.16667
8.00000	106.25000
8.50000	106.25000

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	5	
Depth of top of Layer 5 below pile head	=	28.000	ft

Depth of p-y curve below pile head	=	30.500	ft
Depth of p-y curve below ground surface	=	20.500	ft
Equivalent depth of p-y curve	=	11.226	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1300.000	psf
Average eff. unit weight	=	66.546	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	1253.471	lb/in
Pcd	=	1625.000	lb/in
Pu	=	1253.471	lb/in
y50	=	0.350	in
p-multiplier	=	0.68000	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	9.25203
0.00177	113.64802
0.00896	170.47203
0.02832	227.29604
0.06914	284.12005
0.14336	340.94406
0.26559	397.76806
0.45309	454.59207
0.72576	511.41608
1.10617	568.24009
1.61955	625.06410
2.29376	681.88811
3.15934	738.71212
4.24947	795.53613
5.60000	852.36014
7.00000	852.36014

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water
with Option of Defining Initial k

Soil Layer Number	=	5	
Depth of top of Layer 5 below pile head	=	28.000	ft
Depth of p-y curve below pile head	=	35.500	ft
Depth of p-y curve below ground surface	=	25.500	ft
Equivalent depth of p-y curve	=	16.226	ft
Pile diameter	=	20.000	in
Undrained cohesion	=	1300.000	psf

Average eff. unit weight	=	64.792	pcf
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
k_py	=	500.	pci
Epsilon_50	=	0.00700	
Pct	=	1566.564	lb/in
Pcd	=	1625.000	lb/in
Pu	=	1566.564	lb/in
y50	=	0.350	in
p-multiplier	=	0.68000	
y-multiplier	=	1.00000	
Sloping Ground Factor	=	1.000	

y, inches	p, lbs/in
0.00000	0.00000
0.00011062	11.50862
0.00177	142.03511
0.00896	213.05267
0.02832	284.07022
0.06914	355.08778
0.14336	426.10533
0.26559	497.12289
0.45309	568.14044
0.72576	639.15800
1.10617	710.17555
1.61955	781.19311
2.29376	852.21066
3.15934	923.22822
4.24947	994.24577
5.60000	1065.26333
7.00000	1065.26333

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6	
Depth of p-y curve below pile head	=	40.500	ft
Depth of p-y curve below ground surface	=	30.500	ft
Depth of top of layer 6 below pile head	=	38.000	ft
Equiv. depth of p-y curve below ground surface	=	12.124	ft
Pile diameter	=	20.000	in
Ground slope angle	=	0.000	degrees
Pile batter angle	=	0.000	degrees
Effective slope angle	=	0.000	degrees
Undrained cohesion	=	24.306	psi

Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03658 pci
Average effective unit weight	=	63.203 pcf
Epsilon-50	=	0.00500
Pct	=	3332.801 lb/in
Pcd	=	4375.000 lb/in
Pu	=	3332.801 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68000
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	151.08699
0.00126	302.17398
0.00640	453.26097
0.02023	604.34796
0.04938	755.43494
0.10240	906.52193
0.18971	1057.60892
0.32363	1208.69591
0.51840	1359.78290
0.79012	1510.86989
1.15682	1661.95688
1.63840	1813.04387
2.25667	1964.13085
3.03534	2115.21784
4.00000	2266.30483
5.00000	2266.30483

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	45.500 ft
Depth of p-y curve below ground surface	=	35.500 ft
Depth of top of layer 6 below pile head	=	38.000 ft
Equiv. depth of p-y curve below ground surface	=	17.124 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03571 pci
Average effective unit weight	=	61.710 pcf
Epsilon-50	=	0.00500
Pct	=	4102.307 lb/in

Pcd	=	4375.000 lb/in
Pu	=	4102.307 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68000
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	185.97126
0.00126	371.94253
0.00640	557.91379
0.02023	743.88505
0.04938	929.85631
0.10240	1115.82758
0.18971	1301.79884
0.32363	1487.77010
0.51840	1673.74136
0.79012	1859.71263
1.15682	2045.68389
1.63840	2231.65515
2.25667	2417.62641
3.03534	2603.59768
4.00000	2789.56894
5.00000	2789.56894

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	50.500 ft
Depth of p-y curve below ground surface	=	40.500 ft
Depth of top of layer 6 below pile head	=	38.000 ft
Equiv. depth of p-y curve below ground surface	=	40.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03506 pci
Average effective unit weight	=	60.585 pcf
Epsilon-50	=	0.00500
Pct	=	4870.872 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68000
y-multiplier	=	1.00000

Sloping Ground Factor = 1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	198.33333
0.00126	396.66667
0.00640	595.00000
0.02023	793.33333
0.04938	991.66667
0.10240	1190.00000
0.18971	1388.33333
0.32363	1586.66667
0.51840	1785.00000
0.79012	1983.33333
1.15682	2181.66667
1.63840	2380.00000
2.25667	2578.33333
3.03534	2776.66667
4.00000	2975.00000
5.00000	2975.00000

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	55.500 ft
Depth of p-y curve below ground surface	=	45.500 ft
Depth of top of layer 6 below pile head	=	38.000 ft
Equiv. depth of p-y curve below ground surface	=	45.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03455 pci
Average effective unit weight	=	59.708 pcf
Epsilon-50	=	0.00500
Pct	=	5638.806 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68000
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000

0.00007901	198.33333
0.00126	396.66667
0.00640	595.00000
0.02023	793.33333
0.04938	991.66667
0.10240	1190.00000
0.18971	1388.33333
0.32363	1586.66667
0.51840	1785.00000
0.79012	1983.33333
1.15682	2181.66667
1.63840	2380.00000
2.25667	2578.33333
3.03534	2776.66667
4.00000	2975.00000
5.00000	2975.00000

p-y Curve Computed Using Static Criteria for Stiff Clay without Free Water

Soil Layer Number	=	6
Depth of p-y curve below pile head	=	59.500 ft
Depth of p-y curve below ground surface	=	49.500 ft
Depth of top of layer 6 below pile head	=	38.000 ft
Equiv. depth of p-y curve below ground surface	=	49.500 ft
Pile diameter	=	20.000 in
Ground slope angle	=	0.000 degrees
Pile batter angle	=	0.000 degrees
Effective slope angle	=	0.000 degrees
Undrained cohesion	=	24.306 psi
Undrained cohesion	=	3500.000 psf
Average effective unit weight	=	0.03422 pci
Average effective unit weight	=	59.133 pcf
Epsilon-50	=	0.00500
Pct	=	6252.828 lb/in
Pcd	=	4375.000 lb/in
Pu	=	4375.000 lb/in
y50	=	0.25000 in
p-multiplier	=	0.68000
y-multiplier	=	1.00000
Sloping Ground Factor	=	1.000

y, inches	p, lbs/in
0.00000	0.00000
0.00007901	198.33333
0.00126	396.66667
0.00640	595.00000
0.02023	793.33333
0.04938	991.66667

0.10240	1190.00000
0.18971	1388.33333
0.32363	1586.66667
0.51840	1785.00000
0.79012	1983.33333
1.15682	2181.66667
1.63840	2380.00000
2.25667	2578.33333
3.03534	2776.66667
4.00000	2975.00000
5.00000	2975.00000

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 15000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. p	Distrib. Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	0.4140	-1767435.	15000.	0.00	1451.	4.81E+10	0.00	0.00	0.00
0.6000	0.4131	-1659387.	15000.	-2.57E-04	1370.	4.81E+10	0.00	0.00	0.00
1.2000	0.4103	-1551250.	15000.	-4.97E-04	1288.	4.81E+10	0.00	0.00	0.00
1.8000	0.4059	-1443029.	15000.	-7.21E-04	1207.	4.81E+10	0.00	0.00	0.00
2.4000	0.3999	-1334730.	15000.	-9.29E-04	1126.	4.81E+10	0.00	0.00	0.00
3.0000	0.3925	-1226360.	15000.	-0.00112	1045.	4.81E+10	0.00	0.00	0.00
3.6000	0.3838	-1117923.	15000.	-0.00130	963.4424	4.81E+10			

```
0.00       0.00       0.00
    4.2000     0.3739  -1009426.     15000.   -0.00146   882.0697   4.81E+10
0.00       0.00       0.00
    4.8000     0.3628   -900875.     15000.   -0.00160   800.6561   4.81E+10
0.00       0.00       0.00
    5.4000     0.3508   -792275.     15000.   -0.00173   719.2061   4.81E+10
0.00       0.00       0.00
    6.0000     0.3380   -683632.     15000.   -0.00184   637.7240   4.81E+10
0.00       0.00       0.00
    6.6000     0.3244   -574952.     15000.   -0.00193   556.2143   4.81E+10
0.00       0.00       0.00
    7.2000     0.3102   -466242.     15000.   -0.00201   474.6814   4.81E+10
0.00       0.00       0.00
    7.8000     0.2955   -357506.     15000.   -0.00207   393.1296   4.81E+10
0.00       0.00       0.00
    8.4000     0.2804   -248751.     15000.   -0.00212   311.5633   4.81E+10
0.00       0.00       0.00
    9.0000     0.2650   -139983.     15000.   -0.00215   229.9870   4.81E+10
0.00       0.00       0.00
    9.6000     0.2495    -31207.     15000.   -0.00216   148.4050   4.81E+10
0.00       0.00       0.00
   10.2000     0.2339     77571.     14432.   -0.00215   183.1783   4.81E+10
-157.7598      4856.       0.00
   10.8000     0.2184    178166.     13263.   -0.00214   258.6247   4.81E+10
-166.9345      5502.       0.00
   11.4000     0.2032    270098.     12031.   -0.00210   327.5735   4.81E+10
-175.4411      6217.       0.00
   12.0000     0.1882    352920.     10739.   -0.00205   389.6902   4.81E+10
-183.2695      7012.       0.00
   12.6000     0.1736    426223.      9394.   -0.00200   444.6671   4.81E+10
-190.4119      7898.       0.00
   13.2000     0.1594    489631.      8000.   -0.00193   492.2236   4.81E+10
-196.8631      8891.       0.00
   13.8000     0.1458    542808.      6562.   -0.00185   532.1062   4.81E+10
-202.6203     10005.       0.00
   14.4000     0.1328    585452.      5085.   -0.00177   564.0890   4.81E+10
-207.6828     11262.       0.00
   15.0000     0.1204    617298.      3574.   -0.00168   587.9734   4.81E+10
-212.0519     12683.       0.00
   15.6000     0.1086    638118.      2034.   -0.00158   603.5883   4.81E+10
-215.7305     14297.       0.00
   16.2000    0.09760    647720.   469.4900   -0.00149   610.7897   4.81E+10
-218.7217     16136.       0.00
   16.8000    0.08725    645948.     -1114.   -0.00139   609.4611   4.81E+10
-221.0281     18240.       0.00
   17.4000    0.07760    632684.     -1991.   -0.00129   599.5128   4.81E+10
-22.6600      2103.       0.00
   18.0000    0.06863    618210.     -2151.   -0.00120   588.6578   4.81E+10
-21.7509      2282.       0.00
   18.6000    0.06032    602576.     -2304.   -0.00111   576.9322   4.81E+10
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-20.8358      2487.       0.00
   19.2000    0.05267    585829.     -2451.   -0.00102   564.3721   4.81E+10
-19.9147      2722.       0.00
   19.8000    0.04565    568019.     -2591.  -9.33E-04   551.0141   4.81E+10
-18.9873      2995.       0.00
   20.4000    0.03924    549193.     -2763.  -8.49E-04   536.8948   4.81E+10
-28.8859      5300.       0.00
   21.0000    0.03342    528840.     -2966.  -7.68E-04   521.6302   4.81E+10
-27.3819      5898.       0.00
   21.6000    0.02818    507040.     -3157.  -6.91E-04   505.2797   4.81E+10
-25.8673      6609.       0.00
   22.2000    0.02348    483871.     -3338.  -6.16E-04   487.9029   4.81E+10
-24.3414      7464.       0.00
   22.8000    0.01930    459414.     -3508.  -5.46E-04   469.5601   4.81E+10
-22.8028      8505.       0.00
   23.4000    0.01562    433750.     -3666.  -4.79E-04   450.3122   4.81E+10
-21.2499      9794.       0.00
   24.0000    0.01241    406961.     -3801.  -4.16E-04   430.2206   4.81E+10
-15.9896      9279.       0.00
   24.6000    0.00963    379321.     -3899.  -3.57E-04   409.4908   4.81E+10
-11.3045      8450.       0.00
   25.2000    0.00727    351075.     -3977.  -3.02E-04   388.3062   4.81E+10
-10.2910     10196.       0.00
   25.8000    0.00528    322276.     -4047.  -2.52E-04   366.7072   4.81E+10
-9.2516     12617.       0.00
   26.4000    0.00364    292981.     -4110.  -2.06E-04   344.7356   4.81E+10
-8.1733     16166.       0.00
   27.0000    0.00232    263246.     -4164.  -1.64E-04   322.4342   4.81E+10
-7.0304     21852.       0.00
   27.6000    0.00128    233132.     -4210.  -1.27E-04   299.8489   4.81E+10
-5.7647     32507.       0.00
   28.2000   4.89E-04    202707.     -4362.  -9.43E-05   277.0301   4.81E+10
-36.2785    534643.       0.00
   28.8000  -8.11E-05    170390.     -4470.  -6.64E-05   252.7925   4.81E+10
6.2185    552269.       0.00
   29.4000  -4.67E-04    138386.     -4315.  -4.32E-05   228.7898   4.81E+10
36.9589    569894.       0.00
   30.0000  -7.04E-04    108291.     -3975.  -2.48E-05   206.2185   4.81E+10
57.4097    587520.       0.00
   30.6000  -8.23E-04     81167.     -3519.  -1.06E-05   185.8749   4.81E+10
69.2029    605146.       0.00
   31.2000  -8.56E-04     57625.     -3003.  -1.68E-07   168.2186   4.81E+10
74.0109    622771.       0.00
   31.8000  -8.26E-04     37917.     -2473.   6.99E-06   153.4375   4.81E+10
73.4493    640397.       0.00
   32.4000  -7.55E-04     22014.     -1960.   1.15E-05   141.5106   4.81E+10
69.0042    658022.       0.00
   33.0000  -6.61E-04      9688.     -1488.   1.39E-05   132.2657   4.81E+10
61.9847    675648.       0.00
   33.6000  -5.56E-04   573.8598     -1072.   1.46E-05   125.4304   4.81E+10
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53.4964    693274.       0.00
   34.2000  -4.50E-04     -5767.  -719.9387   1.42E-05   129.3250   4.81E+10
44.4333    710899.       0.00
   34.8000  -3.51E-04     -9804.  -432.2416   1.31E-05   132.3526   4.81E+10
35.4826    728525.       0.00
   35.4000  -2.62E-04    -12000.  -206.7963   1.14E-05   134.0003   4.81E+10
27.1411    746150.       0.00
   36.0000  -1.86E-04    -12790.   -38.0313   9.57E-06   134.5922   4.81E+10
19.7380    763776.       0.00
   36.6000  -1.24E-04    -12555.    81.4839   7.68E-06   134.4162   4.81E+10
13.4606    781402.       0.00
   37.2000  -7.55E-05    -11622.   160.1179   5.87E-06   133.7163   4.81E+10
8.3822    799027.       0.00
   37.8000  -3.96E-05    -10253.   206.4501   4.23E-06   132.6901   4.81E+10
4.4879    816653.       0.00
   38.4000  -1.47E-05     -8652.   249.6090   2.81E-06   131.4889   4.81E+10
7.5007   3683271.       0.00
   39.0000   9.12E-07     -6661.   274.8800   1.66E-06   129.9958   4.81E+10
-0.4809   3796472.       0.00
   39.6000   9.30E-06     -4695.   254.9644   8.14E-07   128.5211   4.81E+10
-5.0512   3909644.       0.00
   40.2000   1.26E-05     -2990.   211.3779   2.38E-07   127.2426   4.81E+10
-7.0562   4022787.       0.00
   40.8000   1.27E-05     -1651.   159.6485  -1.10E-07   126.2384   4.81E+10
-7.3131   4135904.       0.00
   41.4000   1.11E-05  -691.1789   109.8411  -2.85E-07   125.5184   4.81E+10
-6.5223   4248996.       0.00
   42.0000   8.63E-06   -69.2592    67.5434  -3.42E-07   125.0519   4.81E+10
-5.2271   4362064.       0.00
   42.6000   6.13E-06   281.6922    35.0124  -3.26E-07   125.2113   4.81E+10
-3.8093   4475111.       0.00
   43.2000   3.93E-06   435.1547    12.2752  -2.72E-07   125.3264   4.81E+10
-2.5066   4588136.       0.00
   43.8000   2.21E-06   458.6508    -1.9378  -2.05E-07   125.3440   4.81E+10
-1.4414   4701141.       0.00
   44.4000   9.76E-07   407.3980    -9.4772  -1.40E-07   125.3055   4.81E+10
-0.6528   4814128.       0.00
   45.0000   1.84E-07   322.2805   -12.2819  -8.58E-08   125.2417   4.81E+10
-0.1263   4927097.       0.00
   45.6000  -2.60E-07   230.6005   -12.0817  -4.44E-08   125.1730   4.81E+10
0.1819   5040048.       0.00
   46.2000  -4.55E-07   148.3359   -10.2537  -1.61E-08   125.1113   4.81E+10
0.3259   5152984.       0.00
   46.8000  -4.91E-07    82.9590    -7.7876   1.27E-09   125.0622   4.81E+10
0.3591   5265904.       0.00
   47.4000  -4.37E-07    36.1939    -5.3243   1.02E-08   125.0271   4.81E+10
0.3251   5355000.       0.00
   48.0000  -3.44E-07     6.2814    -3.2321   1.34E-08   125.0047   4.81E+10
0.2560   5355000.       0.00
   48.6000  -2.45E-07   -10.3584    -1.6555   1.31E-08   125.0078   4.81E+10
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0.1819   5355000.       0.00
   49.2000  -1.56E-07   -17.5676    -0.5827   1.10E-08   125.0132   4.81E+10
0.1161   5355000.       0.00
   49.8000  -8.65E-08   -18.7578    0.06687   8.25E-09   125.0141   4.81E+10
0.06436   5355000.       0.00
   50.4000  -3.72E-08   -16.6105     0.3982   5.61E-09   125.0125   4.81E+10
0.02768   5355000.       0.00
   51.0000  -5.81E-09   -13.0276     0.5134   3.39E-09   125.0098   4.81E+10
0.00432   5355000.       0.00
   51.6000   1.15E-08    -9.2200     0.4980   1.72E-09   125.0069   4.81E+10
-0.00859   5355000.       0.00
   52.2000   1.90E-08    -5.8572     0.4163   5.91E-10   125.0044   4.81E+10
-0.01410   5355000.       0.00
   52.8000   2.01E-08    -3.2251     0.3119  -8.95E-11   125.0024   4.81E+10
-0.01492   5355000.       0.00
   53.4000   1.77E-08    -1.3661     0.2109  -4.33E-10   125.0010   4.81E+10
-0.01314   5355000.       0.00
   54.0000   1.38E-08    -0.1883     0.1266  -5.50E-10   125.0001   4.81E+10
-0.01027   5355000.       0.00
   54.6000   9.76E-09     0.4568    0.06345  -5.30E-10   125.0003   4.81E+10
-0.00726   5355000.       0.00
   55.2000   6.19E-09     0.7258    0.02077  -4.41E-10   125.0005   4.81E+10
-0.00460   5355000.       0.00
   55.8000   3.40E-09     0.7562   -0.00492  -3.30E-10   125.0006   4.81E+10
-0.00253   5355000.       0.00
   56.4000   1.43E-09     0.6553   -0.01787  -2.24E-10   125.0005   4.81E+10
-0.00107   5355000.       0.00
   57.0000   1.73E-10     0.4990   -0.02217  -1.38E-10   125.0004   4.81E+10
-1.29E-04   5355000.       0.00
   57.6000  -5.51E-10     0.3360   -0.02116  -7.54E-11   125.0003   4.81E+10
4.10E-04   5355000.       0.00
   58.2000  -9.13E-10     0.1943   -0.01724  -3.57E-11   125.0001   4.81E+10
6.79E-04   5355000.       0.00
   58.8000  -1.06E-09    0.08777   -0.01195  -1.45E-11   125.0001   4.81E+10
7.92E-04   5355000.       0.00
   59.4000  -1.12E-09    0.02226   -0.00610  -6.28E-12   125.0000   4.81E+10
8.34E-04   5355000.       0.00
   60.0000  -1.15E-09       0.00       0.00  -4.61E-12   125.0000   4.81E+10
8.59E-04   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 1:

Pile-head deflection             =     0.41402800 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -1767435. inch-lbs
Maximum shear force              =         15000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
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Depth of maximum shear force = 9.60000000 feet below pile head
Number of iterations = 23
Number of zero deflection points = 5

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 30000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	1.4552	-4155303.	30000.	0.00	3241.	4.81E+10	0.00	0.00	0.00
0.6000	1.4529	-3939191.	30000.	-6.06E-04	3079.	4.81E+10	0.00	0.00	0.00
1.2000	1.4464	-3722866.	30000.	-0.00118	2917.	4.81E+10	0.00	0.00	0.00
1.8000	1.4359	-3506341.	30000.	-0.00172	2755.	4.81E+10	0.00	0.00	0.00
2.4000	1.4217	-3289627.	30000.	-0.00223	2592.	4.81E+10	0.00	0.00	0.00
3.0000	1.4038	-3072735.	30000.	-0.00271	2430.	4.81E+10	0.00	0.00	0.00
3.6000	1.3827	-2855678.	30000.	-0.00315	2267.	4.81E+10	0.00	0.00	0.00
4.2000	1.3584	-2638466.	30000.	-0.00356	2104.	4.81E+10	0.00	0.00	0.00
4.8000	1.3314	-2421113.	30000.	-0.00394	1941.	4.81E+10	0.00	0.00	0.00
5.4000	1.3017	-2203628.	30000.	-0.00429	1778.	4.81E+10	0.00	0.00	0.00
6.0000	1.2696	-1986025.	30000.	-0.00460	1615.	4.81E+10	0.00	0.00	0.00
6.6000	1.2354	-1768315.	30000.	-0.00488	1451.	4.81E+10			

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0.00       0.00       0.00
    7.2000     1.1993  -1550510.     30000.   -0.00513      1288.   4.81E+10
0.00       0.00       0.00
    7.8000     1.1615  -1332621.     30000.   -0.00535      1124.   4.81E+10
0.00       0.00       0.00
    8.4000     1.1223  -1114660.     30000.   -0.00553   960.9948   4.81E+10
0.00       0.00       0.00
    9.0000     1.0819   -896639.     30000.   -0.00568   797.4790   4.81E+10
0.00       0.00       0.00
    9.6000     1.0405   -678569.     30000.   -0.00580   633.9269   4.81E+10
0.00       0.00       0.00
   10.2000     0.9984   -460463.     29184.   -0.00588   470.3474   4.81E+10
-226.7511      1635.       0.00
   10.8000     0.9558   -254087.     27498.   -0.00594   315.5653   4.81E+10
-241.4300      1819.       0.00
   11.4000     0.9129    -60213.     25710.   -0.00596   170.1598   4.81E+10
-255.4248      2015.       0.00
   12.0000     0.8699    120423.     23823.   -0.00596   215.3173   4.81E+10
-268.7249      2224.       0.00
   12.6000     0.8271    287122.     21842.   -0.00593   340.3414   4.81E+10
-281.3210      2449.       0.00
   13.2000     0.7846    439222.     19774.   -0.00587   454.4162   4.81E+10
-293.2054      2691.       0.00
   13.8000     0.7425    576098.     17623.   -0.00580   557.0734   4.81E+10
-304.3717      2951.       0.00
   14.4000     0.7011    697164.     15394.   -0.00570   647.8734   4.81E+10
-314.8144      3233.       0.00
   15.0000     0.6604    801873.     13092.   -0.00559   726.4051   4.81E+10
-324.5288      3538.       0.00
   15.6000     0.6206    889716.     10723.   -0.00546   792.2867   4.81E+10
-333.5103      3869.       0.00
   16.2000     0.5818    960221.      8292.   -0.00532   845.1655   4.81E+10
-341.7542      4229.       0.00
   16.8000     0.5440   1012957.      5805.   -0.00518   884.7180   4.81E+10
-349.2551      4623.       0.00
   17.4000     0.5073   1047534.      4395.   -0.00502   910.6506   4.81E+10
-42.3689   601.3711       0.00
   18.0000     0.4717   1079858.      4093.   -0.00486   934.8934   4.81E+10
-41.3540   631.2513       0.00
   18.6000     0.4373   1109980.      3799.   -0.00470   957.4848   4.81E+10
-40.3225   663.9612       0.00
   19.2000     0.4040   1137951.      3513.   -0.00453   978.4635   4.81E+10
-39.2742   699.8806       0.00
   19.8000     0.3720   1163826.      3234.   -0.00436   997.8692   4.81E+10
-38.2087   739.4573       0.00
   20.4000     0.3413   1187656.      2882.   -0.00418      1016.   4.81E+10
-59.4014      1253.       0.00
   21.0000     0.3118   1208344.      2461.   -0.00400      1031.   4.81E+10
-57.6404      1331.       0.00
   21.6000     0.2837   1225978.      2053.   -0.00382      1044.   4.81E+10
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-55.8504      1418.       0.00
   22.2000     0.2568   1240651.      1657.   -0.00363      1055.   4.81E+10
-54.0305      1515.       0.00
   22.8000     0.2313   1252455.      1275.   -0.00345      1064.   4.81E+10
-52.1798      1624.       0.00
   23.4000     0.2072   1261488.   905.7270   -0.00326      1071.   4.81E+10
-50.2971      1748.       0.00
   24.0000     0.1844   1267845.   583.1430   -0.00307      1076.   4.81E+10
-39.3096      1535.       0.00
   24.6000     0.1630   1272095.   337.1608   -0.00288      1079.   4.81E+10
-29.0188      1282.       0.00
   25.2000     0.1429   1274773.   132.6976   -0.00269      1081.   4.81E+10
-27.7765      1399.       0.00
   25.8000     0.1243   1275942.   -62.7339   -0.00250      1082.   4.81E+10
-26.5100      1536.       0.00
   26.4000     0.1070   1275668.  -248.9547   -0.00231      1082.   4.81E+10
-25.2180      1698.       0.00
   27.0000    0.09104   1274018.  -425.7755   -0.00212      1081.   4.81E+10
-23.8989      1890.       0.00
   27.6000    0.07649   1271061.  -592.9967   -0.00193      1078.   4.81E+10
-22.5514      2123.       0.00
   28.2000    0.06331   1266865.     -1559.   -0.00174      1075.   4.81E+10
-245.9167     27966.       0.00
   28.8000    0.05150   1249853.     -3314.   -0.00155      1062.   4.81E+10
-241.4888     33760.       0.00
   29.4000    0.04104   1220255.     -5032.   -0.00136      1040.   4.81E+10
-235.6610     41343.       0.00
   30.0000    0.03189   1178375.     -6702.   -0.00118      1009.   4.81E+10
-228.3023     51538.       0.00
   30.6000    0.02402   1124595.     -8313.   -0.00101   968.4466   4.81E+10
-219.2293     65717.       0.00
   31.2000    0.01736   1059391.     -9852.  -8.46E-04   919.5430   4.81E+10
-208.1661     86354.       0.00
   31.8000    0.01184    983337.    -11302.  -6.93E-04   862.5031   4.81E+10
-194.6554    118406.       0.00
   32.4000    0.00738    897140.    -12643.  -5.52E-04   797.8552   4.81E+10
-177.8288    173558.       0.00
   33.0000    0.00389    801676.    -13843.  -4.25E-04   726.2570   4.81E+10
-155.6460    288431.       0.00
   33.6000    0.00126    698100.    -14838.  -3.13E-04   648.5749   4.81E+10
-120.5641    689969.       0.00
   34.2000  -6.16E-04    588236.    -15053.  -2.16E-04   566.1770   4.81E+10
60.8415    710899.       0.00
   34.8000   -0.00186    481494.    -14331.  -1.36E-04   486.1208   4.81E+10
139.6960    541892.       0.00
   35.4000   -0.00258    381969.    -13269.  -7.15E-05   411.4766   4.81E+10
155.3820    434176.       0.00
   36.0000   -0.00289    290478.    -12120.  -2.11E-05   342.8582   4.81E+10
163.6871    408455.       0.00
   36.6000   -0.00288    207456.    -10932.   1.62E-05   280.5921   4.81E+10
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166.4067    415907.       0.00
   37.2000   -0.00265    133050.     -9746.   4.17E-05   224.7876   4.81E+10
163.0075    442488.       0.00
   37.8000   -0.00228     67087.     -8594.   5.67E-05   175.3154   4.81E+10
156.9677    495571.       0.00
   38.4000   -0.00184      9258.     -6951.   6.24E-05   131.9434   4.81E+10
299.5170   1174368.       0.00
   39.0000   -0.00138    -33045.     -4837.   6.06E-05   149.7837   4.81E+10
287.5542   1497972.       0.00
   39.6000  -9.64E-04    -60439.     -2828.   5.36E-05   170.3294   4.81E+10
270.5904   2021908.       0.00
   40.2000  -6.10E-04    -73803.  -959.4642   4.36E-05   180.3521   4.81E+10
248.3713   2930651.       0.00
   40.8000  -3.36E-04    -74287.   630.3708   3.25E-05   180.7151   4.81E+10
193.2496   4135904.       0.00
   41.4000  -1.43E-04    -64749.      1629.   2.20E-05   173.5616   4.81E+10
84.2481   4248996.       0.00
   42.0000  -1.89E-05    -50840.      1974.   1.34E-05   163.1299   4.81E+10
11.4702   4362064.       0.00
   42.6000   5.01E-05    -36334.      1903.   6.86E-06   152.2502   4.81E+10
-31.1168   4475111.       0.00
   43.2000   7.99E-05    -23438.      1608.   2.38E-06   142.5788   4.81E+10
-50.8992   4588136.       0.00
   43.8000   8.44E-05    -13181.      1226.  -3.58E-07   134.8855   4.81E+10
-55.1120   4701141.       0.00
   44.4000   7.47E-05     -5779.   848.0571  -1.78E-06   129.3344   4.81E+10
-49.9620   4814128.       0.00
   45.0000   5.88E-05  -967.3432   523.3197  -2.28E-06   125.7255   4.81E+10
-40.2428   4927097.       0.00
   45.6000   4.18E-05      1758.   272.9884  -2.22E-06   126.3187   4.81E+10
-29.2937   5040048.       0.00
   46.2000   2.68E-05      2965.    98.5204  -1.87E-06   127.2240   4.81E+10
-19.1696   5152984.       0.00
   46.8000   1.49E-05      3178.    -9.7734  -1.41E-06   127.3838   4.81E+10
-10.9120   5265904.       0.00
   47.4000   6.48E-06      2826.   -66.4142  -9.60E-07   127.1192   4.81E+10
-4.8216   5355000.       0.00
   48.0000   1.09E-06      2223.   -86.6986  -5.82E-07   126.6670   4.81E+10
-0.8130   5355000.       0.00
   48.6000  -1.90E-06      1578.   -84.5396  -2.97E-07   126.1831   4.81E+10
1.4127   5355000.       0.00
   49.2000  -3.19E-06      1006.   -70.9112  -1.04E-07   125.7541   4.81E+10
2.3730   5355000.       0.00
   49.8000  -3.40E-06   556.4819   -53.2724   1.30E-08   125.4174   4.81E+10
2.5267   5355000.       0.00
   50.4000  -3.00E-06   238.3925   -36.1338   7.25E-08   125.1788   4.81E+10
2.2340   5355000.       0.00
   51.0000  -2.35E-06    36.1026   -21.7907   9.31E-08   125.0271   4.81E+10
1.7502   5355000.       0.00
   51.6000  -1.66E-06   -75.4613   -11.0359   9.01E-08   125.0566   4.81E+10
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1.2373   5355000.       0.00
   52.2000  -1.06E-06  -122.8787    -3.7555   7.53E-08   125.0922   4.81E+10
0.7850   5355000.       0.00
   52.8000  -5.80E-07  -129.5948     0.6231   5.64E-08   125.0972   4.81E+10
0.4313   5355000.       0.00
   53.4000  -2.44E-07  -113.9472     2.8289   3.81E-08   125.0855   4.81E+10
0.1815   5355000.       0.00
   54.0000  -3.10E-08   -88.8860     3.5653   2.29E-08   125.0667   4.81E+10
0.02308   5355000.       0.00
   54.6000   8.61E-08   -62.6235     3.4180   1.16E-08   125.0470   4.81E+10
-0.06401   5355000.       0.00
   55.2000   1.36E-07   -39.6758     2.8244   3.91E-09   125.0298   4.81E+10
-0.1009   5355000.       0.00
   55.8000   1.42E-07   -21.9551     2.0800  -7.04E-10   125.0165   4.81E+10
-0.1059   5355000.       0.00
   56.4000   1.25E-07    -9.7231     1.3628  -3.08E-09   125.0073   4.81E+10
-0.09332   5355000.       0.00
   57.0000   9.81E-08    -2.3286     0.7642  -3.98E-09   125.0017   4.81E+10
-0.07295   5355000.       0.00
   57.6000   6.82E-08     1.2845     0.3191  -4.06E-09   125.0010   4.81E+10
-0.05070   5355000.       0.00
   58.2000   3.96E-08     2.2690    0.03039  -3.79E-09   125.0017   4.81E+10
-0.02949   5355000.       0.00
   58.8000   1.36E-08     1.7248    -0.1121  -3.49E-09   125.0013   4.81E+10
-0.01009   5355000.       0.00
   59.4000  -1.06E-08     0.6572    -0.1199  -3.31E-09   125.0005   4.81E+10
0.00792   5355000.       0.00
   60.0000  -3.42E-08       0.00       0.00  -3.26E-09   125.0000   4.81E+10
0.02540   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 2:

Pile-head deflection             =     1.45517879 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -4155303. inch-lbs
Maximum shear force              =         30000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     0.60000000 feet below pile head
Number of iterations             =             26
Number of zero deflection points =              5



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                 Computed Values of Pile Loading and Deflection
                   for Lateral Loading for Load Case Number 3
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Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 45000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil Res.	Soil Spr.	Distrib.
X	y	Moment	Force	S	Stress	Stiffness	p	Es*h	Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	3.0107	-6899366.	45000.	0.00	5300.	4.81E+10	0.00	0.00	0.00
0.6000	3.0070	-6575180.	45000.	-0.00101	5056.	4.81E+10	0.00	0.00	0.00
1.2000	2.9962	-6250639.	45000.	-0.00197	4813.	4.81E+10	0.00	0.00	0.00
1.8000	2.9786	-5925762.	45000.	-0.00288	4569.	4.81E+10	0.00	0.00	0.00
2.4000	2.9547	-5600565.	45000.	-0.00375	4325.	4.81E+10	0.00	0.00	0.00
3.0000	2.9247	-5275065.	45000.	-0.00456	4081.	4.81E+10	0.00	0.00	0.00
3.6000	2.8890	-4949282.	45000.	-0.00533	3837.	4.81E+10	0.00	0.00	0.00
4.2000	2.8480	-4623231.	45000.	-0.00604	3592.	4.81E+10	0.00	0.00	0.00
4.8000	2.8020	-4296931.	45000.	-0.00671	3348.	4.81E+10	0.00	0.00	0.00
5.4000	2.7514	-3970400.	45000.	-0.00733	3103.	4.81E+10	0.00	0.00	0.00
6.0000	2.6965	-3643654.	45000.	-0.00790	2858.	4.81E+10	0.00	0.00	0.00
6.6000	2.6376	-3316712.	45000.	-0.00842	2613.	4.81E+10	0.00	0.00	0.00
7.2000	2.5752	-2989591.	45000.	-0.00889	2367.	4.81E+10	0.00	0.00	0.00
7.8000	2.5096	-2662308.	45000.	-0.00932	2122.	4.81E+10	0.00	0.00	0.00
8.4000	2.4411	-2334883.	45000.	-0.00969	1876.	4.81E+10	0.00	0.00	0.00
9.0000	2.3700	-2007331.	45000.	-0.01002	1630.	4.81E+10	0.00	0.00	0.00
9.6000	2.2968	-1679671.	45000.	-0.01029	1385.	4.81E+10			

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0.00       0.00       0.00
   10.2000     2.2218  -1351920.     44003.   -0.01052      1139.   4.81E+10
-276.9501   897.4794       0.00
   10.8000     2.1454  -1038454.     41942.   -0.01070   903.8406   4.81E+10
-295.5134   991.7690       0.00
   11.4000     2.0678   -740251.     39750.   -0.01083   680.1884   4.81E+10
-313.3536      1091.       0.00
   12.0000     1.9894   -458253.     37432.   -0.01092   468.6894   4.81E+10
-330.4582      1196.       0.00
   12.6000     1.9105   -193360.     34994.   -0.01097   270.0202   4.81E+10
-346.8160      1307.       0.00
   13.2000     1.8314     53564.     32441.   -0.01098   165.1727   4.81E+10
-362.4168      1425.       0.00
   13.8000     1.7524    281697.     29778.   -0.01096   336.2726   4.81E+10
-377.2515      1550.       0.00
   14.4000     1.6736    490258.     27011.   -0.01090   492.6937   4.81E+10
-391.3115      1683.       0.00
   15.0000     1.5954    678508.     24146.   -0.01081   633.8807   4.81E+10
-404.5888      1826.       0.00
   15.6000     1.5180    845746.     21188.   -0.01070   759.3098   4.81E+10
-417.0757      1978.       0.00
   16.2000     1.4414    991318.     18143.   -0.01056   868.4889   4.81E+10
-428.7641      2142.       0.00
   16.8000     1.3659   1114610.     15017.   -0.01040   960.9575   4.81E+10
-439.6456      2317.       0.00
   17.4000     1.2917   1215050.     13226.   -0.01023      1036.   4.81E+10
-57.8561   322.5045       0.00
   18.0000     1.2187   1312425.     12813.   -0.01004      1109.   4.81E+10
-56.7454   335.2537       0.00
   18.6000     1.1471   1406788.     12409.   -0.00983      1180.   4.81E+10
-55.6122   349.0549       0.00
   19.2000     1.0771   1498192.     12013.   -0.00962      1249.   4.81E+10
-54.4565   364.0280       0.00
   19.8000     1.0087   1586693.     11625.   -0.00938      1315.   4.81E+10
-53.2780   380.3107       0.00
   20.4000     0.9419   1672345.     11133.   -0.00914      1379.   4.81E+10
-83.3224   636.9002       0.00
   21.0000     0.8770   1753589.     10540.   -0.00888      1440.   4.81E+10
-81.3627   667.9504       0.00
   21.6000     0.8140   1830519.      9961.   -0.00862      1498.   4.81E+10
-79.3653   701.9949       0.00
   22.2000     0.7530   1903237.      9397.   -0.00834      1552.   4.81E+10
-77.3296   739.4419       0.00
   22.8000     0.6940   1971844.      8848.   -0.00805      1604.   4.81E+10
-75.2550   780.7750       0.00
   23.4000     0.6371   2036442.      8314.   -0.00775      1652.   4.81E+10
-73.1406   826.5697       0.00
   24.0000     0.5824   2097140.      7843.   -0.00744      1698.   4.81E+10
-57.6759   712.9818       0.00
   24.6000     0.5300   2154734.      7480.   -0.00712      1741.   4.81E+10
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-42.9934   584.0295       0.00
   25.2000     0.4799   2209983.      7176.   -0.00679      1782.   4.81E+10
-41.5941   623.9843       0.00
   25.8000     0.4322   2262957.      6882.   -0.00646      1822.   4.81E+10
-40.1678   669.0859       0.00
   26.4000     0.3870   2313727.      6598.   -0.00611      1860.   4.81E+10
-38.7139   720.2876       0.00
   27.0000     0.3442   2362365.      6324.   -0.00576      1897.   4.81E+10
-37.2318   778.7736       0.00
   27.6000     0.3040   2408946.      6062.   -0.00541      1932.   4.81E+10
-35.7214   846.0253       0.00
   28.2000     0.2664   2453544.      4665.   -0.00504      1965.   4.81E+10
-352.1983     9519.        0.00
   28.8000     0.2314   2479753.      2132.   -0.00467      1985.   4.81E+10
-351.5849    10939.        0.00
   29.4000     0.1991   2487601.  -393.2925   -0.00430      1991.   4.81E+10
-349.7465    12647.        0.00
   30.0000     0.1695   2477185.     -2900.   -0.00393      1983.   4.81E+10
-346.6297    14724.        0.00
   30.6000     0.1426   2448666.     -5380.   -0.00356      1961.   4.81E+10
-342.1733    17282.        0.00
   31.2000     0.1183   2402276.     -7822.   -0.00320      1927.   4.81E+10
-336.3062    20477.        0.00
   31.8000    0.09654   2338323.    -10217.   -0.00284      1879.   4.81E+10
-328.9430    24533.        0.00
   32.4000    0.07735   2257191.    -12553.   -0.00250      1818.   4.81E+10
-319.9781    29784.        0.00
   33.0000    0.06060   2159350.    -14819.   -0.00217      1745.   4.81E+10
-309.2749    36748.        0.00
   33.6000    0.04617   2045360.    -17000.   -0.00185      1659.   4.81E+10
-296.6474    46262.        0.00
   34.2000    0.03395   1915881.    -19083.   -0.00155      1562.   4.81E+10
-281.8256    59773.        0.00
   34.8000    0.02379   1771689.    -21049.   -0.00128      1454.   4.81E+10
-264.3841    80004.        0.00
   35.4000    0.01555   1613696.    -22878.   -0.00102      1335.   4.81E+10
-243.5744   112783.        0.00
   36.0000    0.00905   1442989.    -24539.  -7.95E-04      1207.   4.81E+10
-217.8477   173385.        0.00
   36.6000    0.00410   1260911.    -25977.  -5.93E-04      1071.   4.81E+10
-181.7932   319297.        0.00
   37.2000   5.12E-04   1069340.    -26837.  -4.18E-04   927.0052   4.81E+10
-56.8450    799027.        0.00
   37.8000   -0.00192    874765.    -26500.  -2.73E-04   781.0741   4.81E+10
150.3475    563329.        0.00
   38.4000   -0.00341    687937.    -24700.  -1.55E-04   640.9531   4.81E+10
349.6494    737824.        0.00
   39.0000   -0.00416    519198.    -22078.  -6.51E-05   514.3986   4.81E+10
378.7318    655419.        0.00
   39.6000   -0.00435    370064.    -19295.   1.53E-06   402.5483   4.81E+10
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394.3741    652906.       0.00
   40.2000   -0.00414    241355.    -16432.   4.73E-05   306.0162   4.81E+10
400.7865    697289.       0.00
   40.8000   -0.00367    133409.    -13550.   7.54E-05   225.0570   4.81E+10
399.8000    784884.       0.00
   41.4000   -0.00305     46182.    -10698.   8.88E-05   159.6366   4.81E+10
392.3179    925306.       0.00
   42.0000   -0.00239    -20710.     -7922.   9.08E-05   140.5324   4.81E+10
378.7789   1141994.       0.00
   42.6000   -0.00175    -67965.     -5265.   8.41E-05   175.9736   4.81E+10
359.3223   1481868.       0.00
   43.2000   -0.00118    -96589.     -2770.   7.18E-05   197.4416   4.81E+10
333.8078   2042174.       0.00
   43.8000  -7.12E-04   -107903.  -482.2284   5.65E-05   205.9272   4.81E+10
301.6555   3050012.       0.00
   44.4000  -3.64E-04   -103574.      1479.   4.06E-05   202.6801   4.81E+10
243.1714   4814128.       0.00
   45.0000  -1.27E-04    -86632.      2667.   2.64E-05   189.9744   4.81E+10
86.8918   4927097.       0.00
   45.6000   1.63E-05    -65182.      2939.   1.50E-05   173.8867   4.81E+10
-11.4116   5040048.       0.00
   46.2000   8.93E-05    -44320.      2668.   6.82E-06   158.2401   4.81E+10
-63.8974   5152984.       0.00
   46.8000   1.14E-04    -26768.      2137.   1.49E-06   145.0761   4.81E+10
-83.7130   5265904.       0.00
   47.4000   1.11E-04    -13554.      1539.  -1.53E-06   135.1657   4.81E+10
-82.3846   5355000.       0.00
   48.0000   9.25E-05     -4611.   994.4962  -2.89E-06   128.4579   4.81E+10
-68.7676   5355000.       0.00
   48.6000   6.92E-05   768.5553   561.7050  -3.18E-06   125.5764   4.81E+10
-51.4522   5355000.       0.00
   49.2000   4.67E-05      3480.   251.3649  -2.86E-06   127.6102   4.81E+10
-34.7534   5355000.       0.00
   49.8000   2.80E-05      4390.    51.2066  -2.27E-06   128.2927   4.81E+10
-20.8462   5355000.       0.00
   50.4000   1.41E-05      4219.   -61.4978  -1.62E-06   128.1645   4.81E+10
-10.4606   5355000.       0.00
   51.0000   4.65E-06      3506.  -111.6100  -1.04E-06   127.6294   4.81E+10
-3.4595   5355000.       0.00
   51.6000  -9.81E-07      2613.  -121.4380  -5.87E-07   126.9597   4.81E+10
0.7295   5355000.       0.00
   52.2000  -3.79E-06      1758.  -108.6510  -2.59E-07   126.3182   4.81E+10
2.8225   5355000.       0.00
   52.8000  -4.71E-06      1049.   -85.8693  -4.91E-08   125.7864   4.81E+10
3.5057   5355000.       0.00
   53.4000  -4.50E-06   521.1002   -61.1962   6.85E-08   125.3908   4.81E+10
3.3479   5355000.       0.00
   54.0000  -3.73E-06   167.2263   -39.1642   1.20E-07   125.1254   4.81E+10
2.7721   5355000.       0.00
   54.6000  -2.77E-06   -42.9512   -21.7610   1.29E-07   125.0322   4.81E+10
```

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2.0621   5355000.       0.00
   55.2000  -1.86E-06  -146.2246    -9.3453   1.15E-07   125.1097   4.81E+10
1.3866   5355000.       0.00
   55.8000  -1.11E-06  -177.6063    -1.3710   9.09E-08   125.1332   4.81E+10
0.8284   5355000.       0.00
   56.4000  -5.55E-07  -166.0319     3.0972   6.52E-08   125.1245   4.81E+10
0.4127   5355000.       0.00
   57.0000  -1.75E-07  -133.0540     5.0514   4.28E-08   125.0998   4.81E+10
0.1301   5355000.       0.00
   57.6000   6.14E-08   -93.3224     5.3554   2.58E-08   125.0700   4.81E+10
-0.04569   5355000.       0.00
   58.2000   1.97E-07   -55.9544     4.6629   1.47E-08   125.0420   4.81E+10
-0.1467   5355000.       0.00
   58.8000   2.73E-07   -26.1866     3.4050   8.51E-09   125.0196   4.81E+10
-0.2028   5355000.       0.00
   59.4000   3.20E-07    -6.9285     1.8188   6.03E-09   125.0052   4.81E+10
-0.2378   5355000.       0.00
   60.0000   3.60E-07       0.00       0.00   5.51E-09   125.0000   4.81E+10
-0.2674   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 3:

Pile-head deflection             =     3.01073507 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -6899366. inch-lbs
Maximum shear force              =         45000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     0.60000000 feet below pile head
Number of iterations             =             28
Number of zero deflection points =              4



--------------------------------------------------------------------------------
                 Computed Values of Pile Loading and Deflection
                   for Lateral Loading for Load Case Number 4
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Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =      60000.0 lbs
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =      50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
```

Res. Soil Spr. Distrib.

X	y	Moment	Force	S	Stress	Stiffness	p
Es*h	Lat. Load						
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	
lb/inch	lb/inch	lb/inch					
0.00	4.9909	-9889799.	60000.	0.00	7542.	4.81E+10	
0.00	0.00	0.00					
0.6000	4.9855	-9457532.	60000.	-0.00145	7218.	4.81E+10	
0.00	0.00	0.00					
1.2000	4.9700	-9024756.	60000.	-0.00283	6894.	4.81E+10	
0.00	0.00	0.00					
1.8000	4.9447	-8591493.	60000.	-0.00415	6569.	4.81E+10	
0.00	0.00	0.00					
2.4000	4.9102	-8157766.	60000.	-0.00541	6243.	4.81E+10	
0.00	0.00	0.00					
3.0000	4.8669	-7723599.	60000.	-0.00660	5918.	4.81E+10	
0.00	0.00	0.00					
3.6000	4.8152	-7289016.	60000.	-0.00772	5592.	4.81E+10	
0.00	0.00	0.00					
4.2000	4.7557	-6854040.	60000.	-0.00878	5266.	4.81E+10	
0.00	0.00	0.00					
4.8000	4.6888	-6418695.	60000.	-0.00977	4939.	4.81E+10	
0.00	0.00	0.00					
5.4000	4.6149	-5983003.	60000.	-0.01070	4612.	4.81E+10	
0.00	0.00	0.00					
6.0000	4.5346	-5546988.	60000.	-0.01157	4285.	4.81E+10	
0.00	0.00	0.00					
6.6000	4.4484	-5110675.	60000.	-0.01236	3958.	4.81E+10	
0.00	0.00	0.00					
7.2000	4.3566	-4674086.	60000.	-0.01310	3631.	4.81E+10	
0.00	0.00	0.00					
7.8000	4.2598	-4237244.	60000.	-0.01377	3303.	4.81E+10	
0.00	0.00	0.00					
8.4000	4.1584	-3800175.	60000.	-0.01437	2975.	4.81E+10	
0.00	0.00	0.00					
9.0000	4.0529	-3362900.	60000.	-0.01490	2647.	4.81E+10	
0.00	0.00	0.00					
9.6000	3.9438	-2925444.	60000.	-0.01537	2319.	4.81E+10	
0.00	0.00	0.00					
10.2000	3.8315	-2487830.	58857.	-0.01578	1991.	4.81E+10	
-317.3697	596.3909	0.00					
10.8000	3.7165	-2066535.	56494.	-0.01612	1675.	4.81E+10	
-339.0285	656.7977	0.00					
11.4000	3.5993	-1662703.	53978.	-0.01640	1372.	4.81E+10	
-359.9270	719.9864	0.00					
12.0000	3.4804	-1277441.	51314.	-0.01662	1083.	4.81E+10	
-380.0516	786.2326	0.00					
12.6000	3.3600	-911811.	48508.	-0.01678	808.8582	4.81E+10	

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-399.3896   855.8345       0.00
   13.2000     3.2387   -566836.     45566.   -0.01690   550.1273   4.81E+10
-417.9293   929.1159       0.00
   13.8000     3.1167   -243497.     42493.   -0.01696   307.6226   4.81E+10
-435.6599      1006.       0.00
   14.4000     2.9945     57271.     39295.   -0.01697   167.9535   4.81E+10
-452.5711      1088.       0.00
   15.0000     2.8723    334575.     35979.   -0.01694   375.9313   4.81E+10
-468.6532      1175.       0.00
   15.6000     2.7505    587566.     32550.   -0.01687   565.6744   4.81E+10
-483.8966      1267.       0.00
   16.2000     2.6294    815440.     29014.   -0.01677   736.5798   4.81E+10
-498.2917      1364.       0.00
   16.8000     2.5091   1017438.     25377.   -0.01663   888.0786   4.81E+10
-511.8284      1469.       0.00
   17.4000     2.3899   1192849.     23279.   -0.01646      1020.   4.81E+10
-71.0278   213.9812       0.00
   18.0000     2.2720   1364513.     22772.   -0.01627      1148.   4.81E+10
-69.8401   221.3210       0.00
   18.6000     2.1556   1532482.     22274.   -0.01606      1274.   4.81E+10
-68.6262   229.2199       0.00
   19.2000     2.0408   1696812.     21784.   -0.01581      1398.   4.81E+10
-67.3860   237.7351       0.00
   19.8000     1.9279   1857557.     21303.   -0.01555      1518.   4.81E+10
-66.1193   246.9314       0.00
   20.4000     1.8170   2014774.     20692.   -0.01526      1636.   4.81E+10
-103.7215   411.0129       0.00
   21.0000     1.7082   2166506.     19953.   -0.01494      1750.   4.81E+10
-101.6092   428.2795       0.00
   21.6000     1.6018   2312853.     19229.   -0.01461      1860.   4.81E+10
-99.4535   447.0466       0.00
   22.2000     1.4978   2453920.     18521.   -0.01425      1965.   4.81E+10
-97.2542   467.4946       0.00
   22.8000     1.3965   2589813.     17829.   -0.01387      2067.   4.81E+10
-95.0107   489.8338       0.00
   23.4000     1.2981   2720641.     17153.   -0.01348      2165.   4.81E+10
-92.7225   514.3091       0.00
   24.0000     1.2025   2846515.     16555.   -0.01306      2260.   4.81E+10
-73.4410   439.7313       0.00
   24.6000     1.1100   2968429.     16092.   -0.01262      2351.   4.81E+10
-55.0059   356.7929       0.00
   25.2000     1.0207   3087331.     15702.   -0.01217      2440.   4.81E+10
-53.4896   377.3081       0.00
   25.8000     0.9348   3203294.     15322.   -0.01170      2527.   4.81E+10
-51.9439   400.0984       0.00
   26.4000     0.8523   3316391.     14954.   -0.01121      2612.   4.81E+10
-50.3684   425.5202       0.00
   27.0000     0.7733   3426698.     14597.   -0.01071      2695.   4.81E+10
-48.7629   454.0017       0.00
   27.6000     0.6981   3534293.     14252.   -0.01018      2776.   4.81E+10
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-47.1274   486.0598       0.00
   28.2000     0.6267   3639254.     12512.   -0.00965      2854.   4.81E+10
-436.1842      5011.       0.00
   28.8000     0.5592   3721407.      9363.   -0.00910      2916.   4.81E+10
-438.3499      5644.       0.00
   29.4000     0.4957   3780635.      6204.   -0.00853      2960.   4.81E+10
-439.3208      6381.       0.00
   30.0000     0.4363   3816885.      3042.   -0.00796      2988.   4.81E+10
-439.0546      7245.       0.00
   30.6000     0.3810   3830169.  -114.0143   -0.00739      2998.   4.81E+10
-437.5052      8268.       0.00
   31.2000     0.3299   3820566.     -3254.   -0.00682      2990.   4.81E+10
-434.6215      9487.       0.00
   31.8000     0.2828   3788226.     -6368.   -0.00625      2966.   4.81E+10
-430.3464     10956.       0.00
   32.4000     0.2399   3733372.     -9445.   -0.00569      2925.   4.81E+10
-424.6149     12745.       0.00
   33.0000     0.2009   3656306.    -12476.   -0.00513      2867.   4.81E+10
-417.3511     14954.       0.00
   33.6000     0.1660   3557406.    -15449.   -0.00459      2793.   4.81E+10
-408.4644     17720.       0.00
   34.2000     0.1348   3437140.    -18352.   -0.00407      2703.   4.81E+10
-397.8431     21246.       0.00
   34.8000     0.1074   3296064.    -21172.   -0.00356      2597.   4.81E+10
-385.3447     25837.       0.00
   35.4000    0.08350   3134835.    -23894.   -0.00308      2476.   4.81E+10
-370.7783     31970.       0.00
   36.0000    0.06300   2954215.    -26502.   -0.00263      2341.   4.81E+10
-353.8749     40441.       0.00
   36.6000    0.04569   2755091.    -28972.   -0.00220      2191.   4.81E+10
-332.1162     52338.       0.00
   37.2000    0.03134   2538601.    -31256.   -0.00180      2029.   4.81E+10
-302.2658     69432.       0.00
   37.8000    0.01974   2306305.    -33313.   -0.00144      1855.   4.81E+10
-269.2749     98220.       0.00
   38.4000    0.01062   2059926.    -35955.   -0.00111      1670.   4.81E+10
-464.5909    314952.       0.00
   39.0000    0.00372   1789351.    -38955.  -8.24E-04      1467.   4.81E+10
-368.6180    712642.       0.00
   39.6000   -0.00124   1499571.    -39245.  -5.78E-04      1250.   4.81E+10
287.9443   1668528.       0.00
   40.2000   -0.00459   1224636.    -36728.  -3.73E-04      1043.   4.81E+10
411.2325    644788.       0.00
   40.8000   -0.00662    970954.    -33580.  -2.09E-04   853.2156   4.81E+10
463.3544    503895.       0.00
   41.4000   -0.00760    741240.    -30138.  -8.08E-05   680.9299   4.81E+10
492.7872    466713.       0.00
   42.0000   -0.00778    537032.    -26531.   1.49E-05   527.7738   4.81E+10
508.9151    470712.       0.00
   42.6000   -0.00739    359177.    -22844.   8.21E-05   394.3827   4.81E+10
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515.3205    502257.       0.00
   43.2000   -0.00660    208017.    -19140.   1.25E-04   281.0127   4.81E+10
513.7162    560179.       0.00
   43.8000   -0.00559     83477.    -15472.   1.46E-04   187.6075   4.81E+10
504.9971    649978.       0.00
   44.4000   -0.00450    -14889.    -11892.   1.52E-04   136.1667   4.81E+10
489.6178    784230.       0.00
   45.0000   -0.00341    -87872.     -8445.   1.44E-04   190.9040   4.81E+10
467.7407    986912.       0.00
   45.6000   -0.00242   -136603.     -5180.   1.27E-04   227.4520   4.81E+10
439.2666   1304544.       0.00
   46.2000   -0.00158   -162554.     -2145.   1.05E-04   246.9157   4.81E+10
403.7481   1835561.       0.00
   46.8000  -9.18E-04   -167567.   604.5350   7.99E-05   250.6752   4.81E+10
360.0311   2822732.       0.00
   47.4000  -4.34E-04   -153907.      2993.   5.58E-05   240.4299   4.81E+10
303.4846   5038325.       0.00
   48.0000  -1.15E-04   -124505.      4394.   3.49E-05   218.3789   4.81E+10
85.5589   5355000.       0.00
   48.6000   6.93E-05    -90662.      4516.   1.88E-05   192.9963   4.81E+10
-51.5718   5355000.       0.00
   49.2000   1.56E-04    -59487.      3913.   7.57E-06   169.6151   4.81E+10
-115.9795   5355000.       0.00
   49.8000   1.78E-04    -34321.      3018.   5.46E-07   150.7409   4.81E+10
-132.6706   5355000.       0.00
   50.4000   1.64E-04    -16031.      2102.  -3.22E-06   137.0234   4.81E+10
-121.8316   5355000.       0.00
   51.0000   1.32E-04     -4056.      1310.  -4.73E-06   128.0422   4.81E+10
-98.1333   5355000.       0.00
   51.6000   9.57E-05      2832.   700.1631  -4.82E-06   127.1238   4.81E+10
-71.1813   5355000.       0.00
   52.2000   6.25E-05      6030.   276.5073  -4.16E-06   129.5222   4.81E+10
-46.5008   5355000.       0.00
   52.8000   3.58E-05      6816.    13.1395  -3.20E-06   130.1124   4.81E+10
-26.6569   5355000.       0.00
   53.4000   1.65E-05      6221.  -127.0360  -2.22E-06   129.6658   4.81E+10
-12.2807   5355000.       0.00
   54.0000   3.89E-06      4989.  -181.6675  -1.38E-06   128.7416   4.81E+10
-2.8947   5355000.       0.00
   54.6000  -3.35E-06      3606.  -183.1257  -7.35E-07   127.7046   4.81E+10
2.4897   5355000.       0.00
   55.2000  -6.70E-06      2352.  -156.2297  -2.89E-07   126.7642   4.81E+10
4.9814   5355000.       0.00
   55.8000  -7.51E-06      1357.  -118.1855  -1.14E-08   126.0174   4.81E+10
5.5864   5355000.       0.00
   56.4000  -6.86E-06   650.4137   -79.7030   1.39E-07   125.4878   4.81E+10
5.1032   5355000.       0.00
   57.0000  -5.51E-06   208.7587   -46.5779   2.03E-07   125.1566   4.81E+10
4.0982   5355000.       0.00
   57.6000  -3.93E-06   -20.4550   -21.2913   2.17E-07   125.0153   4.81E+10
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2.9258   5355000.       0.00
   58.2000  -2.38E-06   -97.9919    -4.3867   2.09E-07   125.0735   4.81E+10
1.7699   5355000.       0.00
   58.8000  -9.31E-07   -83.7738     4.4777   1.95E-07   125.0628   4.81E+10
0.6925   5355000.       0.00
   59.4000   4.27E-07   -33.6530     5.8269   1.86E-07   125.0252   4.81E+10
-0.3177   5355000.       0.00
   60.0000   1.75E-06       0.00       0.00   1.84E-07   125.0000   4.81E+10
-1.3009   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 4:

Pile-head deflection             =     4.99085744 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -9889799. inch-lbs
Maximum shear force              =         60000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     3.00000000 feet below pile head
Number of iterations             =             33
Number of zero deflection points =              4



--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 5
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Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =      75000.0 lbs
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =      50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
lb/inch    lb/inch    lb/inch
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00     7.3282  -1.31E+07     75000.       0.00      9927.   4.81E+10
0.00       0.00       0.00
    0.6000     7.3211  -1.25E+07     75000.   -0.00192      9521.   4.81E+10
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0.00       0.00       0.00
    1.2000     7.3006  -1.20E+07     75000.   -0.00375      9116.   4.81E+10
0.00       0.00       0.00
    1.8000     7.2671  -1.14E+07     75000.   -0.00551      8709.   4.81E+10
0.00       0.00       0.00
    2.4000     7.2213  -1.09E+07     75000.   -0.00718      8303.   4.81E+10
0.00       0.00       0.00
    3.0000     7.1637  -1.04E+07     75000.   -0.00877      7895.   4.81E+10
0.00       0.00       0.00
    3.6000     7.0949  -9817071.     75000.   -0.01029      7488.   4.81E+10
0.00       0.00       0.00
    4.2000     7.0155  -9273103.     75000.   -0.01172      7080.   4.81E+10
0.00       0.00       0.00
    4.8000     6.9262  -8728635.     75000.   -0.01306      6671.   4.81E+10
0.00       0.00       0.00
    5.4000     6.8274  -8183697.     75000.   -0.01433      6263.   4.81E+10
0.00       0.00       0.00
    6.0000     6.7198  -7638317.     75000.   -0.01552      5854.   4.81E+10
0.00       0.00       0.00
    6.6000     6.6040  -7092526.     75000.   -0.01662      5444.   4.81E+10
0.00       0.00       0.00
    7.2000     6.4805  -6546352.     75000.   -0.01764      5035.   4.81E+10
0.00       0.00       0.00
    7.8000     6.3500  -5999825.     75000.   -0.01858      4625.   4.81E+10
0.00       0.00       0.00
    8.4000     6.2130  -5452974.     75000.   -0.01944      4215.   4.81E+10
0.00       0.00       0.00
    9.0000     6.0701  -4905829.     75000.   -0.02021      3804.   4.81E+10
0.00       0.00       0.00
    9.6000     5.9219  -4358420.     75000.   -0.02091      3394.   4.81E+10
0.00       0.00       0.00
   10.2000     5.7690  -3810776.     73744.   -0.02152      2983.   4.81E+10
-348.9559   435.5140       0.00
   10.8000     5.6120  -3281016.     71135.   -0.02205      2586.   4.81E+10
-375.6200   481.9064       0.00
   11.4000     5.4515  -2770551.     68346.   -0.02250      2203.   4.81E+10
-399.2887   527.3577       0.00
   12.0000     5.2880  -2280636.     65389.   -0.02288      1835.   4.81E+10
-421.9472   574.5169       0.00
   12.6000     5.1220  -1812472.     62273.   -0.02319      1484.   4.81E+10
-443.7832   623.8295       0.00
   13.2000     4.9540  -1367216.     59002.   -0.02343      1150.   4.81E+10
-464.7837   675.4978       0.00
   13.8000     4.7846   -945981.     55583.   -0.02360   834.4855   4.81E+10
-484.9369   729.7420       0.00
   14.4000     4.6142   -549833.     52022.   -0.02371   537.3749   4.81E+10
-504.2311   786.8026       0.00
   15.0000     4.4432   -179795.     48325.   -0.02377   259.8466   4.81E+10
-522.6555   846.9436       0.00
   15.6000     4.2720    163157.     44499.   -0.02377   247.3681   4.81E+10
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-540.1993   910.4571       0.00
   16.2000     4.1009    478098.     40549.   -0.02372   483.5733   4.81E+10
-556.8517   977.6673       0.00
   16.8000     3.9304    764145.     36483.   -0.02363   698.1087   4.81E+10
-572.6019      1049.       0.00
   17.4000     3.7607   1020467.     34124.   -0.02349   890.3504   4.81E+10
-82.6143   158.1686       0.00
   18.0000     3.5921   1272452.     33534.   -0.02332      1079.   4.81E+10
-81.3608   163.0799       0.00
   18.6000     3.4249   1520150.     32953.   -0.02311      1265.   4.81E+10
-80.0781   168.3462       0.00
   19.2000     3.2593   1763615.     32381.   -0.02287      1448.   4.81E+10
-78.7662   174.0010       0.00
   19.8000     3.0956   2002902.     31819.   -0.02258      1627.   4.81E+10
-77.4248   180.0820       0.00
   20.4000     2.9341   2238067.     31102.   -0.02227      1804.   4.81E+10
-121.6865   298.6113       0.00
   21.0000     2.7749   2466803.     30234.   -0.02191      1975.   4.81E+10
-119.4458   309.9197       0.00
   21.6000     2.6185   2689214.     29382.   -0.02153      2142.   4.81E+10
-117.1574   322.1449       0.00
   22.2000     2.4649   2905406.     28547.   -0.02111      2304.   4.81E+10
-114.8211   335.3883       0.00
   22.8000     2.3145   3115490.     27729.   -0.02066      2462.   4.81E+10
-112.4363   349.7664       0.00
   23.4000     2.1675   3319577.     26928.   -0.02018      2615.   4.81E+10
-110.0027   365.4135       0.00
   24.0000     2.0240   3517782.     26218.   -0.01966      2763.   4.81E+10
-87.3598   310.7690       0.00
   24.6000     1.8843   3711269.     25667.   -0.01912      2908.   4.81E+10
-65.6170   250.7259       0.00
   25.2000     1.7486   3901154.     25200.   -0.01855      3051.   4.81E+10
-64.0026   263.5336       0.00
   25.8000     1.6171   4087511.     24745.   -0.01795      3191.   4.81E+10
-62.3566   277.6304       0.00
   26.4000     1.4901   4270414.     24302.   -0.01733      3328.   4.81E+10
-60.6786   293.1975       0.00
   27.0000     1.3676   4449942.     23872.   -0.01668      3462.   4.81E+10
-58.9686   310.4488       0.00
   27.6000     1.2500   4626173.     23453.   -0.01600      3595.   4.81E+10
-57.2265   329.6376       0.00
   28.2000     1.1373   4799188.     21425.   -0.01529      3724.   4.81E+10
-506.2598      3205.       0.00
   28.8000     1.0298   4945700.     17764.   -0.01456      3834.   4.81E+10
-510.6419      3570.       0.00
   29.4000     0.9276   5065474.     14076.   -0.01381      3924.   4.81E+10
-513.8266      3988.       0.00
   30.0000     0.8309   5158337.     10369.   -0.01304      3994.   4.81E+10
-515.7742      4469.       0.00
   30.6000     0.7398   5224184.      6653.   -0.01227      4043.   4.81E+10
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-516.4423      5026.       0.00
   31.2000     0.6543   5262978.      2937.   -0.01148      4072.   4.81E+10
-515.7842      5676.       0.00
   31.8000     0.5745   5274749.  -768.9289   -0.01069      4081.   4.81E+10
-513.7491      6439.       0.00
   32.4000     0.5003   5259603.     -4455.   -0.00990      4070.   4.81E+10
-510.2803      7343.       0.00
   33.0000     0.4319   5217721.     -8112.   -0.00912      4038.   4.81E+10
-505.3137      8425.       0.00
   33.6000     0.3690   5149362.    -11726.   -0.00834      3987.   4.81E+10
-498.7760      9732.       0.00
   34.2000     0.3117   5054868.    -15288.   -0.00758      3916.   4.81E+10
-490.5810     11331.       0.00
   34.8000     0.2599   4934671.    -18784.   -0.00683      3826.   4.81E+10
-480.6259     13314.       0.00
   35.4000     0.2134   4789291.    -22202.   -0.00610      3717.   4.81E+10
-468.7838     15817.       0.00
   36.0000     0.1721   4619352.    -25527.   -0.00540      3590.   4.81E+10
-454.8932     19036.       0.00
   36.6000     0.1357   4425581.    -28735.   -0.00472      3444.   4.81E+10
-435.9694     23133.       0.00
   37.2000     0.1041   4208972.    -31773.   -0.00407      3282.   4.81E+10
-408.0217     28220.       0.00
   37.8000    0.07705   3970983.    -34604.   -0.00346      3103.   4.81E+10
-378.4559     35364.       0.00
   38.4000    0.05429   3713162.    -38481.   -0.00288      2910.   4.81E+10
-698.4268     92633.       0.00
   39.0000    0.03552   3418933.    -43326.   -0.00235      2689.   4.81E+10
-647.4778    131233.       0.00
   39.6000    0.02045   3090955.    -47748.   -0.00186      2443.   4.81E+10
-580.7888    204500.       0.00
   40.2000    0.00871   2732702.    -51577.   -0.00143      2175.   4.81E+10
-482.7364    399192.       0.00
   40.8000  -8.74E-05   2349277.    -53134.   -0.00105      1887.   4.81E+10
50.2210   4135904.       0.00
   41.4000   -0.00635   1968329.    -51257.  -7.22E-04      1601.   4.81E+10
471.1509    534387.       0.00
   42.0000   -0.01049   1611699.    -47587.  -4.54E-04      1334.   4.81E+10
548.3497    376523.       0.00
   42.6000   -0.01289   1283408.    -43480.  -2.37E-04      1088.   4.81E+10
592.3025    330966.       0.00
   43.2000   -0.01390    985753.    -39120.  -6.72E-05   864.3151   4.81E+10
618.8880    320562.       0.00
   43.8000   -0.01385    720129.    -34611.   6.06E-05   665.0965   4.81E+10
633.5866    329307.       0.00
   44.4000   -0.01303    487310.    -30030.   1.51E-04   490.4827   4.81E+10
638.9387    353104.       0.00
   45.0000   -0.01168    287588.    -25439.   2.09E-04   340.6910   4.81E+10
636.2922    392292.       0.00
   45.6000   -0.01002    120836.    -20893.   2.40E-04   215.6268   4.81E+10
```

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626.4021    450193.       0.00
   46.2000   -0.00823    -13450.    -16444.   2.48E-04   135.0878   4.81E+10
609.6787    533530.       0.00
   46.8000   -0.00645   -116130.    -12138.   2.38E-04   212.0976   4.81E+10
586.2948    654303.       0.00
   47.4000   -0.00480   -188410.     -8034.   2.15E-04   266.3075   4.81E+10
553.7558    830481.       0.00
   48.0000   -0.00335   -231973.     -4218.   1.84E-04   298.9798   4.81E+10
506.2454   1086969.       0.00
   48.6000   -0.00216   -249280.  -763.4364   1.48E-04   311.9598   4.81E+10
453.3235   1513906.       0.00
   49.2000   -0.00123   -243073.      2286.   1.11E-04   307.3046   4.81E+10
393.7842   2309869.       0.00
   49.8000  -5.61E-04   -216439.      4869.   7.63E-05   287.3292   4.81E+10
323.8064   4155166.       0.00
   50.4000  -1.28E-04   -173007.      6378.   4.72E-05   254.7555   4.81E+10
95.3141   5355000.       0.00
   51.0000   1.18E-04   -124625.      6405.   2.49E-05   218.4689   4.81E+10
-87.9044   5355000.       0.00
   51.6000   2.30E-04    -80793.      5472.   9.50E-06   185.5951   4.81E+10
-171.1565   5355000.       0.00
   52.2000   2.55E-04    -45830.      4174.   1.19E-08   159.3725   4.81E+10
-189.6013   5355000.       0.00
   52.8000   2.30E-04    -20693.      2874.  -4.97E-06   140.5198   4.81E+10
-171.2843   5355000.       0.00
   53.4000   1.83E-04     -4434.      1767.  -6.85E-06   128.3257   4.81E+10
-136.3686   5355000.       0.00
   54.0000   1.32E-04      4755.   923.5480  -6.83E-06   128.5665   4.81E+10
-97.8960   5355000.       0.00
   54.6000   8.50E-05      8870.   343.4661  -5.81E-06   131.6523   4.81E+10
-63.2378   5355000.       0.00
   55.2000   4.80E-05      9705.   -12.6898  -4.42E-06   132.2790   4.81E+10
-35.6944   5355000.       0.00
   55.8000   2.14E-05      8690.  -198.5588  -3.04E-06   131.5176   4.81E+10
-15.9359   5355000.       0.00
   56.4000   4.23E-06      6848.  -267.2616  -1.88E-06   130.1362   4.81E+10
-3.1482   5355000.       0.00
   57.0000  -5.57E-06      4843.  -263.6683  -9.99E-07   128.6322   4.81E+10
4.1463   5355000.       0.00
   57.6000  -1.02E-05      3052.  -221.5398  -4.08E-07   127.2892   4.81E+10
7.5561   5355000.       0.00
   58.2000  -1.15E-05      1653.  -163.6748  -5.57E-08   126.2398   4.81E+10
8.5175   5355000.       0.00
   58.8000  -1.10E-05   695.3470  -103.6606   1.20E-07   125.5215   4.81E+10
8.1531   5355000.       0.00
   59.4000  -9.72E-06   160.2558   -48.2788   1.84E-07   125.1202   4.81E+10
7.2308   5355000.       0.00
   60.0000  -8.31E-06       0.00       0.00   1.96E-07   125.0000   4.81E+10
6.1800   2677500.       0.00
```

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 5:

```
Pile-head deflection             =     7.32818226 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =     -13068735. inch-lbs
Maximum shear force              =         75000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     0.60000000 feet below pile head
Number of iterations             =             29
Number of zero deflection points =              3
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 6

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                                =       5000.0 lbs
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =      50000.0 lbs
```

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	0.07735	-510232.	5000.	0.00	507.6740	4.81E+10	0.00	0.00	0.00
0.6000	0.07708	-474218.	5000.	-7.37E-05	480.6637	4.81E+10	0.00	0.00	0.00
1.2000	0.07629	-438179.	5000.	-1.42E-04	453.6342	4.81E+10	0.00	0.00	0.00
1.8000	0.07503	-402116.	5000.	-2.05E-04	426.5870	4.81E+10	0.00	0.00	0.00
2.4000	0.07334	-366031.	5000.	-2.63E-04	399.5235	4.81E+10	0.00	0.00	0.00
3.0000	0.07125	-329927.	5000.	-3.15E-04	372.4452	4.81E+10	0.00	0.00	0.00
3.6000	0.06881	-293805.	5000.	-3.61E-04	345.3536	4.81E+10			

```
0.00       0.00       0.00
    4.2000    0.06605   -257667.      5000.  -4.03E-04   318.2501   4.81E+10
0.00       0.00       0.00
    4.8000    0.06301   -221515.      5000.  -4.39E-04   291.1361   4.81E+10
0.00       0.00       0.00
    5.4000    0.05973   -185351.      5000.  -4.69E-04   264.0132   4.81E+10
0.00       0.00       0.00
    6.0000    0.05626   -149177.      5000.  -4.94E-04   236.8828   4.81E+10
0.00       0.00       0.00
    6.6000    0.05262   -112995.      5000.  -5.14E-04   209.7464   4.81E+10
0.00       0.00       0.00
    7.2000    0.04886    -76807.      5000.  -5.28E-04   182.6054   4.81E+10
0.00       0.00       0.00
    7.8000    0.04502    -40615.      5000.  -5.37E-04   155.4613   4.81E+10
0.00       0.00       0.00
    8.4000    0.04113     -4421.      5000.  -5.40E-04   128.3156   4.81E+10
0.00       0.00       0.00
    9.0000    0.03724     31774.      5000.  -5.38E-04   148.8303   4.81E+10
0.00       0.00       0.00
    9.6000    0.03338     67967.      5000.  -5.31E-04   175.9750   4.81E+10
0.00       0.00       0.00
   10.2000    0.02960    104156.      4913.  -5.18E-04   203.1168   4.81E+10
-24.1518      5875.       0.00
   10.8000    0.02593    139087.      4521.  -4.99E-04   229.3155   4.81E+10
-84.6244     23501.       0.00
   11.4000    0.02241    169624.      3853.  -4.76E-04   252.2183   4.81E+10
-101.1102     32492.       0.00
   12.0000    0.01907    194911.      3117.  -4.49E-04   271.1831   4.81E+10
-103.4097     39049.       0.00
   12.6000    0.01594    214826.      2367.  -4.18E-04   286.1195   4.81E+10
-104.8305     47355.       0.00
   13.2000    0.01304    229295.      1610.  -3.85E-04   296.9713   4.81E+10
-105.2984     58129.       0.00
   13.8000    0.01039    238293.   854.3787  -3.50E-04   303.7199   4.81E+10
-104.7116     72539.       0.00
   14.4000    0.00800    241850.   106.9098  -3.14E-04   306.3877   4.81E+10
-102.9187     92613.       0.00
   15.0000    0.00587    240059.  -622.4182  -2.78E-04   305.0442   4.81E+10
-99.6725    122257.       0.00
   15.6000    0.00400    233088.     -1310.  -2.43E-04   299.8157   4.81E+10
-91.3359    164506.       0.00
   16.2000    0.00238    221369.     -1855.  -2.09E-04   291.0266   4.81E+10
-60.1170    182131.       0.00
   16.8000   9.94E-04    206522.     -2171.  -1.77E-04   279.8913   4.81E+10
-27.5856    199757.       0.00
   17.4000  -1.65E-04    190233.     -2260.  -1.47E-04   267.6751   4.81E+10
2.8973    126251.       0.00
   18.0000   -0.00112    174085.     -2230.  -1.20E-04   255.5638   4.81E+10
5.5118     35446.       0.00
   18.6000   -0.00189    158213.     -2186.  -9.46E-05   243.6598   4.81E+10
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6.5610     25045.       0.00
   19.2000   -0.00248    142673.     -2137.  -7.21E-05   232.0045   4.81E+10
7.1908     20859.       0.00
   19.8000   -0.00292    127497.     -2083.  -5.19E-05   220.6229   4.81E+10
7.5952     18701.       0.00
   20.4000   -0.00323    112709.     -2011.  -3.39E-05   209.5316   4.81E+10
12.5609     28010.       0.00
   21.0000   -0.00341     98565.     -1920.  -1.80E-05   198.9240   4.81E+10
12.7943     27000.       0.00
   21.6000   -0.00349     85080.     -1827.  -4.28E-06   188.8099   4.81E+10
12.8898     26603.       0.00
   22.2000   -0.00347     72258.     -1734.   7.50E-06   179.1935   4.81E+10
12.8715     26680.       0.00
   22.8000   -0.00338     60100.     -1642.   1.74E-05   170.0747   4.81E+10
12.7558     27167.       0.00
   23.4000   -0.00322     48599.     -1551.   2.56E-05   161.4493   4.81E+10
12.5543     28047.       0.00
   24.0000   -0.00301     37747.     -1470.   3.20E-05   153.3101   4.81E+10
9.9737     23836.       0.00
   24.6000   -0.00276     27410.     -1407.   3.69E-05   145.5571   4.81E+10
7.4529     19430.       0.00
   25.2000   -0.00248     17457.     -1354.   4.03E-05   138.0928   4.81E+10
7.1916     20868.       0.00
   25.8000   -0.00218      7877.     -1304.   4.22E-05   130.9075   4.81E+10
6.8901     22735.       0.00
   26.4000   -0.00187     -1347.     -1255.   4.26E-05   126.0104   4.81E+10
6.5496     25161.       0.00
   27.0000   -0.00157    -10231.     -1210.   4.18E-05   132.6735   4.81E+10
6.1713     28340.       0.00
   27.6000   -0.00127    -18795.     -1167.   3.96E-05   139.0963   4.81E+10
5.7567     32571.       0.00
   28.2000  -9.98E-04    -27059.  -879.2386   3.62E-05   145.2944   4.81E+10
74.0732    534643.       0.00
   28.8000  -7.52E-04    -31482.  -405.0062   3.18E-05   148.6116   4.81E+10
57.6580    552269.       0.00
   29.4000  -5.40E-04    -32914.   -43.6217   2.70E-05   149.6857   4.81E+10
42.7266    569894.       0.00
   30.0000  -3.63E-04    -32130.   216.9499   2.21E-05   149.0972   4.81E+10
29.6544    587520.       0.00
   30.6000  -2.22E-04    -29806.   390.7775   1.75E-05   147.3545   4.81E+10
18.6310    605146.       0.00
   31.2000  -1.12E-04    -26515.   492.7484   1.32E-05   144.8863   4.81E+10
9.6942    622771.       0.00
   31.8000  -3.11E-05    -22720.   537.5988   9.55E-06   142.0400   4.81E+10
2.7643    640397.       0.00
   32.4000   2.54E-05    -18780.   539.1881   6.44E-06   139.0854   4.81E+10
-2.3228    658022.       0.00
   33.0000   6.17E-05    -14960.   509.9973   3.91E-06   136.2203   4.81E+10
-5.7857    675648.       0.00
   33.6000   8.18E-05    -11439.   460.8275   1.94E-06   133.5795   4.81E+10
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-7.8725    693274.       0.00
   34.2000   8.95E-05     -8326.   400.6636   4.55E-07   131.2444   4.81E+10
-8.8396    710899.       0.00
   34.8000   8.83E-05     -5670.   336.6706  -5.93E-07   129.2526   4.81E+10
-8.9362    728525.       0.00
   35.4000   8.10E-05     -3477.   274.2853  -1.28E-06   127.6080   4.81E+10
-8.3931    746150.       0.00
   36.0000   6.99E-05     -1719.   217.3718  -1.67E-06   126.2896   4.81E+10
-7.4162    763776.       0.00
   36.6000   5.70E-05  -345.9826   168.4112  -1.82E-06   125.2595   4.81E+10
-6.1839    781402.       0.00
   37.2000   4.37E-05   706.9555   128.7002  -1.79E-06   125.5302   4.81E+10
-4.8469    799027.       0.00
   37.8000   3.11E-05      1509.    98.5392  -1.63E-06   126.1314   4.81E+10
-3.5312    816653.       0.00
   38.4000   2.02E-05      2127.    48.5944  -1.36E-06   126.5953   4.81E+10
-10.3424   3683271.       0.00
   39.0000   1.16E-05      2209.   -10.6494  -1.03E-06   126.6570   4.81E+10
-6.1143   3796472.       0.00
   39.6000   5.36E-06      1974.   -43.1328  -7.19E-07   126.4809   4.81E+10
-2.9089   3909644.       0.00
   40.2000   1.25E-06      1589.   -56.1149  -4.52E-07   126.1916   4.81E+10
-0.6972   4022787.       0.00
   40.8000  -1.15E-06      1167.   -56.2513  -2.45E-07   125.8751   4.81E+10
0.6593   4135904.       0.00
   41.4000  -2.29E-06   778.8918   -49.0229  -9.96E-08   125.5842   4.81E+10
1.3486   4248996.       0.00
   42.0000  -2.58E-06   460.8960   -38.5357  -6.77E-09   125.3457   4.81E+10
1.5646   4362064.       0.00
   42.6000  -2.38E-06   223.9825   -27.5718   4.45E-08   125.1680   4.81E+10
1.4810   4475111.       0.00
   43.2000  -1.94E-06    63.8295   -17.7868   6.61E-08   125.0479   4.81E+10
1.2371   4588136.       0.00
   43.8000  -1.43E-06   -32.1945    -9.9690   6.84E-08   125.0241   4.81E+10
0.9345   4701141.       0.00
   44.4000  -9.56E-07   -79.7731    -4.3043   6.01E-08   125.0598   4.81E+10
0.6390   4814128.       0.00
   45.0000  -5.66E-07   -94.2192    -0.6085   4.70E-08   125.0707   4.81E+10
0.3876   4927097.       0.00
   45.6000  -2.79E-07   -88.5691     1.4887   3.33E-08   125.0664   4.81E+10
0.1950   5040048.       0.00
   46.2000  -8.63E-08   -72.8062     2.4129   2.13E-08   125.0546   4.81E+10
0.06175   5152984.       0.00
   46.8000   2.75E-08   -53.8384     2.5628   1.18E-08   125.0404   4.81E+10
-0.02010   5265904.       0.00
   47.4000   8.32E-08   -35.9096     2.2678   5.04E-09   125.0269   4.81E+10
-0.06186   5355000.       0.00
   48.0000   1.00E-07   -21.1855     1.7770   7.69E-10   125.0159   4.81E+10
-0.07447   5355000.       0.00
   48.6000   9.42E-08   -10.3207     1.2566  -1.59E-09   125.0077   4.81E+10
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-0.07009   5355000.       0.00
   49.2000   7.72E-08    -3.0887     0.7976  -2.60E-09   125.0023   4.81E+10
-0.05743   5355000.       0.00
   49.8000   5.69E-08     1.1663     0.4386  -2.74E-09   125.0009   4.81E+10
-0.04229   5355000.       0.00
   50.4000   3.78E-08     3.2287     0.1852  -2.41E-09   125.0024   4.81E+10
-0.02809   5355000.       0.00
   51.0000   2.22E-08     3.8345    0.02470  -1.88E-09   125.0029   4.81E+10
-0.01648   5355000.       0.00
   51.6000   1.07E-08     3.5858   -0.06324  -1.33E-09   125.0027   4.81E+10
-0.00795   5355000.       0.00
   52.2000   3.08E-09     2.9248    -0.1001  -8.38E-10   125.0022   4.81E+10
-0.00229   5355000.       0.00
   52.8000  -1.38E-09     2.1451    -0.1046  -4.58E-10   125.0016   4.81E+10
0.00102   5355000.       0.00
   53.4000  -3.52E-09     1.4184   -0.09153  -1.91E-10   125.0011   4.81E+10
0.00262   5355000.       0.00
   54.0000  -4.13E-09     0.8272   -0.07106  -2.29E-11   125.0006   4.81E+10
0.00307   5355000.       0.00
   54.6000  -3.85E-09     0.3952   -0.04970   6.87E-11   125.0003   4.81E+10
0.00286   5355000.       0.00
   55.2000  -3.14E-09     0.1115   -0.03099   1.07E-10   125.0001   4.81E+10
0.00234   5355000.       0.00
   55.8000  -2.31E-09   -0.05114   -0.01639   1.11E-10   125.0000   4.81E+10
0.00172   5355000.       0.00
   56.4000  -1.54E-09    -0.1246   -0.00608   9.80E-11   125.0001   4.81E+10
0.00115   5355000.       0.00
   57.0000  -9.02E-10    -0.1387   4.61E-04   7.82E-11   125.0001   4.81E+10
6.71E-04   5355000.       0.00
   57.6000  -4.13E-10    -0.1180    0.00398   5.90E-11   125.0001   4.81E+10
3.07E-04   5355000.       0.00
   58.2000  -5.18E-11   -0.08143    0.00523   4.41E-11   125.0001   4.81E+10
3.85E-05   5355000.       0.00
   58.8000   2.22E-10   -0.04282    0.00477   3.48E-11   125.0000   4.81E+10
-1.65E-04   5355000.       0.00
   59.4000   4.49E-10   -0.01276    0.00298   3.06E-11   125.0000   4.81E+10
-3.34E-04   5355000.       0.00
   60.0000   6.62E-10       0.00       0.00   2.97E-11   125.0000   4.81E+10
-4.93E-04   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 6:

Pile-head deflection             =     0.07735362 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =       -510232. inch-lbs
Maximum shear force              =          5000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
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Depth of maximum shear force = 4.80000000 feet below pile head
Number of iterations = 10
Number of zero deflection points = 6

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 7

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 10000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	0.2105	-1101968.	10000.	0.00	951.4758	4.81E+10	0.00	0.00	0.00
0.6000	0.2100	-1029938.	10000.	-1.60E-04	897.4535	4.81E+10	0.00	0.00	0.00
1.2000	0.2082	-957853.	10000.	-3.09E-04	843.3896	4.81E+10	0.00	0.00	0.00
1.8000	0.2055	-885716.	10000.	-4.47E-04	789.2869	4.81E+10	0.00	0.00	0.00
2.4000	0.2018	-813531.	10000.	-5.74E-04	735.1484	4.81E+10	0.00	0.00	0.00
3.0000	0.1972	-741303.	10000.	-6.90E-04	680.9770	4.81E+10	0.00	0.00	0.00
3.6000	0.1919	-669034.	10000.	-7.96E-04	626.7756	4.81E+10	0.00	0.00	0.00
4.2000	0.1858	-596730.	10000.	-8.91E-04	572.5472	4.81E+10	0.00	0.00	0.00
4.8000	0.1791	-524393.	10000.	-9.75E-04	518.2946	4.81E+10	0.00	0.00	0.00
5.4000	0.1717	-452028.	10000.	-0.00105	464.0208	4.81E+10	0.00	0.00	0.00
6.0000	0.1640	-379638.	10000.	-0.00111	409.7287	4.81E+10	0.00	0.00	0.00
6.6000	0.1558	-307228.	10000.	-0.00116	355.4213	4.81E+10			

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0.00       0.00       0.00
    7.2000     0.1472   -234802.     10000.   -0.00120   301.1015   4.81E+10
0.00       0.00       0.00
    7.8000     0.1385   -162363.     10000.   -0.00123   246.7721   4.81E+10
0.00       0.00       0.00
    8.4000     0.1295    -89915.     10000.   -0.00125   192.4362   4.81E+10
0.00       0.00       0.00
    9.0000     0.1204    -17462.     10000.   -0.00126   138.0967   4.81E+10
0.00       0.00       0.00
    9.6000     0.1114     54991.     10000.   -0.00126   166.2436   4.81E+10
0.00       0.00       0.00
   10.2000     0.1024    127442.      9699.   -0.00124   220.5816   4.81E+10
-83.5190      5875.       0.00
   10.8000    0.09348    195556.      8913.   -0.00122   271.6673   4.81E+10
-135.0195     10400.       0.00
   11.4000    0.08481    256661.      7919.   -0.00118   317.4954   4.81E+10
-141.0237     11972.       0.00
   12.0000    0.07642    310440.      6884.   -0.00114   357.8302   4.81E+10
-146.3063     13784.       0.00
   12.6000    0.06837    356619.      5815.   -0.00109   392.4641   4.81E+10
-150.8512     15887.       0.00
   13.2000    0.06070    394958.      4715.   -0.00104   421.2184   4.81E+10
-154.6436     18344.       0.00
   13.8000    0.05345    425259.      3591.  -9.74E-04   443.9443   4.81E+10
-157.6701     21238.       0.00
   14.4000    0.04667    447364.      2447.  -9.09E-04   460.5227   4.81E+10
-159.9181     24672.       0.00
   15.0000    0.04037    461154.      1291.  -8.41E-04   470.8654   4.81E+10
-161.3751     28784.       0.00
   15.6000    0.03456    466554.   126.3476  -7.71E-04   474.9152   4.81E+10
-162.0278     33754.       0.00
   16.2000    0.02926    463529.     -1040.  -7.02E-04   472.6464   4.81E+10
-161.8589     39829.       0.00
   16.8000    0.02446    452088.     -2201.  -6.33E-04   464.0659   4.81E+10
-160.8440     47350.       0.00
   17.4000    0.02014    432285.     -2832.  -5.67E-04   449.2134   4.81E+10
-14.4567      5167.       0.00
   18.0000    0.01630    411709.     -2933.  -5.04E-04   433.7814   4.81E+10
-13.4706      5952.       0.00
   18.6000    0.01289    390412.     -3026.  -4.44E-04   417.8090   4.81E+10
-12.4589      6959.       0.00
   19.2000    0.00991    368449.     -3112.  -3.87E-04   401.3365   4.81E+10
-11.4129      8294.       0.00
   19.8000    0.00732    345874.     -3191.  -3.33E-04   384.4052   4.81E+10
-10.3192     10147.       0.00
   20.4000    0.00511    322745.     -3280.  -2.83E-04   367.0588   4.81E+10
-14.6462     20637.       0.00
   21.0000    0.00325    298840.     -3378.  -2.37E-04   349.1299   4.81E+10
-12.5917     27936.       0.00
   21.6000    0.00170    274266.     -3460.  -1.94E-04   330.6993   4.81E+10
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-10.1608     42958.       0.00
   22.2000   4.57E-04    249150.     -3521.  -1.54E-04   311.8626   4.81E+10
-6.5677    103578.       0.00
   22.8000  -5.21E-04    223681.     -3520.  -1.19E-04   292.7605   4.81E+10
6.8218     94238.       0.00
   23.4000   -0.00126    198553.     -3462.  -8.74E-05   273.9145   4.81E+10
9.1657     52471.       0.00
   24.0000   -0.00178    173889.     -3399.  -5.95E-05   255.4169   4.81E+10
8.3645     33833.       0.00
   24.6000   -0.00211    149650.     -3344.  -3.53E-05   237.2374   4.81E+10
6.8158     23204.       0.00
   25.2000   -0.00229    125756.     -3295.  -1.47E-05   219.3169   4.81E+10
6.9979     22018.       0.00
   25.8000   -0.00233    102218.     -3244.   2.41E-06   201.6634   4.81E+10
7.0366     21780.       0.00
   26.4000   -0.00225     79039.     -3194.   1.60E-05   184.2793   4.81E+10
6.9631     22246.       0.00
   27.0000   -0.00210     56217.     -3144.   2.61E-05   167.1628   4.81E+10
6.7970     23349.       0.00
   27.6000   -0.00188     33744.     -3096.   3.28E-05   150.3083   4.81E+10
6.5524     25126.       0.00
   28.2000   -0.00162     11609.     -2718.   3.62E-05   133.7071   4.81E+10
98.3728    436417.       0.00
   28.8000   -0.00136     -5426.     -2014.   3.67E-05   129.0698   4.81E+10
97.2463    516459.       0.00
   29.4000   -0.00109    -17421.     -1352.   3.50E-05   138.0655   4.81E+10
86.6192    569894.       0.00
   30.0000  -8.52E-04    -24924.  -790.1918   3.18E-05   143.6927   4.81E+10
69.5026    587520.       0.00
   30.6000  -6.36E-04    -28822.  -347.5350   2.78E-05   146.6167   4.81E+10
53.4576    605146.       0.00
   31.2000  -4.51E-04    -29948.   -14.5253   2.34E-05   147.4611   4.81E+10
39.0451    622771.       0.00
   31.8000  -2.99E-04    -29048.   221.8026   1.90E-05   146.7862   4.81E+10
26.6015    640397.       0.00
   32.4000  -1.78E-04    -26768.   376.1594   1.48E-05   145.0759   4.81E+10
16.2754    658022.       0.00
   33.0000  -8.60E-05    -23642.   463.7877   1.10E-05   142.7317   4.81E+10
8.0658    675648.       0.00
   33.6000  -1.93E-05    -20097.   499.5223   7.75E-06   140.0730   4.81E+10
1.8604    693274.       0.00
   34.2000   2.56E-05    -16455.   497.1080   5.01E-06   137.3411   4.81E+10
-2.5311    710899.       0.00
   34.8000   5.28E-05    -12943.   468.7467   2.81E-06   134.7069   4.81E+10
-5.3471    728525.       0.00
   35.4000   6.61E-05     -9707.   424.8384   1.11E-06   132.2801   4.81E+10
-6.8497    746150.       0.00
   36.0000   6.89E-05     -6826.   373.8755  -1.25E-07   130.1193   4.81E+10
-7.3067    763776.       0.00
   36.6000   6.43E-05     -4323.   322.4493  -9.60E-07   128.2422   4.81E+10
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-6.9784    781402.       0.00
   37.2000   5.51E-05     -2182.   275.3304  -1.45E-06   126.6363   4.81E+10
-6.1102    799027.       0.00
   37.8000   4.35E-05  -357.1249   235.5857  -1.64E-06   125.2678   4.81E+10
-4.9300    816653.       0.00
   38.4000   3.15E-05      1212.   159.8528  -1.57E-06   125.9089   4.81E+10
-16.1069   3683271.       0.00
   39.0000   2.08E-05      1946.    62.3591  -1.34E-06   126.4594   4.81E+10
-10.9746   3796472.       0.00
   39.6000   1.22E-05      2111.    -1.0762  -1.03E-06   126.5831   4.81E+10
-6.6463   3909644.       0.00
   40.2000   5.94E-06      1931.   -36.9561  -7.30E-07   126.4484   4.81E+10
-3.3203   4022787.       0.00
   40.8000   1.73E-06      1579.   -52.4837  -4.67E-07   126.1844   4.81E+10
-0.9929   4135904.       0.00
   41.4000  -7.83E-07      1176.   -54.3952  -2.61E-07   125.8818   4.81E+10
0.4619   4248996.       0.00
   42.0000  -2.03E-06   796.0952   -48.3141  -1.13E-07   125.5971   4.81E+10
1.2273   4362064.       0.00
   42.6000  -2.41E-06   480.0653   -38.5024  -1.75E-08   125.3600   4.81E+10
1.4981   4475111.       0.00
   43.2000  -2.28E-06   241.6729   -27.8852   3.66E-08   125.1813   4.81E+10
1.4511   4588136.       0.00
   43.8000  -1.88E-06    78.4920   -18.2345   6.06E-08   125.0589   4.81E+10
1.2297   4701141.       0.00
   44.4000  -1.40E-06   -20.9472   -10.4263   6.49E-08   125.0157   4.81E+10
0.9393   4814128.       0.00
   45.0000  -9.49E-07   -71.6932    -4.7073   5.80E-08   125.0538   4.81E+10
0.6493   4927097.       0.00
   45.6000  -5.70E-07   -88.7743    -0.9326   4.59E-08   125.0666   4.81E+10
0.3992   5040048.       0.00
   46.2000  -2.87E-07   -85.1564     1.2450   3.29E-08   125.0639   4.81E+10
0.2057   5152984.       0.00
   46.8000  -9.64E-08   -70.8703     2.2393   2.12E-08   125.0532   4.81E+10
0.07051   5265904.       0.00
   47.4000   1.82E-08   -52.9252     2.4445   1.19E-08   125.0397   4.81E+10
-0.01351   5355000.       0.00
   48.0000   7.57E-08   -35.6778     2.1933   5.31E-09   125.0268   4.81E+10
-0.05628   5355000.       0.00
   48.6000   9.47E-08   -21.3458     1.7372   1.04E-09   125.0160   4.81E+10
-0.07042   5355000.       0.00
   49.2000   9.07E-08   -10.6634     1.2408  -1.35E-09   125.0080   4.81E+10
-0.06744   5355000.       0.00
   49.8000   7.52E-08    -3.4766     0.7968  -2.41E-09   125.0026   4.81E+10
-0.05591   5355000.       0.00
   50.4000   5.59E-08     0.8118     0.4457  -2.61E-09   125.0006   4.81E+10
-0.04159   5355000.       0.00
   51.0000   3.75E-08     2.9440     0.1955  -2.33E-09   125.0022   4.81E+10
-0.02792   5355000.       0.00
   51.6000   2.23E-08     3.6283    0.03512  -1.84E-09   125.0027   4.81E+10
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-0.01662   5355000.       0.00
   52.2000   1.11E-08     3.4511   -0.05430  -1.31E-09   125.0026   4.81E+10
-0.00822   5355000.       0.00
   52.8000   3.49E-09     2.8474   -0.09322  -8.38E-10   125.0021   4.81E+10
-0.00259   5355000.       0.00
   53.4000  -1.01E-09     2.1092   -0.09985  -4.67E-10   125.0016   4.81E+10
7.52E-04   5355000.       0.00
   54.0000  -3.23E-09     1.4099   -0.08849  -2.03E-10   125.0011   4.81E+10
0.00240   5355000.       0.00
   54.6000  -3.93E-09     0.8351   -0.06930  -3.49E-11   125.0006   4.81E+10
0.00293   5355000.       0.00
   55.2000  -3.73E-09     0.4120   -0.04877   5.85E-11   125.0003   4.81E+10
0.00278   5355000.       0.00
   55.8000  -3.09E-09     0.1328   -0.03049   9.94E-11   125.0001   4.81E+10
0.00230   5355000.       0.00
   56.4000  -2.30E-09    -0.02715  -0.01605   1.07E-10   125.0000   4.81E+10
0.00171   5355000.       0.00
   57.0000  -1.55E-09    -0.09830  -0.00574   9.79E-11   125.0001   4.81E+10
0.00115   5355000.       0.00
   57.6000  -8.95E-10     -0.1098   7.99E-04   8.23E-11   125.0001   4.81E+10
6.65E-04   5355000.       0.00
   58.2000  -3.61E-10    -0.08685    0.00416   6.76E-11   125.0001   4.81E+10
2.69E-04   5355000.       0.00
   58.8000   7.81E-11    -0.04993    0.00492   5.73E-11   125.0000   4.81E+10
-5.81E-05   5355000.       0.00
   59.4000   4.64E-10    -0.01603    0.00347   5.24E-11   125.0000   4.81E+10
-3.45E-04   5355000.       0.00
   60.0000   8.32E-10       0.00       0.00   5.12E-11   125.0000   4.81E+10
-6.19E-04   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 7:

Pile-head deflection             =     0.21054870 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -1101968. inch-lbs
Maximum shear force              =         10000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     3.60000000 feet below pile head
Number of iterations             =             22
Number of zero deflection points =              6



---------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 8
---------------------------------------------------------------------------
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Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 20000.0 lbs
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Lat. Load	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	0.6963	-2512357.	20000.	0.00	2009.	4.81E+10	0.00	0.00	0.00
0.6000	0.6949	-2368289.	20000.	-3.66E-04	1901.	4.81E+10	0.00	0.00	0.00
1.2000	0.6910	-2224093.	20000.	-7.09E-04	1793.	4.81E+10	0.00	0.00	0.00
1.8000	0.6847	-2079778.	20000.	-0.00103	1685.	4.81E+10	0.00	0.00	0.00
2.4000	0.6761	-1935351.	20000.	-0.00133	1577.	4.81E+10	0.00	0.00	0.00
3.0000	0.6655	-1790819.	20000.	-0.00161	1468.	4.81E+10	0.00	0.00	0.00
3.6000	0.6529	-1646190.	20000.	-0.00187	1360.	4.81E+10	0.00	0.00	0.00
4.2000	0.6386	-1501473.	20000.	-0.00210	1251.	4.81E+10	0.00	0.00	0.00
4.8000	0.6226	-1356675.	20000.	-0.00232	1143.	4.81E+10	0.00	0.00	0.00
5.4000	0.6052	-1211803.	20000.	-0.00251	1034.	4.81E+10	0.00	0.00	0.00
6.0000	0.5865	-1066867.	20000.	-0.00268	925.1500	4.81E+10	0.00	0.00	0.00
6.6000	0.5666	-921872.	20000.	-0.00283	816.4043	4.81E+10	0.00	0.00	0.00
7.2000	0.5457	-776828.	20000.	-0.00296	707.6214	4.81E+10	0.00	0.00	0.00
7.8000	0.5240	-631743.	20000.	-0.00306	598.8070	4.81E+10	0.00	0.00	0.00
8.4000	0.5016	-486623.	20000.	-0.00315	489.9670	4.81E+10	0.00	0.00	0.00
9.0000	0.4787	-341477.	20000.	-0.00321	381.1074	4.81E+10	0.00	0.00	0.00
9.6000	0.4554	-196312.	20000.	-0.00325	272.2340	4.81E+10			

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0.00       0.00       0.00
   10.2000     0.4319    -51137.     19338.   -0.00327   163.3526   4.81E+10
-183.8939      3066.       0.00
   10.8000     0.4083     84508.     17973.   -0.00327   188.3810   4.81E+10
-195.1891      3442.       0.00
   11.4000     0.3848    210030.     16530.   -0.00324   282.5223   4.81E+10
-205.8193      3851.       0.00
   12.0000     0.3616    324870.     15012.   -0.00320   368.6528   4.81E+10
-215.7750      4296.       0.00
   12.6000     0.3387    428508.     13425.   -0.00315   446.3809   4.81E+10
-225.0487      4784.       0.00
   13.2000     0.3163    520456.     11774.   -0.00308   515.3417   4.81E+10
-233.6351      5319.       0.00
   13.8000     0.2944    600264.     10063.   -0.00299   575.1977   4.81E+10
-241.5305      5907.       0.00
   14.4000     0.2732    667518.      8298.   -0.00290   625.6388   4.81E+10
-248.7330      6555.       0.00
   15.0000     0.2527    721843.      6484.   -0.00279   666.3821   4.81E+10
-255.2417      7272.       0.00
   15.6000     0.2330    762897.      4625.   -0.00268   697.1724   4.81E+10
-261.0568      8068.       0.00
   16.2000     0.2141    790376.      2727.   -0.00257   717.7820   4.81E+10
-266.1784      8952.       0.00
   16.8000     0.1960    804014.   794.6879   -0.00245   728.0106   4.81E+10
-270.6056      9939.       0.00
   17.4000     0.1789    803581.  -287.2495   -0.00233   727.6856   4.81E+10
-29.9325      1205.       0.00
   18.0000     0.1625    801552.  -499.3831   -0.00221   726.1642   4.81E+10
-28.9935      1284.       0.00
   18.6000     0.1471    797978.  -704.7190   -0.00209   723.4832   4.81E+10
-28.0443      1373.       0.00
   19.2000     0.1325    792906.  -903.1840   -0.00197   719.6796   4.81E+10
-27.0849      1472.       0.00
   19.8000     0.1188    786388.     -1095.   -0.00185   714.7908   4.81E+10
-26.1150      1583.       0.00
   20.4000     0.1059    778473.     -1333.   -0.00173   708.8548   4.81E+10
-40.2152      2734.       0.00
   21.0000    0.09385    768432.     -1617.   -0.00162   701.3238   4.81E+10
-38.6289      2963.       0.00
   21.6000    0.08264    756346.     -1890.   -0.00150   692.2599   4.81E+10
-37.0245      3226.       0.00
   22.2000    0.07224    742301.     -2150.   -0.00139   681.7258   4.81E+10
-35.4013      3528.       0.00
   22.8000    0.06264    726380.     -2399.   -0.00128   669.7853   4.81E+10
-33.7583      3880.       0.00
   23.4000    0.05382    708671.     -2636.   -0.00117   656.5029   4.81E+10
-32.0939      4293.       0.00
   24.0000    0.04577    689259.     -2841.   -0.00107   641.9441   4.81E+10
-24.7053      3886.       0.00
   24.6000    0.03846    668529.     -2994.  -9.65E-04   626.3968   4.81E+10
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-17.9336      3357.       0.00
   25.2000    0.03188    646834.     -3120.  -8.66E-04   610.1252   4.81E+10
-16.8452      3805.       0.00
   25.8000    0.02599    624230.     -3237.  -7.71E-04   593.1725   4.81E+10
-15.7365      4360.       0.00
   26.4000    0.02077    600777.     -3346.  -6.79E-04   575.5828   4.81E+10
-14.6042      5062.       0.00
   27.0000    0.01620    576535.     -3447.  -5.91E-04   557.4009   4.81E+10
-13.4440      5974.       0.00
   27.6000    0.01226    551564.     -3540.  -5.07E-04   538.6730   4.81E+10
-12.2497      7196.       0.00
   28.2000    0.00891    525929.     -4126.  -4.26E-04   519.4466   4.81E+10
-150.6122    121764.      0.00
   28.8000    0.00612    492457.     -5179.  -3.50E-04   494.3430   4.81E+10
-141.8040    166784.      0.00
   29.4000    0.00387    451608.     -6159.  -2.79E-04   463.7062   4.81E+10
-130.5910    243053.      0.00
   30.0000    0.00210    403965.     -7046.  -2.15E-04   427.9738   4.81E+10
-115.6988    396214.      0.00
   30.6000   7.72E-04    350302.     -7696.  -1.59E-04   387.7267   4.81E+10
-64.8947     605146.      0.00
   31.2000  -1.80E-04    293256.     -7873.  -1.10E-04   344.9422   4.81E+10
15.6080     622771.      0.00
   31.8000  -8.17E-04    237004.     -7556.  -7.06E-05   302.7528   4.81E+10
72.6436     640397.      0.00
   32.4000   -0.00120    184504.     -6900.  -3.91E-05   263.3782   4.81E+10
109.4337    658022.      0.00
   33.0000   -0.00138    137668.     -6074.  -1.49E-05   228.2509   4.81E+10
120.1189    627117.      0.00
   33.6000   -0.00141     97051.     -5195.   2.66E-06   197.7882   4.81E+10
124.0569    632445.      0.00
   34.2000   -0.00134     62860.     -4296.   1.46E-05   172.1449   4.81E+10
125.6350    674623.      0.00
   34.8000   -0.00120     35178.     -3406.   2.20E-05   151.3838   4.81E+10
121.5831    728525.      0.00
   35.4000   -0.00102     13798.     -2586.   2.56E-05   135.3485   4.81E+10
106.1620    746150.      0.00
   36.0000  -8.32E-04     -2080.     -1886.   2.65E-05   126.5599   4.81E+10
88.2948     763776.      0.00
   36.6000  -6.43E-04    -13380.     -1317.   2.54E-05   135.0353   4.81E+10
69.7306     781402.      0.00
   37.2000  -4.67E-04    -21065.  -879.5167   2.28E-05   140.7990   4.81E+10
51.8384     799027.      0.00
   37.8000  -3.14E-04    -26062.  -564.5063   1.93E-05   144.5464   4.81E+10
35.6644     816653.      0.00
   38.4000  -1.90E-04    -29208.   -86.4555   1.51E-05   146.9060   4.81E+10
97.1275    3683271.      0.00
   39.0000  -9.68E-05    -27318.   446.9386   1.09E-05   145.4882   4.81E+10
51.0376    3796472.      0.00
   39.6000  -3.32E-05    -22780.   695.5429   7.13E-06   142.0850   4.81E+10
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18.0192   3909644.       0.00
   40.2000   5.86E-06    -17307.   748.6332   4.13E-06   137.9802   4.81E+10
-3.2719   4022787.       0.00
   40.8000   2.62E-05    -12003.   682.6105   1.93E-06   134.0020   4.81E+10
-15.0677   4135904.       0.00
   41.4000   3.37E-05     -7479.   556.8551   4.72E-07   130.6091   4.81E+10
-19.8643   4248996.       0.00
   42.0000   3.30E-05     -3984.   413.3163  -3.87E-07   127.9882   4.81E+10
-20.0076   4362064.       0.00
   42.6000   2.81E-05     -1527.   278.4334  -7.99E-07   126.1450   4.81E+10
-17.4599   4475111.       0.00
   43.2000   2.15E-05    25.7649   166.2286  -9.12E-07   125.0193   4.81E+10
-13.7081   4588136.       0.00
   43.8000   1.50E-05   867.6257    81.7158  -8.45E-07   125.6507   4.81E+10
-9.7677   4701141.       0.00
   44.4000   9.34E-06      1203.    24.0616  -6.90E-07   125.9023   4.81E+10
-6.2473   4814128.       0.00
   45.0000   5.02E-06      1215.   -10.8078  -5.09E-07   125.9110   4.81E+10
-3.4386   4927097.       0.00
   45.6000   2.02E-06      1048.   -28.2677  -3.39E-07   125.7859   4.81E+10
-1.4114   5040048.       0.00
   46.2000   1.38E-07   807.7990   -33.7031  -2.00E-07   125.6058   4.81E+10
-0.09848   5152984.       0.00
   46.8000  -8.70E-07   562.6343   -31.7675  -9.78E-08   125.4220   4.81E+10
0.6361   5265904.       0.00
   47.4000  -1.27E-06   350.4173   -26.0759  -2.94E-08   125.2628   4.81E+10
0.9449   5355000.       0.00
   48.0000  -1.29E-06   187.1625   -19.2123   1.09E-08   125.1404   4.81E+10
0.9617   5355000.       0.00
   48.6000  -1.11E-06    73.7525   -12.7678   3.04E-08   125.0553   4.81E+10
0.8284   5355000.       0.00
   49.2000  -8.55E-07     3.2846    -7.4958   3.62E-08   125.0025   4.81E+10
0.6360   5355000.       0.00
   49.8000  -5.93E-07   -34.2130    -3.6188   3.39E-08   125.0257   4.81E+10
0.4409   5355000.       0.00
   50.4000  -3.67E-07   -48.8507    -1.0475   2.76E-08   125.0366   4.81E+10
0.2733   5355000.       0.00
   51.0000  -1.95E-07   -49.3172     0.4580   2.03E-08   125.0370   4.81E+10
0.1449   5355000.       0.00
   51.6000  -7.53E-08   -42.2708     1.1811   1.34E-08   125.0317   4.81E+10
0.05599   5355000.       0.00
   52.2000  -1.37E-09   -32.3193     1.3863   7.85E-09   125.0242   4.81E+10
0.00102   5355000.       0.00
   52.8000   3.77E-08   -22.3130     1.2891   3.75E-09   125.0167   4.81E+10
-0.02803   5355000.       0.00
   53.4000   5.27E-08   -13.7584     1.0472   1.05E-09   125.0103   4.81E+10
-0.03918   5355000.       0.00
   54.0000   5.28E-08    -7.2339     0.7647  -5.21E-10   125.0054   4.81E+10
-0.03929   5355000.       0.00
   54.6000   4.52E-08    -2.7458     0.5023  -1.27E-09   125.0021   4.81E+10
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-0.03360   5355000.       0.00
   55.2000   3.46E-08   5.17E-04     0.2888  -1.47E-09   125.0000   4.81E+10
-0.02571   5355000.       0.00
   55.8000   2.40E-08     1.4141     0.1321  -1.37E-09   125.0011   4.81E+10
-0.01782   5355000.       0.00
   56.4000   1.49E-08     1.9039    0.02814  -1.12E-09   125.0014   4.81E+10
-0.01106   5355000.       0.00
   57.0000   7.84E-09     1.8200   -0.03269  -8.40E-10   125.0014   4.81E+10
-0.00583   5355000.       0.00
   57.6000   2.77E-09     1.4337   -0.06112  -5.97E-10   125.0011   4.81E+10
-0.00206   5355000.       0.00
   58.2000  -7.47E-10     0.9404   -0.06654  -4.19E-10   125.0007   4.81E+10
5.56E-04   5355000.       0.00
   58.8000  -3.26E-09     0.4758   -0.05583  -3.13E-10   125.0004   4.81E+10
0.00242   5355000.       0.00
   59.4000  -5.25E-09     0.1367   -0.03306  -2.67E-10   125.0001   4.81E+10
0.00390   5355000.       0.00
   60.0000  -7.10E-09       0.00       0.00  -2.57E-10   125.0000   4.81E+10
0.00528   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 8:

Pile-head deflection             =     0.69626852 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -2512357. inch-lbs
Maximum shear force              =         20000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     7.80000000 feet below pile head
Number of iterations             =             24
Number of zero deflection points =              5



--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 9
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Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =      25000.0 lbs
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =      50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
```

Res. Soil Spr. Distrib.

X	y	Moment	Force	S	Stress	Stiffness	p
Es*h	Lat. Load						
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	
lb/inch	lb/inch	lb/inch					
0.00	1.0453	-3311329.	25000.	0.00	2608.	4.81E+10	
0.00	0.00	0.00					
0.6000	1.0435	-3131239.	25000.	-4.83E-04	2473.	4.81E+10	
0.00	0.00	0.00					
1.2000	1.0383	-2950981.	25000.	-9.38E-04	2338.	4.81E+10	
0.00	0.00	0.00					
1.8000	1.0300	-2770564.	25000.	-0.00137	2203.	4.81E+10	
0.00	0.00	0.00					
2.4000	1.0186	-2589997.	25000.	-0.00177	2067.	4.81E+10	
0.00	0.00	0.00					
3.0000	1.0045	-2409291.	25000.	-0.00214	1932.	4.81E+10	
0.00	0.00	0.00					
3.6000	0.9878	-2228455.	25000.	-0.00249	1796.	4.81E+10	
0.00	0.00	0.00					
4.2000	0.9687	-2047498.	25000.	-0.00281	1661.	4.81E+10	
0.00	0.00	0.00					
4.8000	0.9473	-1866431.	25000.	-0.00310	1525.	4.81E+10	
0.00	0.00	0.00					
5.4000	0.9240	-1685264.	25000.	-0.00337	1389.	4.81E+10	
0.00	0.00	0.00					
6.0000	0.8988	-1504006.	25000.	-0.00361	1253.	4.81E+10	
0.00	0.00	0.00					
6.6000	0.8720	-1322666.	25000.	-0.00382	1117.	4.81E+10	
0.00	0.00	0.00					
7.2000	0.8438	-1141255.	25000.	-0.00400	980.9415	4.81E+10	
0.00	0.00	0.00					
7.8000	0.8144	-959783.	25000.	-0.00416	844.8372	4.81E+10	
0.00	0.00	0.00					
8.4000	0.7839	-778259.	25000.	-0.00429	708.6942	4.81E+10	
0.00	0.00	0.00					
9.0000	0.7526	-596693.	25000.	-0.00439	572.5196	4.81E+10	
0.00	0.00	0.00					
9.6000	0.7206	-415095.	25000.	-0.00447	436.3210	4.81E+10	
0.00	0.00	0.00					
10.2000	0.6882	-233474.	24256.	-0.00452	300.1055	4.81E+10	
-206.6098	2162.	0.00					
10.8000	0.6555	-62551.	22721.	-0.00454	171.9136	4.81E+10	
-219.7098	2413.	0.00					
11.4000	0.6228	96985.	21095.	-0.00454	197.7386	4.81E+10	
-232.1373	2684.	0.00					
12.0000	0.5902	244482.	19381.	-0.00451	308.3613	4.81E+10	
-243.8823	2975.	0.00					
12.6000	0.5578	379323.	17585.	-0.00447	409.4919	4.81E+10	

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-254.9366      3291.       0.00
   13.2000     0.5258    500927.     15713.   -0.00440   500.6953   4.81E+10
-265.2936      3633.       0.00
   13.8000     0.4944    608752.     13768.   -0.00432   581.5639   4.81E+10
-274.9481      4004.       0.00
   14.4000     0.4637    702290.     11756.   -0.00422   651.7178   4.81E+10
-283.8964      4408.       0.00
   15.0000     0.4337    781074.      9682.   -0.00411   710.8054   4.81E+10
-292.1353      4850.       0.00
   15.6000     0.4045    844671.      7552.   -0.00399   758.5032   4.81E+10
-299.6624      5334.       0.00
   16.2000     0.3763    892688.      5370.   -0.00386   794.5160   4.81E+10
-306.4750      5865.       0.00
   16.8000     0.3490    924769.      3141.   -0.00372   818.5770   4.81E+10
-312.5695      6449.       0.00
   17.4000     0.3227    940597.      1885.   -0.00358   830.4478   4.81E+10
-36.4388   813.0438       0.00
   18.0000     0.2974    954485.      1626.   -0.00344   840.8638   4.81E+10
-35.4616   858.4728       0.00
   18.6000     0.2732    966483.      1374.   -0.00329   849.8625   4.81E+10
-34.4707   908.5402       0.00
   19.2000     0.2500    976643.      1129.   -0.00315   857.4819   4.81E+10
-33.4658   963.9204       0.00
   19.8000     0.2278    985014.   892.1208   -0.00300   863.7606   4.81E+10
-32.4468      1025.       0.00
   20.4000     0.2067    991651.   594.3717   -0.00285   868.7380   4.81E+10
-50.2613      1750.       0.00
   21.0000     0.1867    995628.   238.5287   -0.00271   871.7211   4.81E+10
-48.5840      1873.       0.00
   21.6000     0.1678    997033.  -105.1500   -0.00256   872.7750   4.81E+10
-46.8823      2012.       0.00
   22.2000     0.1499    995954.  -436.4861   -0.00241   871.9657   4.81E+10
-45.1555      2169.       0.00
   22.8000     0.1331    992481.  -755.2947   -0.00226   869.3606   4.81E+10
-43.4024      2347.       0.00
   23.4000     0.1174    986704.     -1061.   -0.00211   865.0278   4.81E+10
-41.6219      2553.       0.00
   24.0000     0.1027    978716.     -1328.   -0.00196   859.0369   4.81E+10
-32.3475      2267.       0.00
   24.6000    0.08915    968998.     -1530.   -0.00182   851.7487   4.81E+10
-23.7323      1917.       0.00
   25.2000    0.07659    957998.     -1696.   -0.00167   843.4986   4.81E+10
-22.5612      2121.       0.00
   25.8000    0.06507    945777.     -1854.   -0.00153   834.3326   4.81E+10
-21.3677      2365.       0.00
   26.4000    0.05456    932397.     -2004.   -0.00139   824.2975   4.81E+10
-20.1499      2659.       0.00
   27.0000    0.04506    917922.     -2144.   -0.00125   813.4413   4.81E+10
-18.9054      3021.       0.00
   27.6000    0.03656    902417.     -2276.   -0.00111   801.8130   4.81E+10
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-17.6318      3473.       0.00
   28.2000    0.02902    885950.     -3068.  -9.80E-04   789.4626   4.81E+10
-202.3483     50202.       0.00
   28.8000    0.02244    858945.     -4503.  -8.49E-04   769.2091   4.81E+10
-196.2055     62949.       0.00
   29.4000    0.01679    821723.     -5888.  -7.24E-04   741.2924   4.81E+10
-188.4730     80828.       0.00
   30.0000    0.01202    774686.     -7210.  -6.04E-04   706.0146   4.81E+10
-178.8915    107137.       0.00
   30.6000    0.00809    718334.     -8455.  -4.92E-04   663.7502   4.81E+10
-167.0233    148630.       0.00
   31.2000    0.00493    653284.     -9604.  -3.89E-04   614.9628   4.81E+10
-152.0134    221800.       0.00
   31.8000    0.00248    580318.    -10625.  -2.97E-04   560.2388   4.81E+10
-131.7465    382065.       0.00
   32.4000   6.57E-04    500492.    -11316.  -2.16E-04   500.3690   4.81E+10
-60.0244    658022.       0.00
   33.0000  -6.29E-04    417527.    -11319.  -1.47E-04   438.1452   4.81E+10
59.0644    675648.       0.00
   33.6000   -0.00147    337601.    -10656.  -9.08E-05   378.2009   4.81E+10
125.1892    615135.       0.00
   34.2000   -0.00194    264147.     -9709.  -4.57E-05   323.1103   4.81E+10
137.7265    511916.       0.00
   34.8000   -0.00212    197819.     -8693.  -1.11E-05   273.3639   4.81E+10
144.5004    489831.       0.00
   35.4000   -0.00210    138970.     -7642.   1.41E-05   229.2276   4.81E+10
147.6004    506647.       0.00
   36.0000   -0.00192     87766.     -6578.   3.11E-05   190.8245   4.81E+10
147.8689    554151.       0.00
   36.6000   -0.00165     44222.     -5525.   4.09E-05   158.1669   4.81E+10
144.7762    631651.       0.00
   37.2000   -0.00133      8182.     -4509.   4.49E-05   131.1364   4.81E+10
137.2160    741937.       0.00
   37.8000   -0.00100    -20746.     -3605.   4.39E-05   140.5595   4.81E+10
113.8882    816653.       0.00
   38.4000  -6.99E-04    -43769.     -2349.   3.91E-05   157.8265   4.81E+10
235.2687   2423467.       0.00
   39.0000  -4.41E-04    -54593.  -723.4642   3.17E-05   165.9445   4.81E+10
216.1340   3528279.       0.00
   39.6000  -2.42E-04    -54209.   527.7174   2.36E-05   165.6571   4.81E+10
131.4164   3909644.       0.00
   40.2000  -1.01E-04    -47011.      1205.   1.60E-05   160.2579   4.81E+10
56.6783   4022787.       0.00
   40.8000  -1.16E-05    -36871.      1433.   9.72E-06   152.6532   4.81E+10
6.6466   4135904.       0.00
   41.4000   3.85E-05    -26385.      1375.   4.98E-06   144.7886   4.81E+10
-22.7418   4248996.       0.00
   42.0000   6.02E-05    -17076.      1162.   1.73E-06   137.8072   4.81E+10
-36.4640   4362064.       0.00
   42.6000   6.34E-05     -9657.   888.5658  -2.74E-07   132.2427   4.81E+10
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-39.4191   4475111.       0.00
   43.2000   5.62E-05     -4281.   617.6372  -1.32E-06   128.2105   4.81E+10
-35.8388   4588136.       0.00
   43.8000   4.44E-05  -762.0204   384.1510  -1.70E-06   125.5715   4.81E+10
-29.0185   4701141.       0.00
   44.4000   3.18E-05      1252.   203.0829  -1.66E-06   125.9393   4.81E+10
-21.2782   4814128.       0.00
   45.0000   2.06E-05      2164.    75.8432  -1.40E-06   126.6227   4.81E+10
-14.0661   4927097.       0.00
   45.6000   1.16E-05      2345.    -4.0766  -1.07E-06   126.7591   4.81E+10
-8.1338   5040048.       0.00
   46.2000   5.21E-06      2106.   -46.7920  -7.32E-07   126.5792   4.81E+10
-3.7316   5152984.       0.00
   46.8000   1.08E-06      1672.   -63.0670  -4.49E-07   126.2542   4.81E+10
-0.7893   5265904.       0.00
   47.4000  -1.25E-06      1198.   -62.5558  -2.34E-07   125.8983   4.81E+10
0.9313   5355000.       0.00
   48.0000  -2.29E-06   771.5780   -53.0674  -8.66E-08   125.5787   4.81E+10
1.7044   5355000.       0.00
   48.6000  -2.50E-06   433.6807   -40.2407   3.69E-09   125.3253   4.81E+10
1.8586   5355000.       0.00
   49.2000  -2.24E-06   192.1086   -27.5562   5.06E-08   125.1441   4.81E+10
1.6649   5355000.       0.00
   49.8000  -1.77E-06    36.8347   -16.8209   6.77E-08   125.0276   4.81E+10
1.3171   5355000.       0.00
   50.4000  -1.26E-06   -50.1612    -8.6959   6.67E-08   125.0376   4.81E+10
0.9398   5355000.       0.00
   51.0000  -8.10E-07   -88.4346    -3.1428   5.63E-08   125.0663   4.81E+10
0.6027   5355000.       0.00
   51.6000  -4.53E-07   -95.4579     0.2387   4.26E-08   125.0716   4.81E+10
0.3366   5355000.       0.00
   52.2000  -1.98E-07   -85.0276     1.9796   2.90E-08   125.0638   4.81E+10
0.1470   5355000.       0.00
   52.8000  -3.45E-08   -66.9721     2.6011   1.76E-08   125.0502   4.81E+10
0.02563   5355000.       0.00
   53.4000   5.65E-08   -47.5843     2.5421   9.07E-09   125.0357   4.81E+10
-0.04202   5355000.       0.00
   54.0000   9.61E-08   -30.3721     2.1334   3.23E-09   125.0228   4.81E+10
-0.07150   5355000.       0.00
   54.6000   1.03E-07   -16.8651     1.6002  -3.07E-10   125.0126   4.81E+10
-0.07662   5355000.       0.00
   55.2000   9.17E-08    -7.3293     1.0788  -2.12E-09   125.0055   4.81E+10
-0.06822   5355000.       0.00
   55.8000   7.25E-08    -1.3293     0.6391  -2.77E-09   125.0010   4.81E+10
-0.05393   5355000.       0.00
   56.4000   5.19E-08     1.8751     0.3060  -2.73E-09   125.0014   4.81E+10
-0.03858   5355000.       0.00
   57.0000   3.32E-08     3.0796    0.07816  -2.36E-09   125.0023   4.81E+10
-0.02473   5355000.       0.00
   57.6000   1.79E-08     3.0022   -0.05891  -1.90E-09   125.0023   4.81E+10
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-0.01335   5355000.       0.00
   58.2000   5.88E-09     2.2327    -0.1227  -1.51E-09   125.0017   4.81E+10
-0.00438   5355000.       0.00
   58.8000  -3.77E-09     1.2362    -0.1284  -1.25E-09   125.0009   4.81E+10
0.00280   5355000.       0.00
   59.4000  -1.21E-08     0.3851   -0.08591  -1.13E-09   125.0003   4.81E+10
0.00899   5355000.       0.00
   60.0000  -2.00E-08       0.00       0.00  -1.10E-09   125.0000   4.81E+10
0.01487   2677500.       0.00

* The above values of total stress are combined axial and bending stresses.


Output Summary for Load Case No. 9:

Pile-head deflection             =     1.04526800 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -3311329. inch-lbs
Maximum shear force              =         25000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     1.20000000 feet below pile head
Number of iterations             =             25
Number of zero deflection points =              5



--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 10
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Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =      35000.0 lbs
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =      50000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending   Soil
Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness      p
      Es*h     Lat. Load
   feet      inches     in-lbs       lbs      radians     psi*      in-lb^2
lb/inch    lb/inch    lb/inch
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00     1.9216  -5037615.     35000.       0.00      3903.   4.81E+10
0.00       0.00       0.00
    0.6000     1.9189  -4785479.     35000.  -7.36E-04      3714.   4.81E+10
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0.00       0.00       0.00
    1.2000     1.9110  -4533085.     35000.   -0.00143      3525.   4.81E+10
0.00       0.00       0.00
    1.8000     1.8982  -4280447.     35000.   -0.00209      3335.   4.81E+10
0.00       0.00       0.00
    2.4000     1.8809  -4027578.     35000.   -0.00272      3146.   4.81E+10
0.00       0.00       0.00
    3.0000     1.8591  -3774492.     35000.   -0.00330      2956.   4.81E+10
0.00       0.00       0.00
    3.6000     1.8333  -3521202.     35000.   -0.00385      2766.   4.81E+10
0.00       0.00       0.00
    4.2000     1.8037  -3267722.     35000.   -0.00436      2576.   4.81E+10
0.00       0.00       0.00
    4.8000     1.7706  -3014066.     35000.   -0.00483      2386.   4.81E+10
0.00       0.00       0.00
    5.4000     1.7343  -2760247.     35000.   -0.00526      2195.   4.81E+10
0.00       0.00       0.00
    6.0000     1.6949  -2506280.     35000.   -0.00565      2005.   4.81E+10
0.00       0.00       0.00
    6.6000     1.6529  -2252178.     35000.   -0.00601      1814.   4.81E+10
0.00       0.00       0.00
    7.2000     1.6084  -1997954.     35000.   -0.00633      1623.   4.81E+10
0.00       0.00       0.00
    7.8000     1.5617  -1743622.     35000.   -0.00661      1433.   4.81E+10
0.00       0.00       0.00
    8.4000     1.5132  -1489196.     35000.   -0.00685      1242.   4.81E+10
0.00       0.00       0.00
    9.0000     1.4631  -1234690.     35000.   -0.00705      1051.   4.81E+10
0.00       0.00       0.00
    9.6000     1.4117   -980118.     35000.   -0.00722   860.0882   4.81E+10
0.00       0.00       0.00
   10.2000     1.3591   -725492.     34118.   -0.00735   669.1191   4.81E+10
-244.9296      1297.       0.00
   10.8000     1.3059   -483525.     32297.   -0.00744   487.6435   4.81E+10
-261.0218      1439.       0.00
   11.4000     1.2520   -255063.     30362.   -0.00749   316.2969   4.81E+10
-276.4169      1590.       0.00
   12.0000     1.1980    -40916.     28319.   -0.00752   155.6871   4.81E+10
-291.1037      1750.       0.00
   12.6000     1.1438    158142.     26173.   -0.00751   243.6062   4.81E+10
-305.0722      1920.       0.00
   13.2000     1.0899    341376.     23929.   -0.00747   381.0320   4.81E+10
-318.3137      2103.       0.00
   13.8000     1.0363    508091.     21592.   -0.00741   506.0679   4.81E+10
-330.8207      2299.       0.00
   14.4000     0.9832    657628.     19167.   -0.00732   618.2210   4.81E+10
-342.5864      2509.       0.00
   15.0000     0.9309    789370.     16661.   -0.00721   717.0277   4.81E+10
-353.6046      2735.       0.00
   15.6000     0.8794    902739.     14078.   -0.00708   802.0543   4.81E+10
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-363.8695      2979.       0.00
   16.2000     0.8289    997196.     11424.   -0.00694   872.8972   4.81E+10
-373.3750      3243.       0.00
   16.8000     0.7795   1072244.      8704.   -0.00679   929.1829   4.81E+10
-382.1143      3530.       0.00
   17.4000     0.7312   1127425.      7156.   -0.00662   970.5687   4.81E+10
-47.8602   471.2882       0.00
   18.0000     0.6841   1180064.      6816.   -0.00645      1010.   4.81E+10
-46.8105   492.6627       0.00
   18.6000     0.6383   1230213.      6482.   -0.00627      1048.   4.81E+10
-45.7419   515.9511       0.00
   19.2000     0.5939   1277924.      6157.   -0.00608      1083.   4.81E+10
-44.6541   541.3942       0.00
   19.8000     0.5508   1323252.      5840.   -0.00589      1117.   4.81E+10
-43.5470   569.2734       0.00
   20.4000     0.5091   1366250.      5438.   -0.00568      1150.   4.81E+10
-67.8723   959.8708       0.00
   21.0000     0.4689   1405657.      4956.   -0.00548      1179.   4.81E+10
-66.0374      1014.       0.00
   21.6000     0.4303   1441564.      4488.   -0.00526      1206.   4.81E+10
-64.1698      1074.       0.00
   22.2000     0.3931   1474067.      4032.   -0.00504      1231.   4.81E+10
-62.2690      1140.       0.00
   22.8000     0.3576   1503262.      3591.   -0.00482      1252.   4.81E+10
-60.3339      1215.       0.00
   23.4000     0.3237   1529249.      3164.   -0.00459      1272.   4.81E+10
-58.3637      1298.       0.00
   24.0000     0.2915   1552128.      2789.   -0.00436      1289.   4.81E+10
-45.7901      1131.       0.00
   24.6000     0.2609   1572549.      2502.   -0.00413      1304.   4.81E+10
-33.9455   936.8630       0.00
   25.2000     0.2320   1591126.      2262.   -0.00389      1318.   4.81E+10
-32.6434      1013.       0.00
   25.8000     0.2048   1607924.      2032.   -0.00365      1331.   4.81E+10
-31.3160      1101.       0.00
   26.4000     0.1794   1623013.      1811.   -0.00341      1342.   4.81E+10
-29.9621      1203.       0.00
   27.0000     0.1557   1636460.      1600.   -0.00317      1352.   4.81E+10
-28.5809      1322.       0.00
   27.6000     0.1338   1648338.      1400.   -0.00292      1361.   4.81E+10
-27.1715      1462.       0.00
   28.2000     0.1136   1658719.   277.1292   -0.00267      1369.   4.81E+10
-284.6459     18033.       0.00
   28.8000    0.09530   1654254.     -1762.   -0.00242      1366.   4.81E+10
-281.6485     21279.       0.00
   29.4000    0.07873   1635099.     -3774.   -0.00218      1351.   4.81E+10
-277.3426     25364.       0.00
   30.0000    0.06393   1601478.     -5750.   -0.00194      1326.   4.81E+10
-271.6420     30596.       0.00
   30.6000    0.05085   1553689.     -7680.   -0.00170      1290.   4.81E+10
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-264.4384     37444.       0.00
   31.2000    0.03945   1492108.     -9552.   -0.00147      1244.   4.81E+10
-255.5884     46652.       0.00
   31.8000    0.02965   1417197.    -11354.   -0.00125      1188.   4.81E+10
-244.8912     59460.       0.00
   32.4000    0.02139   1329514.    -13071.   -0.00105      1122.   4.81E+10
-232.0437     78107.       0.00
   33.0000    0.01456   1229730.    -14686.  -8.57E-04      1047.   4.81E+10
-216.5428    107081.       0.00
   33.6000    0.00906   1118655.    -16176.  -6.81E-04   963.9910   4.81E+10
-197.4331    156963.       0.00
   34.2000    0.00476    997284.    -17508.  -5.22E-04   872.9628   4.81E+10
-172.4688    260923.       0.00
   34.8000    0.00154    866918.    -18609.  -3.83E-04   775.1888   4.81E+10
-133.3466    624461.       0.00
   35.4000  -7.49E-04    729594.    -18809.  -2.63E-04   672.1951   4.81E+10
77.6443    746150.       0.00
   36.0000   -0.00225    596254.    -17976.  -1.64E-04   572.1908   4.81E+10
153.7810    492302.       0.00
   36.6000   -0.00311    470855.    -16812.  -8.37E-05   478.1413   4.81E+10
169.5531    393059.       0.00
   37.2000   -0.00345    354220.    -15575.  -2.19E-05   390.6651   4.81E+10
174.1327    362901.       0.00
   37.8000   -0.00342    246593.    -14323.   2.31E-05   309.9448   4.81E+10
173.7173    365533.       0.00
   38.4000   -0.00312    147958.    -12466.   5.26E-05   235.9686   4.81E+10
342.0183    788582.       0.00
   39.0000   -0.00266     67046.    -10015.   6.87E-05   175.2841   4.81E+10
338.8080    915647.       0.00
   39.6000   -0.00213      3693.     -7607.   7.40E-05   127.7698   4.81E+10
330.0521   1113970.       0.00
   40.2000   -0.00160    -42550.     -5281.   7.11E-05   156.9122   4.81E+10
315.9595   1423269.       0.00
   40.8000   -0.00111    -72411.     -3077.   6.25E-05   179.3081   4.81E+10
296.5003   1924325.       0.00
   41.4000  -6.98E-04    -86897.     -1032.   5.06E-05   190.1730   4.81E+10
271.3370   2796963.       0.00
   42.0000  -3.81E-04    -87313.   776.0876   3.75E-05   190.4849   4.81E+10
231.0105   4362064.       0.00
   42.6000  -1.58E-04    -75749.      1962.   2.53E-05   181.8115   4.81E+10
98.3874   4475111.       0.00
   43.2000  -1.70E-05    -59080.      2355.   1.52E-05   169.3098   4.81E+10
10.8212   4588136.       0.00
   43.8000   6.06E-05    -41847.      2252.   7.64E-06   156.3850   4.81E+10
-39.5779   4701141.       0.00
   44.4000   9.31E-05    -26663.      1885.   2.51E-06   144.9972   4.81E+10
-62.2361   4814128.       0.00
   45.0000   9.68E-05    -14704.      1423.  -5.86E-07   136.0282   4.81E+10
-66.2345   4927097.       0.00
   45.6000   8.46E-05     -6178.   970.7859  -2.15E-06   129.6337   4.81E+10
```

```
-59.2480   5040048.       0.00
   46.2000   6.58E-05  -723.3367   587.8926  -2.67E-06   125.5425   4.81E+10
-47.1113   5152984.       0.00
   46.8000   4.62E-05      2289.   296.5624  -2.55E-06   126.7170   4.81E+10
-33.8137   5265904.       0.00
   47.4000   2.91E-05      3549.    96.8934  -2.11E-06   127.6617   4.81E+10
-21.6499   5355000.       0.00
   48.0000   1.58E-05      3686.   -23.3844  -1.57E-06   127.7646   4.81E+10
-11.7606   5355000.       0.00
   48.6000   6.49E-06      3213.   -83.1043  -1.05E-06   127.4100   4.81E+10
-4.8282   5355000.       0.00
   49.2000   6.36E-07      2490.  -102.1899  -6.27E-07   126.8676   4.81E+10
-0.4733   5355000.       0.00
   49.8000  -2.53E-06      1742.   -97.1114  -3.10E-07   126.3067   4.81E+10
1.8840   5355000.       0.00
   50.4000  -3.82E-06      1092.   -80.0909  -9.75E-08   125.8190   4.81E+10
2.8439   5355000.       0.00
   51.0000  -3.94E-06   589.0722   -59.3132   2.85E-08   125.4418   4.81E+10
2.9277   5355000.       0.00
   51.6000  -3.41E-06   237.8784   -39.6325   9.04E-08   125.1784   4.81E+10
2.5391   5355000.       0.00
   52.2000  -2.63E-06    18.2989   -23.4370   1.10E-07   125.0137   4.81E+10
1.9597   5355000.       0.00
   52.8000  -1.84E-06   -99.6930   -11.4663   1.03E-07   125.0748   4.81E+10
1.3655   5355000.       0.00
   53.4000  -1.14E-06  -146.8904    -3.4854   8.50E-08   125.1102   4.81E+10
0.8514   5355000.       0.00
   54.0000  -6.12E-07  -149.9447     1.2176   6.28E-08   125.1125   4.81E+10
0.4550   5355000.       0.00
   54.6000  -2.41E-07  -129.4015     3.5001   4.19E-08   125.0971   4.81E+10
0.1790   5355000.       0.00
   55.2000  -9.05E-09   -99.5726     4.1687   2.47E-08   125.0747   4.81E+10
0.00673   5355000.       0.00
   55.8000   1.15E-07   -69.3897     3.8846   1.21E-08   125.0520   4.81E+10
-0.08566   5355000.       0.00
   56.4000   1.65E-07   -43.6436     3.1356   3.59E-09   125.0327   4.81E+10
-0.1224   5355000.       0.00
   57.0000   1.67E-07   -24.2397     2.2482  -1.49E-09   125.0182   4.81E+10
-0.1241   5355000.       0.00
   57.6000   1.43E-07   -11.2682     1.4185  -4.15E-09   125.0085   4.81E+10
-0.1064   5355000.       0.00
   58.2000   1.07E-07    -3.8109     0.7488  -5.28E-09   125.0029   4.81E+10
-0.07962   5355000.       0.00
   58.8000   6.70E-08    -0.4809     0.2829  -5.60E-09   125.0004   4.81E+10
-0.04980   5355000.       0.00
   59.4000   2.63E-08     0.2674    0.03312  -5.62E-09   125.0002   4.81E+10
-0.01959   5355000.       0.00
   60.0000  -1.40E-08       0.00       0.00  -5.60E-09   125.0000   4.81E+10
0.01040   2677500.       0.00
```

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     1.92160881 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -5037615. inch-lbs
Maximum shear force              =         35000. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     0.60000000 feet below pile head
Number of iterations             =             27
Number of zero deflection points =              5
```

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Load 1	Load 2 Type	Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	15000.	S, rad	0.00	50000.	0.4140	0.00	15000.	-1767435.
2	V, lb	30000.	S, rad	0.00	50000.	1.4552	0.00	30000.	-4155303.
3	V, lb	45000.	S, rad	0.00	50000.	3.0107	0.00	45000.	-6899366.
4	V, lb	60000.	S, rad	0.00	50000.	4.9909	0.00	60000.	-9889799.
5	V, lb	75000.	S, rad	0.00	50000.	7.3282	0.00	75000.	-1.31E+07
6	V, lb	5000.	S, rad	0.00	50000.	0.07735	0.00	5000.	-510232.
7	V, lb	10000.	S, rad	0.00	50000.	0.2105	0.00	10000.	-1101968.

```
  8  V, lb     20000.   S, rad         0.00     50000.     0.6963       0.00
20000.  -2512357.
  9  V, lb     25000.   S, rad         0.00     50000.     1.0453       0.00
25000.  -3311329.
 10  V, lb     35000.   S, rad         0.00     50000.     1.9216       0.00
35000.  -5037615.


Maximum pile-head deflection = 7.3281822580 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.
```

FINAL BRIDGE AND ROADWAY GEOTECHNICAL ENGINEERING REPORT

I-95 Southbound Bridge Replacement over Bagshaw Swamp
Jasper County, South Carolina
SCDOT Project ID: P030260
Terracon Project No.: EN175299
October 14, 2021 (Rev1)

1.0 INTRODUCTION

Terracon has completed a final bridge and roadway geotechnical engineering report for the I-95 Southbound Bridge Replacement over Bagshaw Swamp in Jasper County, South Carolina. The considerations presented in this report are based upon geotechnical data collected at the specific bridge sites by Terracon. The final exploration for the bridge site included three Soil Test Borings (STBs), four Cone Penetration Test (CPT) soundings, and two Flat Plate Dilatometer Test (DMT) soundings. The preliminary exploration, conducted previously and reported in the preliminary bridge and roadway geotechnical engineering report dated 1/19/2021, included five Soil Test Borings (STBs) and one Multichannel Analysis of Surface Waves (MASW) geophone array. Final Testing logs along with the field exploration description, site location, exploration plan, and subsurface profile are presented in Appendix A. Related laboratory data is presented in Appendix B.

The purpose of the study is to provide geotechnical engineering considerations relative to:

- subsurface soil conditions
- seismic considerations
- deep foundation design recommendations
- embankment design
- potential construction difficulties
- other geotechnical considerations that may affect the proposed construction

2.0 PROJECT INFORMATION

2.1 Site Location and Description

ITEM	DESCRIPTION
Locations	The bridge being replaced is the I-95 southbound bridge over Bagshaw Swamp near mile post 8.0 or 4.4 miles north of the SC-46 crossing.
Existing Conditions	The existing four span southbound bridge was constructed in the 1960's with concrete beams and reinforced concrete decking which are founded upon driven prestressed concrete piles. The interior concrete bents are buttressed by HP and W shape steel members.

ITEM	DESCRIPTION
Current Bridge Design[1]	Bridge design is planned to be four flat slab spans (30' - 30' - 40' - 30') totaling 130 ft. The interior and end bents supporting the flat slabs are founded upon driven piles. The concrete approach slabs transitioning between the roadway and bridge are 20 feet in length and span the width of the new bridge. The new roadway will be widened into the existing median approximately 20 ft to accommodate the new 3-lane bridge with full width shoulders that can subsequently be restriped to 4 lanes with reduced width shoulders.
Ground Cover at Existing Embankments	The ground cover vegetation is thick necessitating mechanized clearing. Standing shallow water is between the end bents and dislodged rip rap blanketing the end slopes beneath the overpass. A gravel road was recently constructed by a Beaufort Jasper Water & Sewer Authority (BJWSA) contractor beneath the north and southbound bridges.
Ground Cover at the Proposed Embankments	Concrete pavement for the roadway with asphalt paved shoulders and vegetated side slopes. Bridge embankment is a spill-through slope design with rip rap facing beneath the bridge overpass and flared outward from the wing walls. Shallow surface water and a gravel path for BJWSA maintenance traffic is expected to remain in place after the bridge replacement and embankment widening construction.
Existing Topography[1]	At the proposed construction centerline, existing elevations range approximately from 15 to 28 feet NAVD88.
Bridge Operation Class[2]	OC I

1. Based on bridge plans dated 7/8/2021 and roadway plans dated 6/3/2021 provided by ICE.
2. The SCDOT Seismic Design Specifications for Highway Bridges, 2008, Table 3.1

3.0 GEOLOGICAL AND SUBSURFACE CONDITIONS

3.1 South Carolina Geology

The rock and soil deposits of South Carolina have been formed by geological forces over the past several hundred million years. Erosion and deposition of sediments over this time frame have created a complex geological framework that is still not fully understood today. However, if we simplify the geological features of our state, we can divide South Carolina into three geological provinces consisting of the Blue Ridge, Piedmont, and Coastal Plain. The delineation of these geological provinces is illustrated in Figure 1. The project site is situated in the Coastal Plain Province. As illustrated, the Coastal Plain can further be divided into the Upper and Lower Coastal Plains.

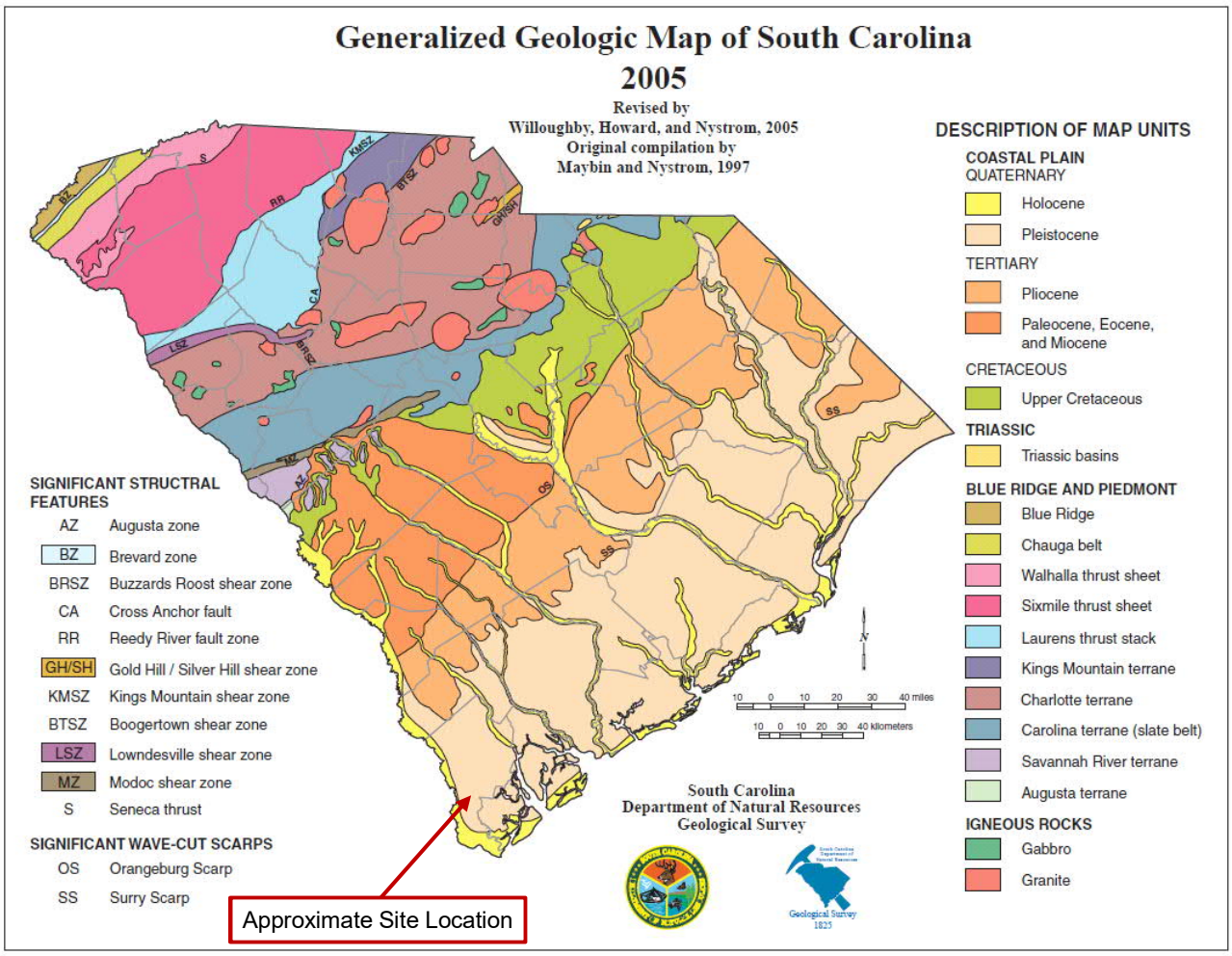


Figure 1. Generalized Geologic Map of South Carolina

3.2 Coastal Plain Province

The Coastal Plain Province is situated between the Piedmont Province and the Atlantic coast. The boundary between the Piedmont Province and the Coastal Plain Province is known as the Fall Line. The Fall Line is considered a zone where the rocks underlying the Piedmont transition to the unconsolidated sediments underlying the Coastal Plain. Elevations in the Coastal Plain range from sea level in the very flat portions located near the coast to 300 ft msl in the rolling hills located in the uplands near the Fall Line.

The Coastal Plain is composed of eroded sediments that were deposited upon a base older Piedmont-type, crystalline rocks that had previously undergone metamorphism. This crystalline basement is close to the surface near the Upper Coastal Plain but now slopes downward toward the present-day coast line at a steeper angle than the sedimentary beds that lie on top of it. As a result, the Coastal Plain sediments are deposited on top of the crystalline bedrock in a triangular

wedge. At the Fall Line, the depth to the bedrock is relatively shallow. However, as you approach the present-day coast line, the depth to crystalline bedrock increases to depths over 3,000 feet.

Some erosion occurs in the Upper Coastal Plain; however large portions of the Lower Coastal Plain have poorly drained soils. The soils of the Upper Coastal Plain are composed mainly of sand and clay sediments that were derived from the erosion of the rocks of the Piedmont Province. Alluvial sediments along streams and rivers have accumulated in recent geologic time and as a result, extensive swamps adjoin the rivers of the Lower Coastal Plain. The Lower Coastal Plain sediments consist of recent alluvial deposits that cover older marine deposits. It is typical to encounter layers of limestone and/or Marl in the Lower Coastal Plain.

According to Doar[1], moved earth, Holocene, Pleistocene, and undifferentiated Miocene age deposits could lie within the range of the boring depths at the project sites. The Holocene age sediments deposited in stream valleys and areas of locally low elevation. Deposits occur in areas of poor drainage, such as a swale in a dune field or slow drainage of a stream system. Fluvial deposits of Pleistocene age are deeply weathered and very stiff with a minor fraction of heavy minerals. The sediments are moderately well-sorted, clayey, fine phosphatic quartz sand. The Miocene age deposits are greenish black to dark greenish gray, grayish olive and olive gray, moderately sorted, subangular to well-rounded, fine to medium phosphorite-quartz sand and mud. Sediment is stiff or soft to the touch. The upper contact is often a phosphorite pebble or cobble zone.

3.3 Typical Profiles

Based on the results of the field testing, the following generalized profile is considered representative of the soils at the bridge site.

Table 1. Generalized Subsurface Conditions (Bagshaw Swamp)

Name	Description	Approximate Elevation of Layer Bottom (ft)[1]	Material Encountered
Stratum 1	Existing Fill	23	Very loose to medium dense silty sand, clayey sand with seams of sandy silt
		20	
		14 to 16	
Stratum 2	Sandy lean Clay	9	Soft to very stiff sandy clay and medium dense clayey sand
Stratum 3		0	Very loose to medium dense sand with silt, silty sand, and clayey sand

[1] Doar, W. R., III, 2008, Geologic Map of the Hardeeville and Rincon quadrangles, Beaufort and Jasper counties, South Carolina: South Carolina Geological Survey, Open-File Report OFR-152, scale 1:24,000.

Name	Description	Approximate Elevation of Layer Bottom (ft)[1]	Material Encountered
	Very Loose to Medium Dense Sand	-12	
Stratum 4[2]	Hard Sandy Silt	PMDE[3]	Very stiff and hard silt, sandy silt, sandy lean clay, and dense to very dense clayey sand, silty sand

1. Elevations based on survey data provided by Surveying Consultants of Bluffton, SC.
2. Approximate termination of deepest boring
3. PMDE = Present to Maximum Depth Explored

3.4 Groundwater Observations

Groundwater at the Bagshaw Swamp site was observed as standing water at the ground surface to about 3 feet below the ground surface. For purposes of engineering analyses, the ground water level was assumed at the existing ground surface or approximately 15 feet NAVD88. Groundwater levels will fluctuate with seasonal, climatic, and local variations.

4.0 SEISMIC CONSIDERATIONS

4.1 3-Point Acceleration Design Response Spectrum (ADRS)

The design parameters (PGA, S_{DS}, and S_{D1}) from the SCDOT 3-Point Acceleration Design Response Spectrum is summarized in Table 2. Additional parameters are presented in Exhibit C-2. The PGA for the SEE event is used for liquefaction screening and slope stability evaluations.

Table 2. Design ADRS Parameters Summary

Design Earthquake	PGA	S_{DS}	S_{D1}	M_w
FEE	0.14	0.30	0.12	7.30
SEE	0.37	0.85	0.48	7.30

4.2 Soil Shear Strength Loss Susceptibility Screening

A Soil Shear Strength Loss (SSL) susceptibility screening has been conducted on the Soil Test Borings and Cone Penetration Test soundings performed at the sites. Sand-like and clay-like soils have been screened for SSL under FEE and SEE events.

The SSL screening in sand-like soils was based on soil saturation (saturated if soil layer is below the ground water table), soil classification, plasticity indices, and corrected Standard Penetration

Test (SPT) blow counts[2]. As depicted on the boring logs, the site primarily consists of clayey sands, sandy clays, sands and silty sands above a very stiff and hard sandy silt deposit of the Miocene geologic age.

The SSL screening indicates that some of the sandy sediments beneath the clayey overburden are susceptible to cyclic liquefaction. The MASW shear wave velocities measured in the sand-like zone are less than 200 m/s (or 656 ft/s) which also indicate a risk of triggering liquefaction. Based on the results of SSL screening, both CPT and STB data indicate that the sand-like soils between elevations 9 and -12 feet NAVD88 is expected to undergo liquefaction. Seismic-induced liquefaction differential settlements are in the order of 3 inches which is satisfactory. Global instability displacements are calculated and reported for the structural engineer to verify if not adversely affecting the bridge structure.

5.0 BRIDGE FOUNDATIONS

5.1 Type and Size

Deep foundations consisting of driven Steel H-piles HP14x89 are being considered for end bents and driven PSC 20-inch Concrete Piles are being considered for the interior bent. There will be a total of 9 piles installed at each bent. The piles will have a center-to-center spacing of 7'-9".

Axial capacity for HP 14x89 steel piles and 20-inch concrete piles are provided in Exhibit C-5 based on the axial loads provided by ICE as shown in Exhibit C-4. Preliminary pile drivability analysis is provided in Exhibit C-6. Lateral stability of deep foundations is provided in Exhibit C-7.

5.1.1 Axial Analysis of Driven Piles

Axial capacities of driven piles were calculated using the computer software APILE 2019 by Ensoft. The FHWA analysis method was used in APILE which generally follows the methods outlined in Section 10 of the AASHTO *LRFD Bridge Design Specifications*. APILE uses soil strength parameters to estimate the pile's side friction and end resistance. The soil strength parameters were estimated based on index properties such as fines content, Atterberg limits, and $N_{1,60}$ values per SCDOT GDM Chapter 7.

- The efficiency factor η for reducing the pile group capacity based on spacing for the trestle bent is determined based on Section 16.3.3 of GDM. Nominal spacing (7'-9") (Exhibit C-4) divided by pile diameter (or width 14.7") = 6.3 > 2.5 => η = 1.0
- Side resistance above the hard bearing layer is included as a driving force upon the pile when estimating the liquefaction downdrag load. Liquefaction of the hard-cohesive bearing layer, of Miocene geologic age, has been neglected.

[2] The SCDOT Geotechnical Design Manual 2019, Section 13.6

- Settlement of the approach embankments is anticipated to be essentially complete approximately fifteen days after placing the fill. Placing fill shall take place towards the beginning of construction schedule to allow the settlements to complete before pile Installation. The additional fill above bottom of bent cap (Elev. 21.41) can be placed after pile installation. With this consideration, consolidation downdrag was not considered in the design of the end bents.
- Scour has been considered in the design under strength and service loads using the 100-year design flood profile as seen on the bridge plans shown in Exhibit C-4. Per coordination with the SEOR, the 500-year check flood under EEII is expected to pass by inspection.

5.1.2 Lateral Analysis of Pile Foundations

Lateral loading analyses were performed using the software program LPile version 2019 based upon the load reactions and structural information provided by ICE. The steel piles are analyzed as strong and weak-axis H-Piles.

- Group reduction factor = 1.0 for the longitudinal direction since only a single row of piles will be used in the longitudinal direction. In the transverse direction, group reduction factors of 0.97 for End Bents and 0.68 for Interior Bents have been used per AASHTO LRFD-8 Table 10.7.2.4-1.
- The critical depth (or pile tip fixity) to achieve lateral stability was determined as the pile length at which the pile head deflection is approximately constant when increasing pile length for Strength Limit State loads. For EE I loads, the tip fixity was determined as the depth at which lateral deflection diminishes.

5.2 Foundation Recommendations

The axial capacity and the lateral loading analyses indicate that, for end bents, the axial loading at Extreme Event I limit state governs the driven pile lengths. For interior bents, the lateral loading at Extreme Event I limit state governs the driven pile lengths. Based on the results of our foundation analyses, final driven pile lengths were based on the governing conditions presented in Table 3. Tables 4a thru 4c summarize the loading conditions and corresponding foundation resistances for driven piles.

Table 3. Governing Conditions

Limit State	End Bent 1	Interior Bents 2, 3, 4	End Bent 5
Strength	Axial – Compression	Axial – Compression	Axial – Compression
Extreme Event I	Axial – Compression	Lateral	Axial - Compression

Table 4a. Pile Resistances (End Bents)

Description	End Bent 1 Strength	End Bent 1 EE I	End Bent 5 Strength	End Bent 5 EE I
Factored Design Load	143 kips	410 kips	143 kips	415 kips
Geotechnical Resistance Factor	0.65	1.00	0.65	1.00
Nominal Resistance	220 kips	410 kips	220 kips	415 kips
Resistance from: Design Flood Scourable Soils Soils undergoing static downdrag	 0 kips 0 kips	NA	 0 kips 0 kips	NA
Resistance from Liquefiable Soils	NA	194 kips	NA	194 kips
Required Driving Resistance	220 kips	604 kips	220 kips	609 kips

The required minimum tip elevation to achieve critical penetration for the HP14x89 piles at End Bent 1 is -65.6 feet and at End Bent 5 is -66.6 feet NAVD 88.

Table 4b. Pile Resistances (Interior Bents – Strength)

Description	Interior Bents 2 Strength	Interior Bent 3 Strength	Interior Bent 4 Strength
Factored Design Load	231 kips	231 kips	231 kips
Geotechnical Resistance Factor	0.65	0.65	0.65
Nominal Resistance	356 kips	356 kips	356 kips
Resistance from: Design Flood Scourable Soils Soils undergoing static downdrag	 37 kips 0 kips	 25 kips 0 kips	 35 kips 0 kips
Resistance from Liquefiable Soils	NA	NA	NA
Required Driving Resistance	393 kips	381 kips	391 kips

Table 4c. Pile Resistances (Interior Bents – Extreme Event I - governed by lateral loads)

Description	Interior Bent 2 EE I	Interior Bent 3 EE I	Interior Bent 4 EE I
Factored Design Load	90 kips	50 kips	100 kips
Geotechnical Resistance Factor	1.00	1.00	1.00
Nominal Resistance	325 kips	328 kips	325 kips
Resistance from: Design Flood Scourable Soils Soils undergoing static downdrag	NA	NA	NA
Resistance from Liquefiable Soils	287 kips	278 kips	285 kips
Required Driving Resistance	612 kips	606 kips	610 kips

The required minimum tip elevation to achieve critical penetration for the PSC 20-inch Concrete Piles with Points at Interior Bents 2, 3, and 4 is -28 feet NAVD 88.

Preliminary Pile drivability analysis results are listed in Table 5.

Table 5. Drivability Analysis

Estimated Pile Drivability Analysis Parameters				
Description	**End Bents 1 and 5**	**Interior Bent 2**	**Interior Bent 3**	**Interior Bent 4**
Skin Quake (QS)	0.10 in	0.10 in	0.10 in	0.10 in
Toe Quake (QT)	0.10 in	0.10 in	0.10 in	0.10 in
Skin Damping (SD)	0.15 s/ft	0.15 s/ft	0.15 s/ft	0.15 s/ft
Toe Damping (TD)	0.15 s/ft	0.15 s/ft	0.15 s/ft	0.15 s/ft
% Skin Friction for End Bents	100 %	82%	83%	82%
Distribution Shape	Variable	Variable	Variable	Variable
Estimated Driving Resistance	607.4 and 614 kips	611.6 kips	605.9 kips	609.6 kips
Pile Penetration for End Bents	100%	89%	85%	87%
Hammer Energy Range	110 to 130 ft-kips	80 to 100 ft-kips	80 to 100 ft-kips	80 to 100 ft-kips

Distribution Shape varies with depth.
End Bents 1 and 5: 0 at surface to 0.5 at 6.4 ft, 1.2 at 6.4 ft to 1.2 at 12.4 ft, 0.7 at 12.4 ft to 0.8 at 21.4 ft, 0.4 at 21.4 ft to 2.8 at 33.4 ft, 1.5 at 33.4 ft to 1.5 at 101.4 ft
Interior Bent 2: 0 at surface to 0.5 at 7.0 ft, 1.2 at 7.0 ft to 1.2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft, 2.1 at 22.0 ft to 2.8 at 34.0 ft , 2.2 at 34.0 ft to 2.2 at 102.0 ft
Interior Bent 3: 0 at surface to 1.2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft, 2.1 at 22.0 ft to 2.8 at 34.0 ft , 2.2 at 34.0 ft to 2.2 at 102.0 ft
Interior Bent 4: 0 at surface to 0.5 at 7.0 ft, 1,2 at 7.0 ft to 1,2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft , 2.1 at 22 ft to 2.8 at 34 ft, 2.2 at 34.0 ft to 2.2 at 102.0 ft

5.3 Long Term Durability

Corrosion and deterioration of steel deep foundations may compromise the long-term durability of the foundation. Therefore, soil samples collected near the end bents of the bridge site were tested to characterize the aggressiveness of the subsurface environment to the deterioration of the foundation materials. Corrosion tests were conducted during the preliminary phase of the project and it was found that a corrosive environment was not present at the site. Results are copied here in Table P-4 for completeness.

Table P-4. Bagshaw Swamp Corrosion Test Results and Limits

Corrosion Test	**Bagshaw Swamp - Composite Samples' Results**		**Indication of Corrosivity [1]**
	BS-STB14 6.0 to 10.0 ft End Bent 1	**BS-STB11** 8.0 to 15.0 ft End Bent 5	

Resistivity (ohm-cm)	12,610	7,954	Less than 2,000 ohm-cm
Sulfate (ppm)	18	17	Greater than 500 ppm
pH	7.96	7.90	Less than 5.5
Chloride (ppm)	47	30	Greater than 500 ppm

1. AASHTO LRFD bridge design specification, Fifth Edition 2014, Section 10.7.5

5.4 Potential Construction Difficulties

For PSC piles at the interior bents, hard driving conditions are expected to be encountered which will necessitate casting steel HP 'stinger' section to the pile tip. Per SCDOT Standard drawing 704-02, 2'-6" steel HP "stinger" section to be added to the pile tip and should be embedded into the concrete pile a minimum 6 feet.

6.0 EMBANKMENTS

Cross sections dated 6/3/2021 indicate that the embankment filling at the two ends of the bridge will have approximately 14 feet of new fill where widening occurs. The side slopes of the embankments will be 2H:1V.

6.1 Slope Stability Analyses

We performed slope stability analyses using Slide2 version 9.012 distributed by Rocscience. Slope stability analyses have been conducted for the proposed approach embankment longitudinal slopes at the bridge location and side slopes where the slopes are most critical. Based on the roadway cross sections and the anticipated subsurface conditions, the selected sections were considered most critical. The longitudinal slope geometry was determined from bridge and roadway drawings by ICE dated 6/3/2021. The side slope geometry was based on roadway cross sections by ICE dated 6/3/2021.

Slope stability was checked using Spencer method under End of Construction, Long-term and Extreme Event I loading conditions. Additionally, per GDM Section 17.4.7, Partial Submergence loading condition was checked using the 100-year high water elevation of 17.4 feet NAVD 88. Rapid drawdown was not evaluated as stipulated in GDM Section 17.4.5. Total stress parameters were used for end of construction and effective stress parameters were used for long-term loading condition. Total stress parameters were used for partial submergence condition. Earthquake loading condition was checked with total stress and residual strength parameters.

For the proposed embankment configuration, slope stability results indicate the demand/capacity ratios satisfy the resistance factors for the short-term (or end of construction) and permanent (or long-term) limit states.

For the safety evaluation event (SEE) loading case (also referred to as the Extreme Event), the proposed grades along the centerline of the north bridge embankment in conjunction with the subsurface material strengths indicate the demand loads exceed the resisting capacity. Since the computed D/C ratios for the Extreme Event did not satisfy the resistance factor of 1.0 set forth in Table 9-5 in Section 9.6 of the SCDOT GDM, a Newmark Displacement Analysis was performed to report the possible global instability deformation for a circular failure surface. Maximum vertical (GI-01) and lateral (GI-02) displacements are reported in Exhibit C-8. The structural engineer should verify this amount of displacement against the performance objectives and movements established for the bridge in the Seismic Specs.

The slope stability analyses are included in Exhibit C-8.

6.2 Settlement Analyses

6.2.1 Static Settlement

We performed static settlement analysis using Settle3 version 5.008 by Rocscience. As seen in Table 1, the in-situ embankment soils are primarily loose to medium dense sands. The embankments are sitting on clayey sands and sandy lean clays. Therefore, immediate settlement, as well as primary and secondary consolidation settlement was evaluated. Consolidation parameters were estimated based on index test results and correlations listed in GDM 2019 Chapter 7.

Static settlement analysis indicates that immediate (elastic) settlements of the approach embankments will be less than an inch near the bridge. There will be an additional 2 inches (Begin Bridge) to 1.8 inches (End Bridge) of consolidation settlement under the bridge embankments. Settlements analyses indicate that settlements will essentially complete after 15 days of embankment construction. As such, the embankment settlement will meet performance limits as detailed in Exhibit C-10. Fill placement to take place towards the early stages of construction to allow settlements to complete before pile installation at the end bents. Settlement analyses are included in Exhibit C-9.

6.2.2 Seismic Settlement

Based on the SSL screening, sand-like soils encountered in the borings, are susceptible to liquefaction. Additionally, the strain-softening phenomenon on the clay-like material has been considered in the seismic settlement analysis. We have conducted a liquefaction analysis on these soils in accordance with Chapter 13 of the SCDOT GDM 2019. Our analysis, as shown in Exhibit C-2, indicates that differential liquefaction settlements meet performance limits. Performance limits are listed in Exhibit C-10.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Bridge Construction Considerations

7.1.1 Pile Drivability

Terracon conducted a preliminary Wave Equation Analysis of Piles (WEAP) drivability analysis. Based on this analysis and our experience with similar projects, air, hydraulic, or diesel hammers with a minimum rated energy of 40 to 60 ft-kip should be suitable for end bents and 80 to 100 ft-kip should be suitable for interior bents pile installation.

The maximum allowable compressive and tensile driving stresses should be calculated from the material properties using the guidelines provided in Section 711.4.2 of the SCDOT 2007 *Standard Specifications for Highway Construction*. The preliminary drivability analysis results are presented in Appendix C-6. A final drivability analysis shall be conducted upon the selection of the hammer system and reported in the Pile Installation Plan.

7.1.1.1 Dynamic Pile Testing

The dynamic pile test will consist of testing production piles at select bent locations. The test piles will be monitored using the Pile Driving Analyzer (PDA) and the CAPWAP analysis will be performed to verify the pile capacity. A minimum of 10 piles shall be tested[3]. Although, the number of piles for dynamic test is based on the low site variability for the end bents (see Exhibit C-5) and the SCDOT reviewers' input. Given the stiff to hard cohesive nature of the bearing layer, an additional PDA equipment setup to measure the pile capacity during pile driving restrike (approximately one inch or 10 to 20 hammer blows) shall occur between three and seven days after initial pile driving. The following locations have been selected for dynamic tests:

- End Bent 1: Piles 1, 6
- Interior Bent 2: Piles 2, 7
- Interior Bent 3: Piles 3,8
- Interior Bent 4: Piles 4, 9
- End Bent 5: Piles 1, 5

The location and number of index piles may be altered by either the Geotechnical Engineer or the SCDOT based on results of the pile testing program.

[3] The SCDOT Geotechnical Design Manual 2019, Section 9.5.1

7.1.2 Earth-borne Vibration Monitoring

Based on the anticipated construction and the distance from the adjacent structures, we have selected that a Level 1 Earth-borne Vibration Monitoring will be applicable; therefore, no Earth-borne Vibration Monitoring is required[4].

7.2 End Bent Slope Construction Considerations

Roadway construction can proceed according to the SCDOT procedures outlined in the Standard Specifications for Highway Construction 2007.

7.2.1 Temporary Shoring

Temporary shoring may be required for maintenance of traffic during construction. Use buoyant unit weights in computations for soils below the water level. Designer shall determine appropriate water level and consider all unbalanced water forces in design and confirm soil profile and parameters are appropriate for the final wall configuration and location. Design shall accommodate live loading. Use the following soil strength parameters for determining earth pressure coefficients. The following earth pressures can be used for the fill and existing materials:

Table 6. Earth Pressures at Begin Bridge and End Bridge

Soil Type	Elevation (ft, NAVD88)	C (psf)	Phi (°)	Earth Pressure Coefficient			Total Unit Weight (pcf)
				Active	Passive	At-Rest	
Fill	28 - 23	58	29	0.28	3.44	0.52	120
	23 - 20	--	36	0.26	3.85	0.41	120
	20 - 15	--	30	0.33	3.00	0.50	120
Alluvium	15 - 9	1,200	--	1.00	1.00	1.00	125
	9 - 0	--	28	0.36	2.77	0.53	100
	0 - -12	--	36	0.26	3.85	0.41	120
	below -12	3,500	--	1.00	1.00	1.00	115

1. Ground water elevation is approx. Elev. 15 feet.
2. Unit weight of water = 62.4 pcf is used to calculate pressures below the ground water elevation.

7.2.2 Embankment Fill Materials

All roadway fill material will meet the Borrow Excavation requirements on Section 203.2.1.8 of SCDOT *Standard Specifications for Highway Construction* 2007.

Prior to fill placement, the existing grade shall be cleared and prepared, as required by SCDOT Standard Specifications for Highway Construction 2007. Fill shall be placed at the beginning of construction schedule and prior to pile installation.

[4] The SCDOT GDM, Chapter 24.

8.0 GENERAL COMMENTS

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of SCDOT for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A – FIELD EXPLORATION

Exhibit A-1	Field Testing Summary
Exhibit A-2	Site Location Plan
Exhibit A-3	Test Location Plan and Subsurface Profile
Exhibit A-4	Soil Test Boring/Sounding Logs
Exhibit A-5	Field Exploration Description and General Notes
Exhibit A-6	SPT Rig Calibrations

APPENDIX B – LABORATORY TEST RESULTS

Exhibit B-1	Laboratory Testing Summary
Exhibit B-2	Laboratory Testing Description
Exhibit B-3	Laboratory Test Results (9 sheets)

APPENDIX C – DESIGN CALCULATIONS

Exhibit C-1	Three-Point ADRS Curves by SCDOT
Exhibit C-2	Soil Shear Strength Loss Susceptibility Analysis
Exhibit C-3	Soil Profile and Parameters
Exhibit C-4	Bridge Loads
Exhibit C-5	Axial Analysis of Foundations
Exhibit C-6	Pile Drivability Analysis
Exhibit C-7	Lateral Analysis of Foundations
Exhibit C-8	Slope Stability Analysis
Exhibit C-9	Embankment Settlement Analysis
Exhibit C-10	Performance Limits

APPENDIX D – GEOTECHNICAL PLAN NOTES

APPENDIX A – FIELD EXPLORATION

Exhibit A-1	Field Testing Summary
Exhibit A-2	Site Location Plan
Exhibit A-3	Test Location Plan and Subsurface Profile
Exhibit A-4	Soil Test Boring/Sounding Logs
Exhibit A-5	Field Exploration Description and General Notes
Exhibit A-6	SPT Rig Calibrations

EXHIBIT A-1: FIELD TESTING SUMMARY

FIELD TESTING SUMMARY

I-95 Bridge Replacement over Bagshaw Swamp
SCDOT Project ID: P030260, Terracon Project No.: EN175299

Test	Type	Elevation	Latitude	Longitude	Northing	Easting	Route	Station	Offset	Soil Depth
Final Borings										
BS-STB1	Soil Test Boring	27.8	32.377143	-81.030559	197,876.5	1,990,564.9	I-95	517+22	11 L	100.0
BS-STB3	Soil Test Boring	26.9	32.377441	-81.030363	197,984.7	1,990,625.3	I-95	515+99	25 L	110.0
BS-CPT4	Cone Penetration Sounding	24.5	32.376377	-81.030898	197,598.0	1,990,460.0	I-95	520+20	19 L	60.0
BS-CPT5	Cone Penetration Sounding	26.3	32.376729	-81.030728	197,726.0	1,990,512.7	I-95	518+81	19 L	60.1
BS-CPT6	Cone Penetration Sounding	26.8	32.377833	-81.030196	198,127.6	1,990,677.0	I-95	514+47	18.5 L	60.1
BS-CPT7	Cone Penetration Sounding	22.0	32.378195	-81.029958	198,259.3	1,990,750.4	I-95	512+97	36.5 L	65.2
BS-DMT8	Flat Blade Dilatometer Sounding	28.3	32.377131	-81.030536	197,872.0	1,990,571.7	I-95	517+23	18 L	8.9
BS-DMT9	Flat Blade Dilatometer Sounding	27.9	32.377470	-81.030360	197,995.4	1,990,626.2	I-95	515+89	22 L	35.8
BS-SBT13	Soil Test Boring	14.4	32.377320	-81.030314	197,940.8	1,990,640.3	I-95	516+34	56 L	125.0

EXHIBIT A-2: SITE LOCATION PLAN

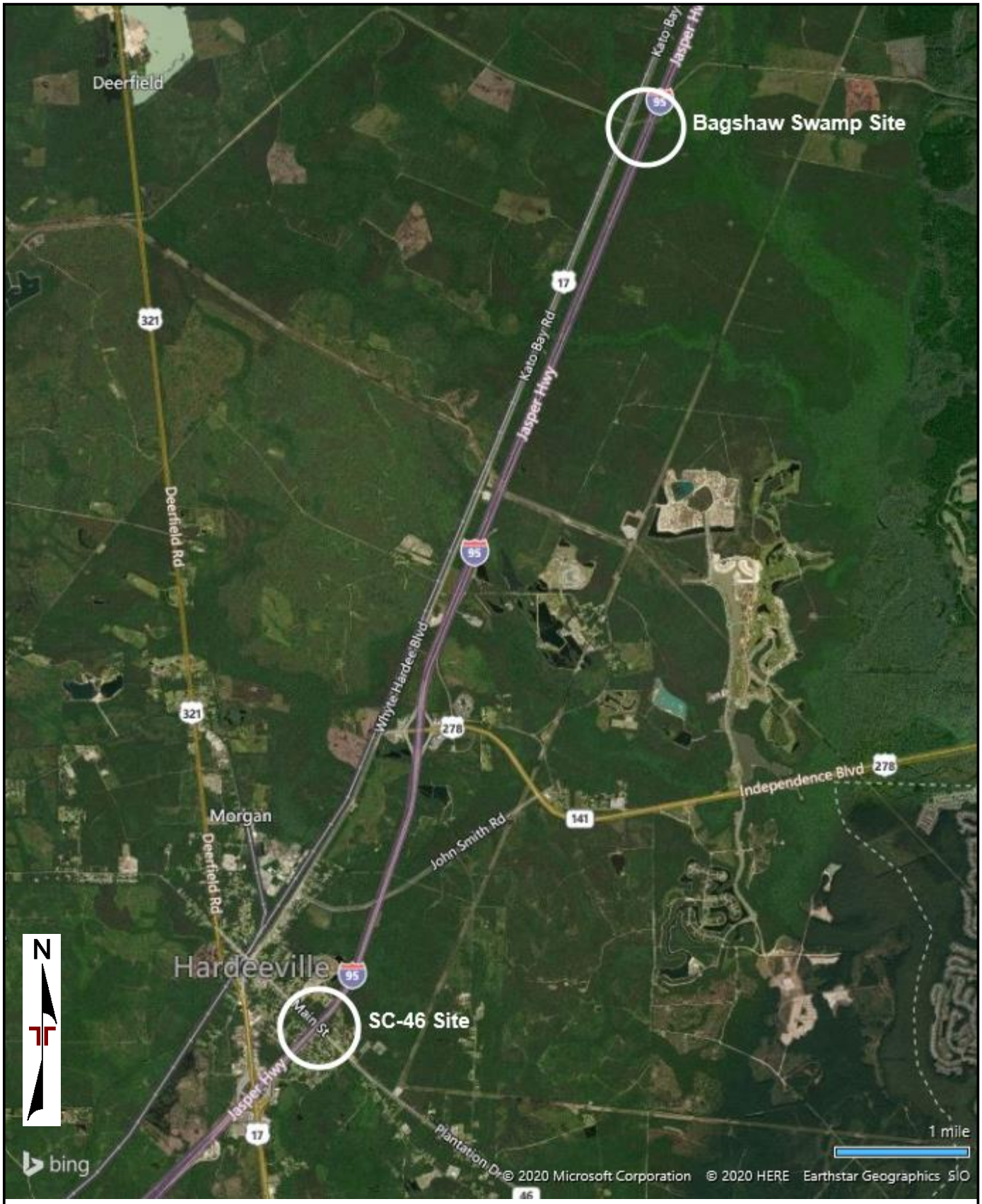


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager:	HJC
Drawn by:	HJC
Checked by:	TCS
Approved by:	DJC

Project No.	EN175299
Scale:	AS SHOWN
File Name:	N/A
Date:	JAN 2021

Terracon
1450 Fifth St W
North Charleston, SC 29405-2326

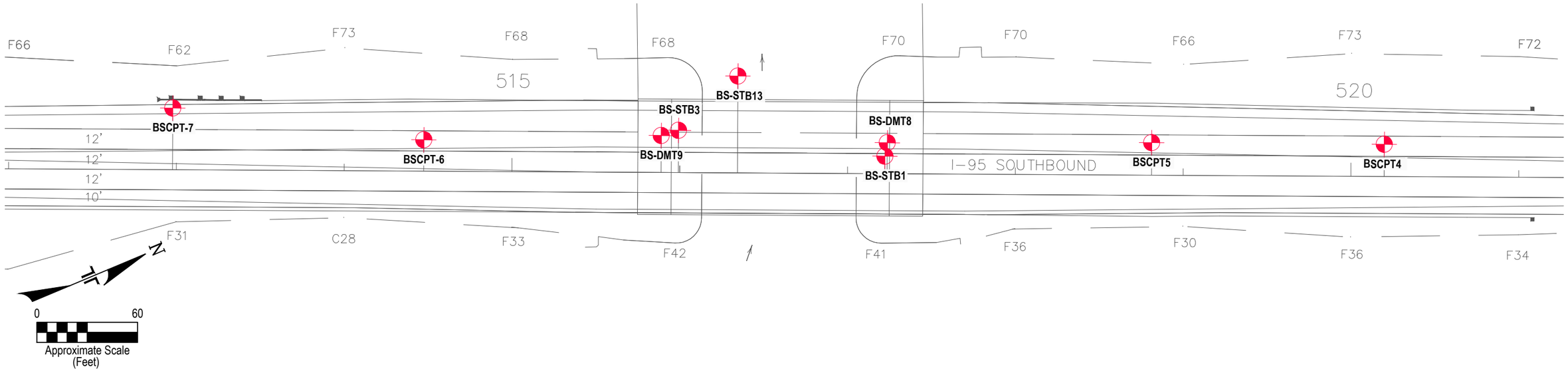
SITE PLAN

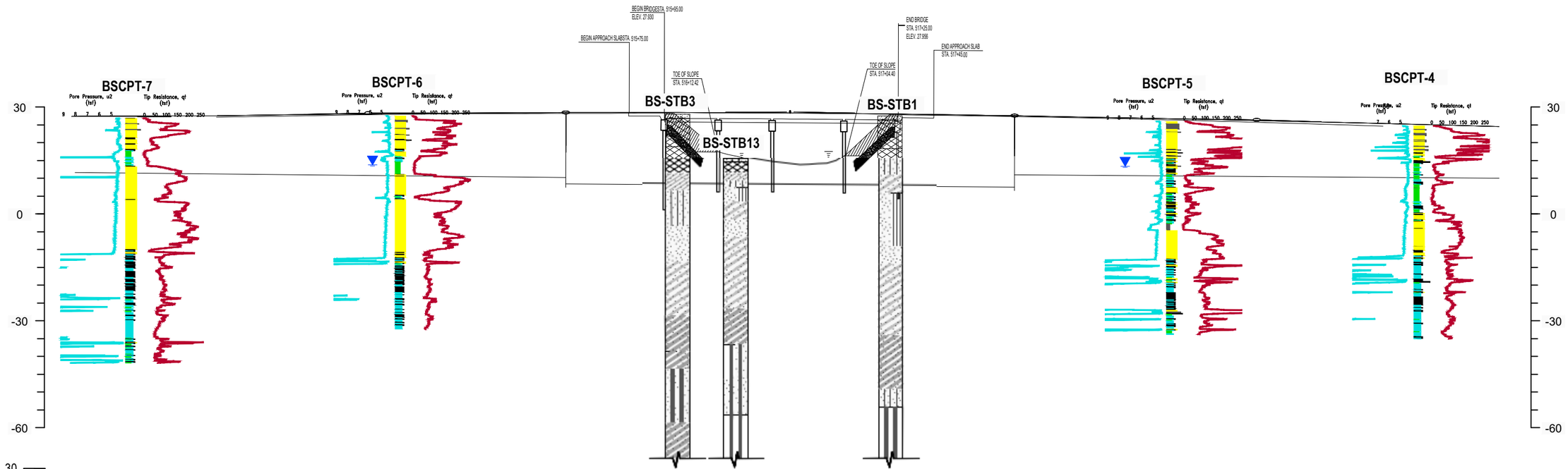
I-95 SB Bridge Replacement over Bagshaw Swamp
Jasper County, South Carolina

Exhibit

A-2

EXHIBIT A-3: TEST LOCATION PLAN AND SUBSURFACE PROFILE





LEGEND

APPROXIMATE BORING LOCATION

Project Mngr:	HJC	Project No.	EN175229
Drawn By:	MRF	Scale:	AS SHOWN
Checked By:	HJC	File No.	EN172599-BAGSHAW
Approved By:	HJC	Date:	JULY 2021

Terracon
Consulting Engineers and Scientists
1450 5th St., West North Charleston, SC 29405
843-884-1234 843-884-9234

BORING LOCATION PLAN

GEOTECHNICAL ENGINEERING REPORT
I-95 BRIDGE REPLACEMENT - BAGSHAW SWAMP
INTERSTATE 95
HARDEEVILLE, SOUTH CAROLINA

EXHIBIT

A-3

EXHIBIT A-4: SOIL TEST BORING/SOUNDING LOGS

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper			**Boring No.:**	BS-STB1
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	517+22	**Offset:**	11 L	**Alignment:**	Existing
Elev.:	27.8 ft	**Latitude:**	32.377143	**Longitude:**	-81.030559	**Date Started:**	6/17/2021
Total Depth:	100 ft	**Soil Depth:**	98.8 ft	**Core Depth:**	1.2 ft	**Date Completed:**	6/18/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55 Trailer	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	77.8%
Core Size:	4 inches	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** Not Meas.	**24HR**	Not Meas.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
	0.0	Top of SB I-95 pavement								
	1.2	Concrete (14 inches)		1.2						
22.8		**FILL** - Loose to medium dense, moist, brown, subangular, non-reactive, weakly cemented, fine, Silty SAND (SM) (A-2-4) 7.5YR 4/3		3.2	SS1	2	4	5	4	9
				5.2	SS2	2	17	5	3	22
				7.2	SS3	1	2	4	5	6
				9.2	SS4	6	6	6	6	12
	9.2									
17.8		Soft, wet, light brown, non-reactive, weakly to moderately cemented, Sandy SILT (ML) (A-4) 7.5YR 6/4			SS5	1	2	2	2	4
	12.4			13.5						
12.8		**ALLUVIUM** - Medium dense, moist, brown to grayish brown, subangular, non-reactive, weakly cemented, fine, Silty SAND (SM) (A-2-4) 7.5YR 4/3 to 10YR 5/2			SS6	7	7	8		15
	17.0	LL=PL=PI=0, NMC=13, %200=21								
7.8		Very loose, moist, brown, subangular, non-reactive, weakly cemented, fine to medium, Clayey SAND (SM) (A-2-4) 7.5YR 4/3		18.5	SS7	1	1	1		2
	22.0	LL=21, PL=12, PI=9, NMC=18, %200=24								
2.8		Loose to medium dense, moist, brown to grayish brown, subangular, non-reactive, weakly cemented, fine, Poorly graded SAND with silt (SP-SM) (A-3) 7.5YR 4/3 to 10YR 5/2		23.5	SS8	2	2	3		5
		LL=PL=PI=0, NMC=22, %200=5		28.5	SS9	4	6	8		14
-2.2		LL=PL=PI=0, NMC=18, %200=6								
				33.5	SS10	8	10	11		21
-7.2										
	37.0			38.5	SS11	7	5	7		12
-12.2		Medium dense, moist, brown to grayish brown, subangular, non-reactive, weakly cemented, fine, Poorly graded SAND (SP) (A-3) 7.5YR 4/3 to 10YR 5/2								
	42.0	LL=PL=PI=0, NMC=21, %200=3								
		Medium dense, moist, dark greenish gray, subangular, non-reactive, weakly cemented, fine, Clayey SAND (SC) (A-7-6) 10GY 4/1		43.5	SS12	5	8	10		18

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%) ✿ RQD (%) ■ REC (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT EN175299 I-95 BRO BAGSHAW.GPJ SCDOT_DATATEMPLATE.GDT 7/27/21

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper			**Boring No.:**	BS-STB1
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	517+22	**Offset:**	11 L	**Alignment:**	Existing
Elev.:	27.8 ft	**Latitude:**	32.377143	**Longitude:**	-81.030559	**Date Started:**	6/17/2021
Total Depth:	100 ft	**Soil Depth:**	98.8 ft	**Core Depth:**	1.2 ft	**Date Completed:**	6/18/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55 Trailer	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	77.8%
Core Size:	4 inches	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** Not Meas.	**24HR**	Not Meas.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
			48.5	SS13	6	8	12		20
-22.2		LL=54, PL=26, PI=28, NMC=48, %200=39							
			53.5	SS14	7	8	14		22
-27.2									
			58.5	SS15	11	10	17		27
-32.2		LL=59, PL=26, PI=33, NMC=42, %200=45							
	62.0	Very stiff, moist, dark greenish gray, non-reactive, Sandy fat CLAY (CH) (A-7-6) 10GY 4/1	63.5	SS16	6	8	11		19
-37.2		LL=70, PL=29, PI=41, NMC=63, %200=60							
			68.5	SS17	5	8	11		19
-42.2									
			73.5	SS18	4	6	11		17
-47.2									
	77.0	Dense, moist, dark greenish gray, subangular, non-reactive, weakly cemented, fine, Silty SAND (SM) (A-7-5) 10GY 4/1	78.5	SS19	5	12	23		35
-52.2		LL=64, PL=32, PI=32, NMC=51, %200=39							
	82.0	Stiff to hard, moist, dark greenish gray, Elastic SILT (MH) (A-7-5) 10GY 4/1	83.5	SS20	6	7	10		17
-57.2		LL=106, PL=44, PI=62, NMC=75, %200=90							
			88.5	SS21	16	22	24		46

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) ✿ RQD (%) ■ REC (%)
0 10 20 30 40 50 60 70 80 90

106

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper	**Boring No.:**	BS-STB1		
Site Description:	I-95 SB BRO Bagshaw Swamp			**Route:**	I-95		
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	517+22	**Offset:**	11 L	**Alignment:**	Existing
Elev.:	27.8 ft	**Latitude:**	32.377143	**Longitude:**	-81.030559	**Date Started:**	6/17/2021
Total Depth:	100 ft	**Soil Depth:**	98.8 ft	**Core Depth:**	1.2 ft	**Date Completed:**	6/18/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55 Trailer	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	77.8%
Core Size:	4 inches	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** Not Meas.	**24HR**	Not Meas.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
				93.5	SS22	50/2"				100+
-67.2		with strongly cemented seams								
				98.5	SS23	7	6	5		11
-72.2	100.0	BORING TERMINATED AT 100 FEET								
-77.2										
-82.2										
-87.2										
-92.2										
-97.2										
-102.2										

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) ✿ RQD (%) ■ REC (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

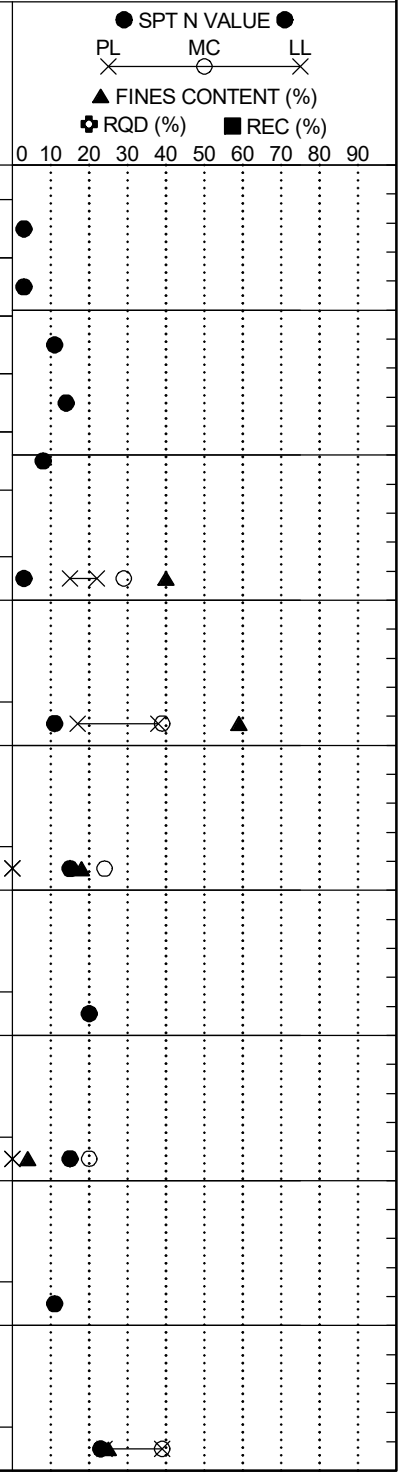
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT EN175299 I-95 BRO BAGSHAW.GPJ SCDOT_DATATEMPLATE.GDT 7/27/21

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper			**Boring No.:**	BS-STB3
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	515+99	**Offset:**	25 L	**Alignment:**	Existing
Elev.:	26.9 ft	**Latitude:**	32.377441	**Longitude:**	-81.030363	**Date Started:**	6/16/2021
Total Depth:	110 ft	**Soil Depth:**	108.8 ft	**Core Depth:**	1.2 ft	**Date Completed:**	6/17/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55 Trailer	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	77.8%
Core Size:	4 inches	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** Not Meas.	**24HR**	Not Meas.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
	0.0	Top of SB I-95 pavement								
	1.2	Concrete (14.5 inches)		1.2						
21.9		**FILL** - Very loose to medium dense, moist, brown, subangular, non-reactive, weakly cemented, fine, Silty SAND (SM) (A-2-4) 7.5YR 4/3		3.2	SS1	1	1	2	2	3
				5.2	SS2	1	1	2	7	3
				7.2	SS3	WOH	4	7	4	11
	9.2			9.2	SS4	7	7	7	6	14
16.9		Very loose to loose, moist, grayish brown, subangular, non-reactive, weakly cemented, fine, Silty, clayey SAND (SC-SM) (A-4) 10YR 5/2			SS5	5	4	4	5	8
				13.5						
11.9		LL=22, PL=15, PI=7, NMC=29, %200=40			SS6	1	2	1		3
	17.0									
		ALLUVIUM - Stiff, moist, light brown, Sandy lean CLAY (CL) (A-6) 7.5YR 6/4		18.5						
6.9		LL=38, PL=17, PI=21, NMC=39, %200=59			SS7	1	3	8		11
	22.0									
		Medium dense, moist, dark gray, subangular, non-reactive, weakly cemented, fine to medium, Silty SAND (SM) (A-2-4) 7.5YR		23.5						
1.9		LL=PL=PI=0, NMC=24, %200=18			SS8	5	7	8		15
				28.5						
-3.1					SS9	7	9	11		20
	32.0									
		Medium dense, moist, dark gray, subangular, non-reactive, weakly cemented, fine to medium, Poorly graded SAND (SP) (A-3) 7.5YR 4/1		33.5						
-8.1		LL=PL=PI=0, NMC=20, %200=4			SS10	6	7	8		15
				38.5						
-13.1					SS11	5	4	7		11
	42.0									
		Medium dense, moist, dark greenish gray, subangular, non-reactive, weakly cemented, fine, Clayey SAND (SC) (A-2-6 to A-7-6)		43.5						
					SS12	5	7	16		23



LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT EN175299 I-95 BRO BAGSHAW.GPJ SCDOT_DATATEMPLATE.GDT 7/27/21

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper			**Boring No.:**	BS-STB3
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	515+99	**Offset:**	25 L	**Alignment:**	Existing
Elev.:	26.9 ft	**Latitude:**	32.377441	**Longitude:**	-81.030363	**Date Started:**	6/16/2021
Total Depth:	110 ft	**Soil Depth:**	108.8 ft	**Core Depth:**	1.2 ft	**Date Completed:**	6/17/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55 Trailer	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	77.8%
Core Size:	4 inches	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** Not Meas.	**24HR**	Not Meas.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
		10GY 4/1								
		LL=39, PL=24, PI=15, NMC=39, %200=25		48.5						
-23.1		LL=51, PL=28, PI=23, NMC=46, %200=36			SS13	5	6	11		17
				53.5						
-28.1					SS14	5	8	13		21
	57.0									
		Stiff to very stiff, moist, dark greenish gray, non-reactive, Sandy fat CLAY (CH) (A-7-5) 10GY 4/1		58.5						
-33.1		LL=82, PL=31, PI=51, NMC=60, %200=64			SS15	4	7	9		16
				63.5						
-38.1					SS16	5	5	9		14
	67.0									
		Stiff, moist, dark greenish gray, non-reactive, Fat CLAY with sand (CH) (A-7-5) 10GY 4/1		68.5						
-43.1		LL=74, PL=30, PI=44, NMC=57, %200=70			SS17	5	5	8		13
	72.0									
		Stiff to very stiff, moist, dark greenish gray, non-reactive, Sandy elastic SILT (MH) (A-7-5) 10GY 4/1		73.5						
-48.1		LL=88, PL=42, PI=46, NMC=59, %200=64			SS18	9	10	12		22
				78.5						
-53.1					SS19	5	5	7		12
				83.5						
-58.1					SS20	5	15	10		25
	87.0									
		Stiff to hard, moist, dark greenish gray, non-reactive, Sandy fat CLAY (CH) (A-7-6) 10GY 4/1		88.5						
					SS21	11	12	16		28

SPT N VALUE ● PL × MC ○ LL ×
▲ FINES CONTENT (%)
✿ RQD (%) ■ REC (%)
0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper			**Boring No.:**	BS-STB3
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	515+99	**Offset:**	25 L	**Alignment:**	Existing
Elev.:	26.9 ft	**Latitude:**	32.377441	**Longitude:**	-81.030363	**Date Started:**	6/16/2021
Total Depth:	110 ft	**Soil Depth:**	108.8 ft	**Core Depth:**	1.2 ft	**Date Completed:**	6/17/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55 Trailer	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	77.8%
Core Size:	4 inches	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** Not Meas.	**24HR**	Not Meas.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
		LL=77, PL=26, PI=51, NMC=53, %200=60		93.5						
					SS22	10	13	10		23
-68.1				98.5						
					SS23	4	5	8		13
-73.1				103.5						
					SS24	50/5"				100+
-78.1		with moderately cemented seams		108.5						
					SS25	9	7	8		15
-83.1	110.0	BORING TERMINATED AT 110 FEET								
-88.1										
-93.1										
-98.1										
-103.1										

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) ✿ RQD (%) ■ REC (%)
0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT EN175299 I-95 BRO BAGSHAW.GPJ SCDOT_DATATEMPLATE.GDT 7/27/21

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper			**Boring No.:**	BS-STB13
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	516+34	**Offset:**	56 L	**Alignment:**	Existing
Elev.:	14.4 ft	**Latitude:**	32.37732	**Longitude:**	-81.030314	**Date Started:**	6/24/2021
Total Depth:	125 ft	**Soil Depth:**	125 ft	**Core Depth:**	0 ft	**Date Completed:**	6/24/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-45C Track	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	82.1%
Core Size:	NA	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** 3.4 ft	**24HR**	3.4 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
	0.0								
	0.7	Topsoil (8 inches)	0.0	SS1	1	3	3	2	6
		FILL - Loose, moist, brown, subangular, non-reactive, weakly cemented, fine, Clayey SAND (SC) (A-6) 7.5YR 4/3	2.0	SS2	2	3	3	4	6
	4.0		4.0						
9.4		**ALLUVIUM** - Stiff, moist, gray, non-reactive, weakly cemented, Sandy lean CLAY (CL) (A-6) 5YR 5/1		SS3	2	4	6	6	10
	6.0		6.0	SS4	4	6	5	3	11
	8.0	Medium dense, moist, light gray, subangular, non-reactive, weakly cemented, fine, Silty SAND (SM) (A-2-4) 5YR 7/1	8.0	SS5	3	4	5	7	9
4.4		LL=PL=PI=0, NMC=29, %200=13							
	12.0	Loose, moist, light gray, subangular, non-reactive, weakly cemented, fine, Poorly graded SAND with silt (SP-SM) (A-2-4) 5YR 7/1	13.5	SS6	2	2	2		4
-0.6		LL=PL=PI=0, NMC=27, %200=12							
	17.0	Very loose, moist, light gray, subangular, non-reactive, weakly cemented, fine, Clayey SAND (SC) (A-6), 5YR 7/1	18.5	SS7	4	5	4		9
-5.6		Loose, moist, light gray, subangular, non-reactive, weakly cemented, fine, Poorly graded SAND (SP) (A-3), 5YR 7/1							
	22.0	LL=PL=PI=0, NMC=30, %200=4	23.5	SS8	6	6	6		12
-10.6		Medium dense, moist, dark greenish gray, subangular, non-reactive, weakly cemented, fine, Clayey SAND (SC) (A-2-6 to A-7-6), 10Y 4/1							
			28.5	SS9	5	8	14		22
-15.6		LL=39, PL=21, PI=18, NMC=37, %200=31							
			33.5	SS10	5	7	11		18
-20.6									
			38.5	SS11	6	9	13		22
-25.6		LL=46, PL=25, PI=21, NMC=44, %200=43							
	42.0								
		Very stiff, moist, dark gray to dark greenish gray, non-reactive, Sandy fat CLAY (CH) (A-7-5) 5Y 4/1 to 10Y 4/1	43.5	SS12	5	8	14		22

SPT N VALUE ● PL × MC ○ LL ×
▲ FINES CONTENT (%)
✿ RQD (%) ■ REC (%)
0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030260	**County:**	Jasper			**Boring No.:**	BS-STB13
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	516+34	**Offset:**	56 L	**Alignment:**	Existing
Elev.:	14.4 ft	**Latitude:**	32.37732	**Longitude:**	-81.030314	**Date Started:**	6/24/2021
Total Depth:	125 ft	**Soil Depth:**	125 ft	**Core Depth:**	0 ft	**Date Completed:**	6/24/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-45C Track	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	82.1%
Core Size:	NA	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** 3.4 ft	**24HR**	3.4 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
-35.6	52.0	LL=70, PL=32, PI=38, NMC=49, %200=52		48.5	SS13	10	15	15		30
-40.6	62.0	Stiff to very stiff, moist, dark gray to dark greenish gray, non-reactive, Elastic SILT with sand (MH) (A-7-5) 5Y 4/1 to 10Y 4/1 LL=51, PL=37, PI=14, NMC=62, %200=72		53.5	SS14	5	5	7		12
-45.6				58.5	SS15	13	14	13		27
-50.6	72.0	Very stiff, moist, dark gray to dark greenish gray, non-reactive, Sandy elastic SILT (MH) (A-7-5) 5Y 4/1 to 10Y 4/1 LL=72, PL=41, PI=31, NMC=60, %200=62		63.5	SS16	8	10	13		23
-55.6				68.5	SS17	21	14	14		28
-60.6		Stiff to hard, moist, dark greenish gray, non-reactive, Elastic SILT (MH) (A-7-5) 10Y 4/1 LL=76, PL=42, PI=34, NMC=55, %200=87		73.5	SS18	6	8	8		16
-65.6		LL=93, PL=52, PI=41, NMC=55, %200=97		78.5	SS19	20	26	39		65
-70.6				83.5	SS20	50/2"				100+
				88.5	SS21	28	45	24		69

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) ✿ RQD (%) ■ REC (%)
0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030260			**County:**	Jasper	**Boring No.:**	BS-STB13
Site Description:	I-95 SB BRO Bagshaw Swamp					**Route:**	I-95
Eng./Geo.:	Terracon (LVB)	**Boring Location:**	516+34	**Offset:**	56 L	**Alignment:**	Existing
Elev.:	14.4 ft	**Latitude:**	32.37732	**Longitude:**	-81.030314	**Date Started:**	6/24/2021
Total Depth:	125 ft	**Soil Depth:**	125 ft	**Core Depth:**	0 ft	**Date Completed:**	6/24/2021
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-45C Track	**Drill Method:**	RW	**Hammer Type:**	Automatic	**Energy Ratio:**	82.1%
Core Size:	NA	**Driller:**	Bridger Drilling	**Groundwater:**	**TOB** 3.4 ft	**24HR**	3.4 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
-80.6		LL=110, PL=67, PI=43, NMC=108, %200=99		93.5	SS22	4	7	8		15
-85.6				98.5	SS23	23	43	50/3"		100+
-90.6				103.5	SS24	6	8	10		18
-95.6				108.5	SS25	50/1"				100+
-100.6				113.5	SS26	6	11	16		27
-105.6				118.5	SS27	7	7	9		16
-110.6	125.0	BORING TERMINATED AT 125 FEET		123.5	SS28	8	8	12		20
-115.6										

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) ✿ RQD (%) ■ REC (%)
0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT EN175299 I-95 BRO BAGSHAW.GPJ SCDOT_DATATEMPLATE.GDT 7/27/21

CPT LOG NO. BS-CPT4

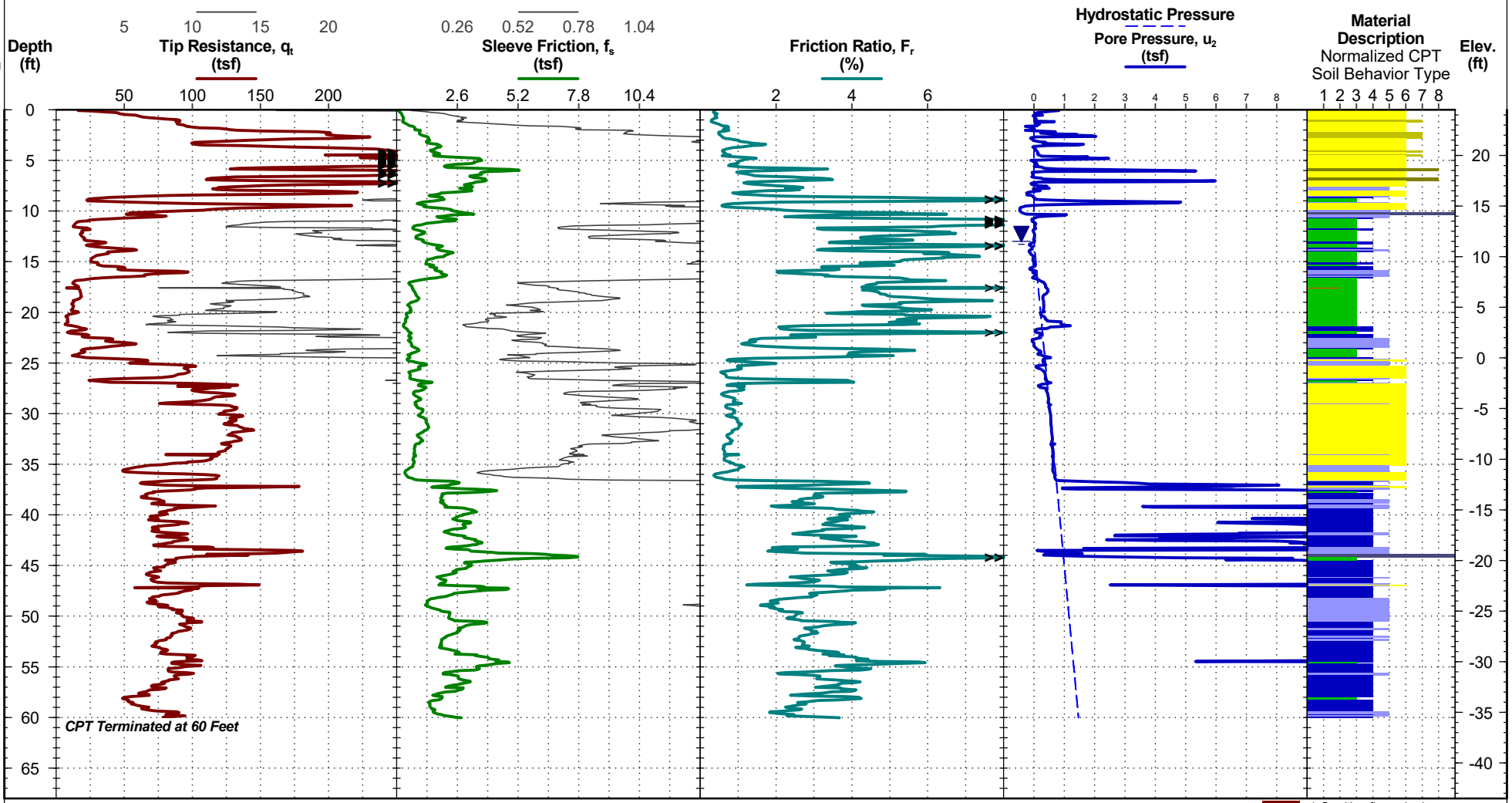
PROJECT: I-95 Bridge Replacements - Jasper County

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

TEST LOCATION: See Exhibit A-2

SITE: Bagshaw Swamp
Hardeeville, SC

Surface Elev.: 24.5 ft
Latitude: 32.376377° Station: 520+20
Longitude: -81.030898° Offset: 19 L



See Terracon's CPT General Notes for explanation of symbols and abbreviations.
NAVD88

CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION
▼ 13 ft estimated water depth
(used in normalizations and correlations)

Probe no. 5454 with net area ratio of .857
U2 pore pressure transducer location
Calibrated 4/1/2021
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 2 in

Terracon
1450 Fifth St W
North Charleston, SC

CPT Started: 6/16/2021
CPT Completed: 6/16/2021
Rig: Pagani TG73-200
Operator: BR
Project No.: EN175299

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT REPORT EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT 7/20/21

CPT LOG NO. BS-CPT5

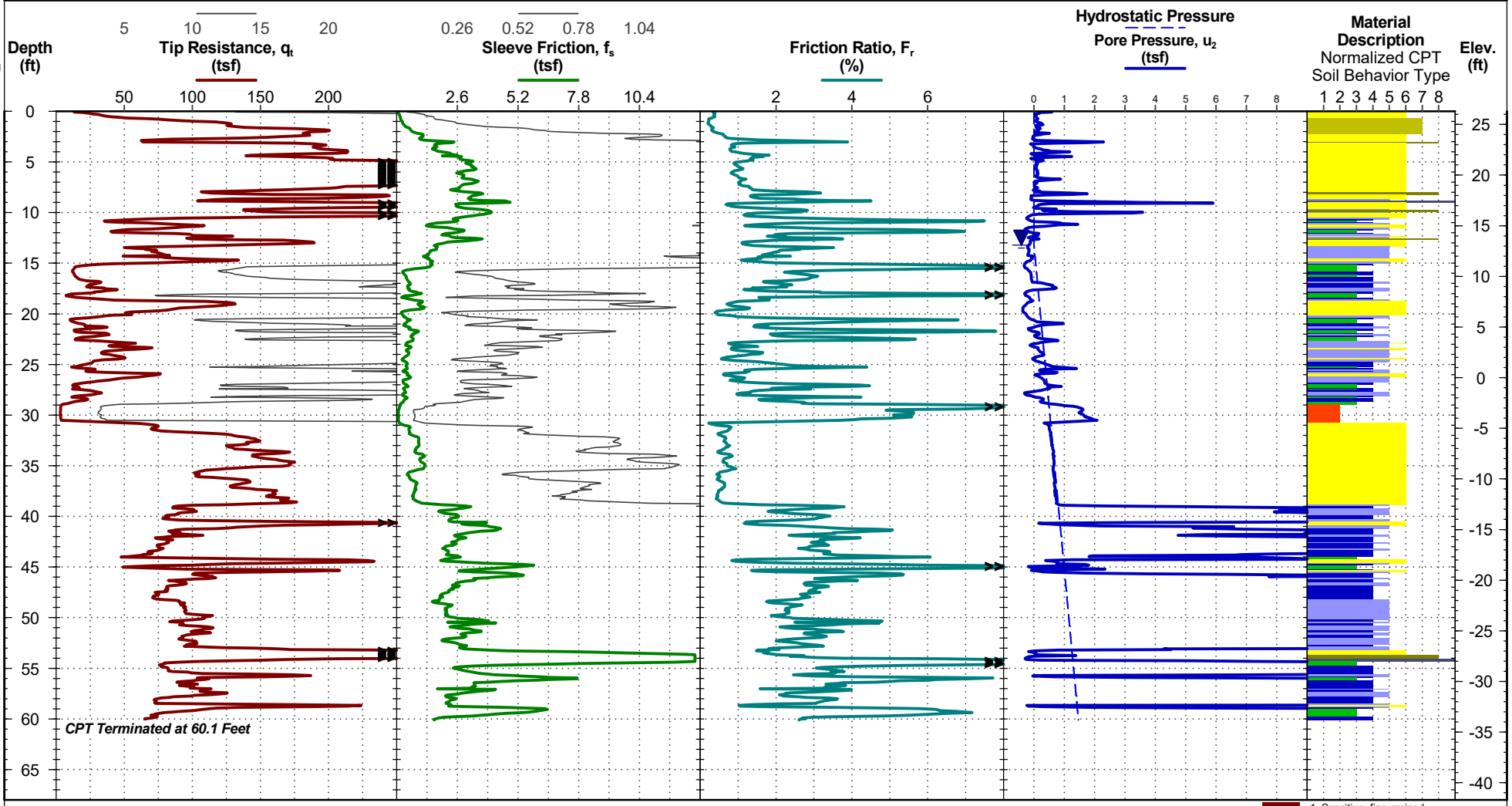
PROJECT: I-95 Bridge Replacements - Jasper County

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

TEST LOCATION: See Exhibit A-2

Surface Elev.: 26.3 ft
Latitude: 32.376729° Station: 518+81
Longitude: -81.030728° Offset: 19 L

SITE: Bagshaw Swamp
Hardeeville, SC



See Terracon's CPT General Notes for explanation of symbols and abbreviations.
NAVD88

CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION
13.2 ft measured water depth
(used in normalizations and correlations)

Probe no. 5454 with net area ratio of .857
U2 pore pressure transducer location
Calibrated 4/1/2021
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 2 in

Terracon
1450 Fifth St W
North Charleston, SC

CPT Started: 6/16/2021
CPT Completed: 6/16/2021
Rig: Pagani TG73-200
Operator: BR
Project No.: EN175299

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT REPORT EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT 7/20/21

CPT LOG NO. BS-CPT6

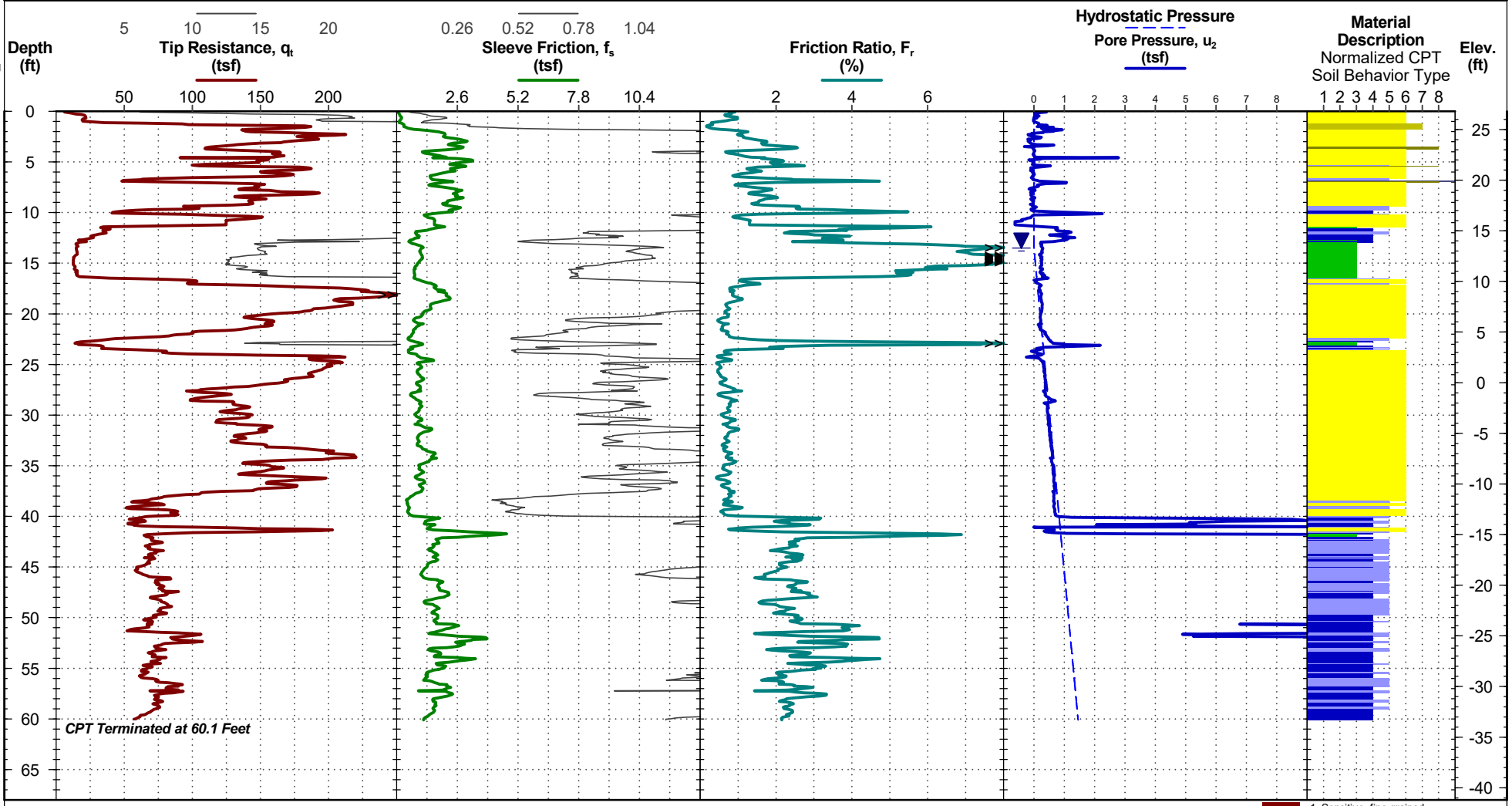
PROJECT: I-95 Bridge Replacements - Jasper County

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

TEST LOCATION: See Exhibit A-2

Surface Elev.: 26.8 ft
Latitude: 32.377833° Station: 514+47
Longitude: -81.030196° Offset: 18.5 L

SITE: Bagshaw Swamp
Hardeeville, SC



See Terracon's CPT General Notes for explanation of symbols and abbreviations.
NAVD88

CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION
▼ 13.5 ft measured water depth
(used in normalizations and correlations)

Probe no. 5454 with net area ratio of .857
U2 pore pressure transducer location
Calibrated 4/1/2021
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 2 in

Terracon
1450 Fifth St W
North Charleston, SC

CPT Started: 6/16/2021
CPT Completed: 6/16/2021
Rig: Pagani TG73-200
Operator: BR
Project No.: EN175299

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT REPORT EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT 7/20/21

CPT LOG NO. BS-CPT7

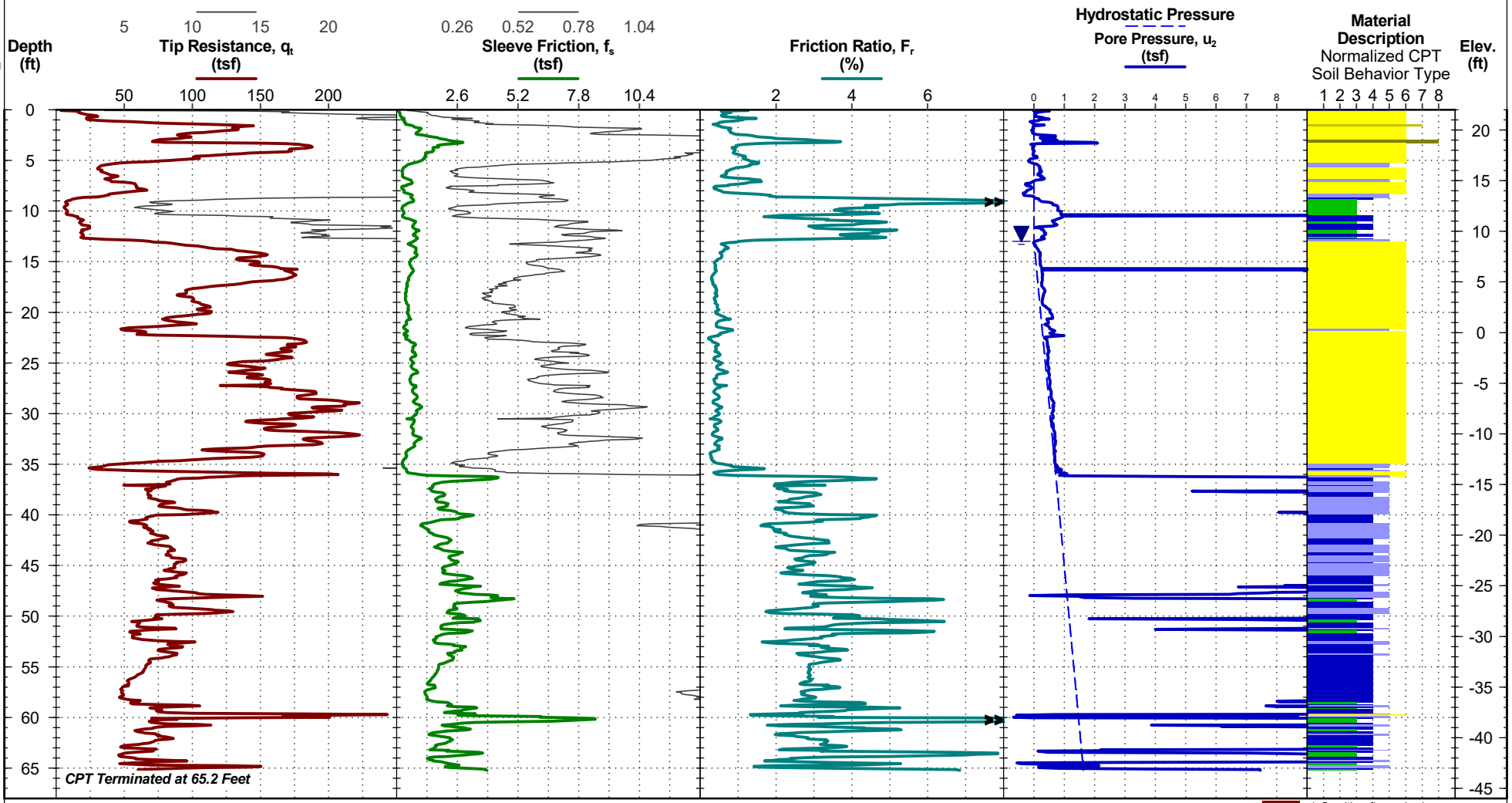
PROJECT: I-95 Bridge Replacements - Jasper County

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

TEST LOCATION: See Exhibit A-2

Surface Elev.: 22.0 ft
Latitude: 32.378195°
Longitude: -81.029958°
Station: 512+97
Offset: 36.5 L

SITE: Bagshaw Swamp
Hardeeville, SC



See Terracon's CPT General Notes for explanation of symbols and abbreviations.
NAVD88

CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION
13 ft estimated water depth
(used in normalizations and correlations)

Probe no. 5454 with net area ratio of .857
U2 pore pressure transducer location
Calibrated 4/1/2021
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 2 in

Terracon
1450 Fifth St W
North Charleston, SC

CPT Started: 6/16/2021
CPT Completed: 6/16/2021
Rig: Pagani TG73-200
Operator: BR
Project No.: EN175299

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT REPORT EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT 7/20/21

DMT LOG NO. BS-DMT8

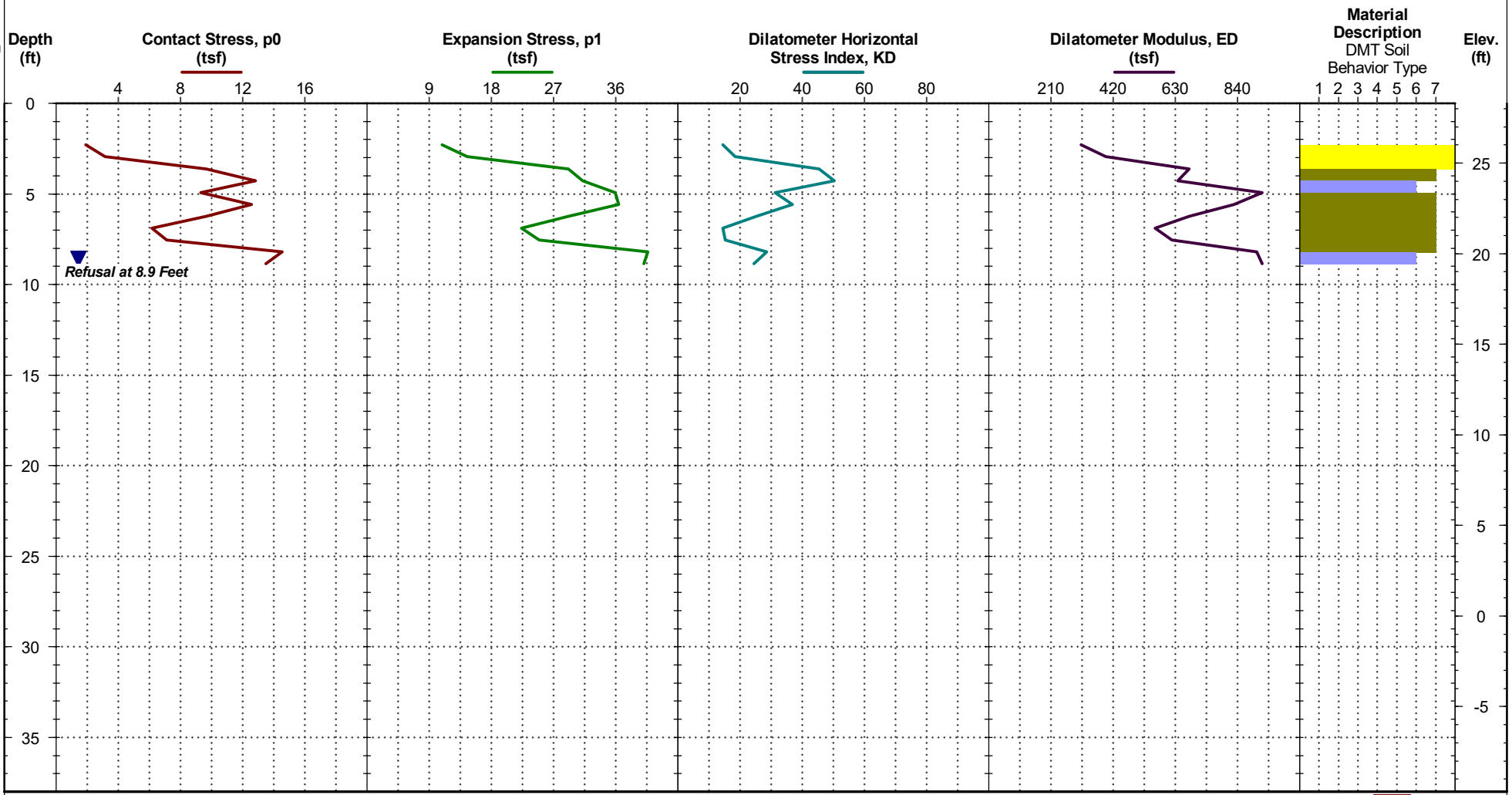
PROJECT: I-95 Bridge Replacements - Jasper County

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

SITE: Bagshaw Swamp
Hardeeville, SC

TEST LOCATION: See Exhibit A-2

Surface Elev.: 28.3 ft
Latitude: 32.377131° Station: 517+23
Longitude: -81.030536° Offset: 18 L



See Plan Sheets for
explanation of symbols and abbreviations.
NAVD88

DMT specification reports available upon request.

1 Muck / peat
2 Clay
3 Silty clay
4 Clayey silt
5 Silt
6 Sandy silt
7 Silty sand
8 Sand

WATER LEVEL OBSERVATION

9 ft estimated water depth
(used in normalizations and correlations)

Calibrations: ΔA - 0.1 bar; ΔB - 0.6 bar; Zm - 0 bar
Blade no. 507

Terracon
1450 Fifth St W
North Charleston, SC

DMT Started: 6/16/2021
DMT Completed: 6/16/2021
Rig: Pagani TG73-200
Operator: BR
Project No.: EN175299

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. DMT REPORT EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT 7/20/21

DMT LOG NO. BS-DMT9

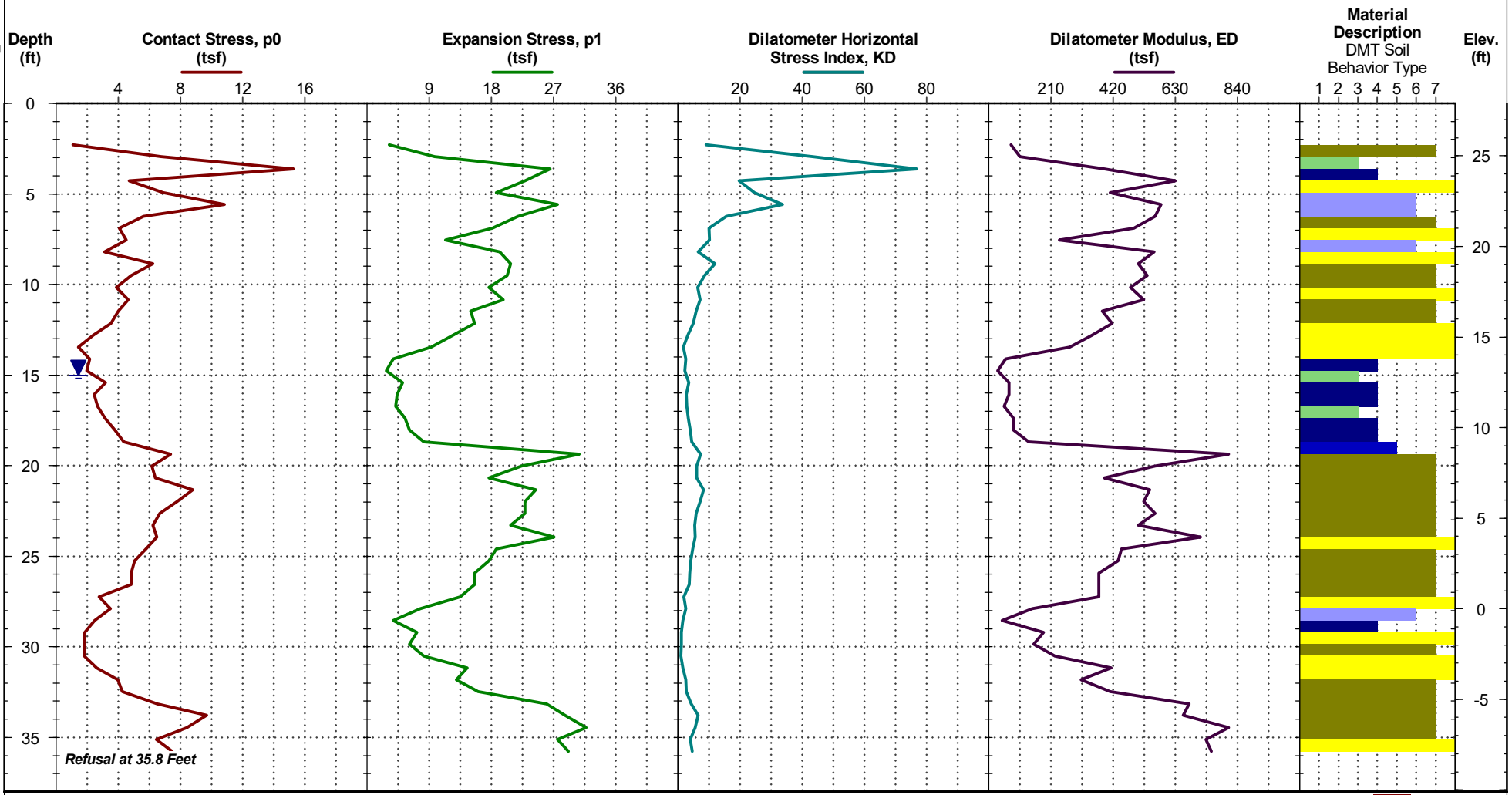
PROJECT: I-95 Bridge Replacements - Jasper County

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

SITE: Bagshaw Swamp
Hardeeville, SC

TEST LOCATION: See Exhibit A-2

Surface Elev.: 27.9 ft
Latitude: 32.37747° Station: 515+89
Longitude: -81.03036° Offset: 22 L



See Plan Sheets for
explanation of symbols and abbreviations.
NAVD88

DMT specification reports available upon request.

1 Muck / peat
2 Clay
3 Silty clay
4 Clayey silt
5 Silt
6 Sandy silt
7 Silty sand
8 Sand

WATER LEVEL OBSERVATION

15 ft estimated water depth
(used in normalizations and correlations)

Calibrations: ΔA - 0.1 bar; ΔB - 0.6 bar; Zm - 0 bar
Blade no. 507

Terracon
1450 Fifth St W
North Charleston, SC

DMT Started: 6/16/2021
DMT Completed: 6/16/2021
Rig: Pagani TG73-200
Operator: BR
Project No.: EN175299

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. DMT REPORT EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT 7/20/21

EXHIBIT A-5: FIELD EXPLORATION DESCRIPTION AND GENERAL NOTES

Field Exploration Description

The locations of the borings, were initially located in the field using hand-held GPS units and landmarks. After competition of testing, the locations were surveyed by a licensed surveyor in the state of South Carolina. These locations should be considered accurate only to the degree implied by the means and methods used to define them.

Terracon field representatives supervised field operations and recorded and visually classified soil samples for field logs.

Soil Test Borings (STB)

All soil test borings and operations were conducted in accordance with:

- ASTM D1586 Test Method for Penetration Test and Split-Barrel Sampling of Soils
- ASTM D4220 Standard Practices for Preserving and Transporting Soil
- ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- SCDOT Geotechnical Design Manual 2019 (version 2.0)

Cone Penetration Test (CPT) Soundings

CPT was conducted in accordance with ASTM D5778 – *Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils.*

Dilatometer Test (DMT) Soundings

DMT was conducted in accordance with ASTM D6635 – *Standard Test Method for Performing the Flat Plate Dilatometer.*

Soil Test Boring General Notes

Terracon

SCDOT Soil Test Boring Log Descriptors

Relative Density / Consistency Terms

Relative Density[1] / Consistency[2]

Descriptive Term	Relative Density	SPT Blow Count	Descriptive Term	Unconfined Compression Strength (q_u) (tsf)	SPT Blow Count
Very Loose	0 to 15%	< 4	Very Soft	<0.25	<2
Loose	16 to 35%	5 to 10	Soft	0.26 to 0.50	3 to 4
Medium Dense	36 to 65%	11 to 30	Firm	0.51 to 1.00	5 to 8
Dense	66 to 85%	31 to 50	Stiff	1.01 to 2.00	9 to 15
Very Dense	86to 100%	>51	Very Stiff	2.01 to 4.00	16 to 30
			Hard	>4.01	> 31

Moisture Condition

Descriptive Term	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually in coarse-grained soils below the water table

Color

Describe the sample color while sample is still moist.

Angularity[1]

Descriptive Term	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

HCl Reaction[3]

Descriptive Term	Criteria
None Reactive	No visible reaction
Weakly Reactive	Some reaction, with bubbles forming slowly
Strongly Reactive	Violent reaction, with bubbles forming immediately

Cementation[3]

Descriptive Term	Criteria
Weakly Cemented	Crumbles or breaks with handling or little finger pressure
Moderately Cemented	Crumbles or breaks with considerable finger pressure
Strongly Cemented	Will not crumble or break with finger pressure

Particle-Size Range[1]

Gravel	mm	Sieve size	Sand	mm	Sieve size
Fine	4.76 to 19.1	#4 to ¾ inch	Fine	0.074 to 0.42	#200 to #40
Coarse	19.1 to 76.2	¾ inch to 3 inch	Medium	0.42 to 2.00	#40 to #10
			Coarse	4.00 to 4.76	#10 to #4

Primary Soil Type[1, 2]

The primary soil type will be shown in all capital letters

USCS Soil Designation

Indicate USCS soil designation as defined in ASTM D-2487 and D-2488

AASHTO Soil Designation

Indicate AASHTO soil designation as defined in AASHTO M-145 and ASTM D-3282

[1]Applies to coarse-grained soils (major portion retained on No. 200 sieve)
[2]Appiles to fine-grained soils (major portion passing No. 200 sieve)
[3]Use as required

EXHIBIT A-6: SPT RIG CALIBRATIONS

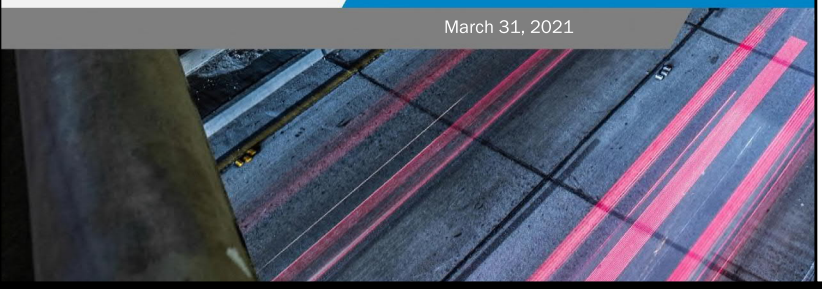


CAROLINAS GEOTECHNICAL GROUP

Report of SPT Hammer Energy

Prepared for:
Bridger Drilling Enterprise, Inc.
114 Chimney Lane
Wilmington, North Carolina 28409

March 31, 2021



CAROLINAS GEOTECHNICAL GROUP

N.C. Firm License: P-1904

2400 Crownpoint Executive Drive
Suite 800
Charlotte, NC 28227

(980) 339-8684
contact@carolinasgeotech.com
www.carolinasgeotech.com

March 31, 2021

Mr. George R. Bridger
Bridger Drilling Enterprise, Inc.
114 Chimney Lane
Wilmington, North Carolina 28409

SUBJECT: **Report of SPT Hammer Energy**
Bridger Drilling CME 55 Trailer Rig (SN 72425)
Clayton, North Carolina
CG2 Project No.: 240019016

Dear Mr. Bridger:

Carolinas Geotechnical Group, PLLC (CG2) has completed the Standard Penetration Test (SPT) energy measurements on the automatic hammer mounted on a Bridger Drilling Enterprise, Inc. (BD) CME 55 trailer-mounted drill rig with a serial number of 72425, see attached Drill Rig Photo Log. This service was performed by Mr. Robert E. Kral, PE on March 15, 2021. SPT energy testing was performed in general accordance with ASTM D4633 and the most recent revision of the North Carolina Department of Transportation (NCDOT), Geotechnical Engineering Unit's requirements. The testing procedures, equipment used during testing, and detailed results are presented in this report.

CG2 recommends BD submit this Report of SPT Hammer Energy to the NCDOT Geotechnical Engineering Unit for review and approval no later than April 12, 2021.

DYNAMIC TESTING METHODOLOGY

Testing was performed using a model SPT (Serial No. 4549 TB) Pile Driving Analyzer™ (PDA) manufactured by Pile Dynamics, Inc. The PDA was used to record and interpret data from one piezoresistive accelerometer (Serial No. K10960) bolted to a 2-foot long AWJ drill rod (SN 528AWJ) internally instrumented with two strain transducers. The instrumented AWJ drill rod has a cross-sectional area of 1.19 square inches, an outside diameter of approximately 1.75 inches, and an estimated inside diameter of 1.25 inches at the gauge location. The accelerometer and strain gauges, which are mounted on opposing axis near the middle of the instrumented rod, monitor acceleration and strain for each hammer blow. The analyzer converts the data to velocities and forces and computes the maximum transferred hammer energies with the "EFV" method described in ASTM D4633. Preliminary results are recorded and displayed in real-time for each blow. Calibration sheets for the PDA, accelerometers, and the instrumented rod are included in the Appendix III.

TESTING AND OBSERVATIONS

CG2 personnel was on site March 15, 2021 to observe and perform high-strain dynamic testing during SPT sampling on the CME 55 trailer-mounted drill rig operated by J. Radford of BD. The measurements were taken during drilling operations at the NCDOT test site located in the north-west quadrant of the US 70 and NC 42 interchange in Clayton, North Carolina (Johnston County). The approximate coordinates (not professionally surveyed) for the test location are 35.6236774, -78.5119757. No Soil Test Boring Log was maintained. SPT energy measurements were recorded during three intervals at depths of approximately 28½, 33½, and 38½ feet below the existing ground surface. The information presented in the table below summarizes the equipment tested and tooling used during the SPT energy measurements.

Table 1: SPT Field Data

Drill Rig Information	
Manufacturer	CME
Model	55
Serial Number	72425
Operator	J. Radford
Carrier	Trailer
Hammer Information	
Model / Type	CME / Auto
Serial Number	N/A
Anvil Height (inches)	11.5
Anvil Diameter (inches)	2.5
Drop Height (inches)	30
Ram Weight (pounds)	140
Ram Serial Number	N/A
Drilling and Instrumented Rod Information	
Drill Rod Type	AWJ
OD (inches)	1.75
ID (inches)	1.25
Cross-Sectional Area (in²)	1.19
Typical Lengths (feet)	5 and 10
Instrumented Rod Type	AWJ (SN 528)
OD (inches)	1.75
ID (inches)	1.25
Cross-Sectional Area (in²)	1.19
Total Instrumented Rod Length (feet)	2.00
Length Below Gages (feet)	0.70
Split-Spoon Length (feet)	2.85

DYNAMIC TESTING RESULTS

The total rod length from the instrumentation to the tip of the split-spoon sampler was determined by adding 3.6 feet to the required drill rod length at each sample depth. Based on the test data, the automatic hammer on the CME 55 trailer-mounted drill rig operated at a rate of about 48.2 to 54.7 blows per minute (BPM) during dynamic testing. The measured transferred hammer energy (EFV) ranged from 260.8 to 292.8 foot-pounds, which corresponds to Energy Transfer Ratio (ETR) values of 74.5 to 83.7%, respectively.

The SPT Energy Measurement Data Summary tables in the Appendix present the test data from every hammer blow at each sampling interval along with representative force and velocity traces for each test interval. The reported blow counts, obtained by the drill rig personnel, and a summary of the test data and average computed hammer energy and transfer ratio values are provided in Table 2. Plots and tables of the following are also included in the Appendix and present the test data with depth for each test interval:

- Penetration vs. BLC
- Penetration vs. FMX
- Penetration vs. EFV
- Penetration vs. CSX
- Penetration vs. VMX
- Penetration vs. ETR
- Average ETR vs. Rod Length
- ETR vs. Rod Length

Table 2: Summary of Dynamic Testing Results

Data Set ID	Sample Depth (ft)	Drill Rod Length (ft)	Instrumentation to Sampler Tip Length (ft)	Blows per 6" Increment / N-value	Soil Sample Description (Piedmont Residual)	Avg. BPM	Avg. EFV (ft-lbs)	Avg. ETR (%)
1	28½ - 30	30	33.6	2-4-5 / 9	SA SILT	51.0	264.7	75.6
2	33½ - 35	35	38.6	4-5-9 / 14	SA SILT	53.0	273.4	78.1
3	38½ - 40	40	43.6	2-5-7 / 12	SA SILT	54.1	277.0	79.1
					Overall Average	**52.9**	**272.4**	**77.8**

The average hammer rate, transferred energy, and transfer ratio were calculated for each depth interval. Per ASTM D4633, only the blows from the final foot of each sample interval (i.e., the blows that determine the N-value) were included when computing the average values shown in Table 2. The overall average transferred hammer energy for the automatic hammer on the CME 55 trailer-mounted drill rig (for all the depth intervals tested) was 272.4 foot-pounds, with an average ETR of 77.8%.

Report of SPT Hammer Energy
Clayton, North Carolina
CG2 Project No.: 240019016

LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The information contained in this report were based on the applicable standards of our profession in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

CLOSING

CG2 is pleased to have the opportunity to provide these services to you. If you have questions concerning the content of this report, or if CG2 can be of further service, please contact CG2 at (980) 339-8684.

Sincerely,
Carolinas Geotechnical Group, PLLC

DocuSigned by:
D. Matthew Brewer
386129C0A4C1482...
D. Matthew Brewer, PE
Senior Project Engineer

DocuSigned by:
Robert E. Kral
8AD703B2A84B4F4...
Robert E. Kral, PE
Senior Project Engineer
NC Registration No. 042642

NORTH CAROLINA PROFESSIONAL SEAL 042642 ENGINEER ROBERT E. KRAL

Appendices:

- Appendix I - CME 55 Trailer Rig (SN 72425) SPT Energy Measurements Summary Plots and Tables
- Appendix II - SPT Hammer Energy Field Form (Field Log) and Drill Rig Photo Log
- Appendix III - Instrumented Rod and Accelerometer Calibration Sheets
- Appendix IV - Certificate of Proficiency

APPENDIX I

Pile Dynamics, Inc.
SPT Analyzer Results

Page 1 of 4
PDA-S Ver. 2020.32 - Printed: 3/31/2021

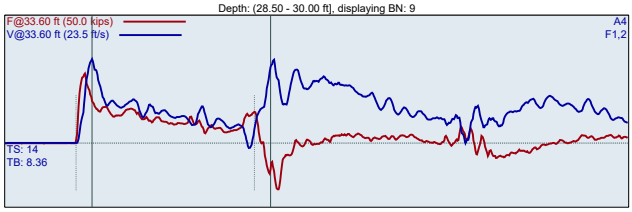
CME 55 (SN 72425)
REK
B-2

B-2
Interval start: 3/15/2021

AR: 1.19 in^2
LE: 33.60 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (28.50 - 30.00 ft], displaying BN: 9



F1 : [528AWJ1] 205.26 PDICAL (1) FF1
F2 : [528AWJ2] 205.86 PDICAL (1) FF1

A4 (PR): [K10960] 425.732 mv/6.4v/5000g (1) VF1

BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement
CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

LP	BL#	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
ft		/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
28.75	1	2	1.9	27.8	15.7	3.2	23.4	3.0	245.9	70.3
29.00	2	2	44.5	28.0	16.0	3.0	23.5	3.0	257.7	73.6
29.13	3	4	48.2	28.0	16.1	2.1	23.6	1.5	264.1	75.5
29.25	4	4	50.7	27.9	16.3	1.7	23.4	1.5	267.6	76.5
29.38	5	4	51.3	27.7	16.0	1.5	23.3	1.5	263.2	75.2
29.50	6	4	51.5	27.2	16.3	1.7	22.8	1.5	269.2	76.9
29.60	7	5	51.5	27.1	15.8	1.4	22.8	1.2	260.8	74.5
29.70	8	5	51.1	28.1	15.8	1.3	23.6	1.2	262.3	74.9
29.80	9	5	51.5	27.2	15.5	1.3	22.9	1.2	261.7	74.8
29.90	10	5	51.4	27.9	15.6	1.3	23.4	1.2	268.2	76.6
30.00	11	5	51.6	27.7	15.6	1.2	23.3	1.2	265.2	75.8
	Average	51.0	27.6	15.9	1.5	23.2	1.3	264.7	75.6	
	Std Dev	1.0	0.4	0.3	0.3	0.3	0.1	2.9	0.8	
	Maximum	51.6	28.1	16.3	2.1	23.6	1.5	269.2	76.9	
	Minimum	48.2	27.1	15.5	1.2	22.8	1.2	260.8	74.5	

N-value: 9

Sample Interval Time: 11.94 seconds.

Pile Dynamics, Inc.
SPT Analyzer Results

Page 2 of 4
PDA-S Ver. 2020.32 - Printed: 3/31/2021

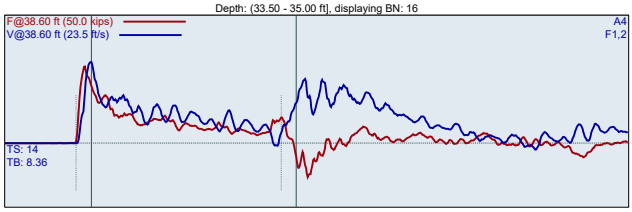
CME 55 (SN 72425)
REK
B-2

B-2
Interval start: 3/15/2021

AR: 1.19 in^2
LE: 38.60 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (33.50 - 35.00 ft], displaying BN: 16



F1 : [528AWJ1] 205.26 PDICAL (1) FF1
F2 : [528AWJ2] 205.86 PDICAL (1) FF1

A4 (PR): [K10960] 425.732 mv/6.4v/5000g (1) VF1

LP	BL#	BC	BPM	FMX	VMX	DMX	CSX	DFN	EFV	ETR
ft		/6"	bpm	kips	ft/s	in	ksi	in	ft-lb	%
33.63	1	4	1.9	29.2	14.6	1.7	24.5	1.5	252.9	72.3
33.75	2	4	46.9	29.7	14.6	1.8	25.0	1.5	270.9	77.4
33.88	3	4	50.5	29.8	14.3	1.5	25.1	1.5	267.2	76.3
34.00	4	4	52.6	29.8	14.6	1.5	25.1	1.5	269.0	76.8
34.10	5	5	52.6	29.9	14.7	1.2	25.1	1.2	266.2	76.1
34.20	6	5	52.9	29.9	14.9	1.3	25.1	1.2	269.8	77.1
34.30	7	5	52.8	29.8	14.9	1.2	25.1	1.2	270.2	77.2
34.40	8	5	52.9	30.1	14.4	1.3	25.3	1.2	270.0	77.2
34.50	9	5	52.8	30.0	14.6	1.2	25.2	1.2	272.1	77.8
34.56	10	9	52.7	29.9	14.9	0.8	25.2	0.7	272.8	78.0
34.61	11	9	53.0	30.2	14.7	0.8	25.4	0.7	269.8	77.1
34.67	12	9	53.1	30.0	14.7	0.8	25.2	0.7	275.7	78.8
34.72	13	9	53.1	30.1	15.0	0.7	25.3	0.7	275.7	78.8
34.78	14	9	53.2	30.1	14.7	0.7	25.3	0.7	273.4	78.1
34.83	15	9	53.4	30.1	14.8	0.7	25.3	0.7	277.0	79.1
34.89	16	9	53.0	29.9	14.9	0.7	25.1	0.7	277.0	79.2
34.94	17	9	53.3	30.2	14.8	0.7	25.3	0.7	280.7	80.2
35.00	18	9	53.4	30.1	14.7	0.7	25.3	0.7	276.8	79.1
	Average	53.0	30.0	14.8	0.9	25.2	0.9	273.4	78.1	
	Std Dev	0.2	0.1	0.1	0.2	0.1	0.3	3.8	1.1	
	Maximum	53.4	30.2	15.0	1.3	25.4	1.2	280.7	80.2	
	Minimum	52.6	29.8	14.4	0.7	25.1	0.7	266.2	76.1	

N-value: 14

Sample Interval Time: 19.45 seconds.

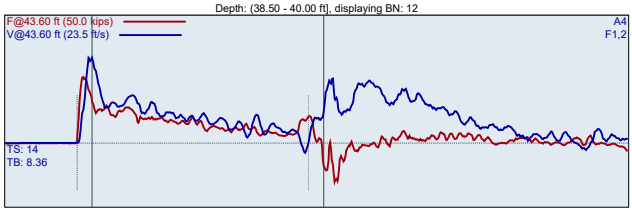
CME 55 (SN 72425)
REK
B-2

B-2
Interval start: 3/15/2021

AR: 1.19 in^2
LE: 43.60 ft
WS: 16807.9 ft/s

SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (38.50 - 40.00 ft], displaying BN: 12



F1 : [528AWJ1] 205.26 PDICAL (1) FF1
F2 : [528AWJ2] 205.86 PDICAL (1) FF1

A4 (PR): [K10960] 425.732 mv/6.4v/5000g (1) VF1

LP ft	BL#	BC /6"	BPM bpm	FMX kips	VMX ft/s	DMX in	CSX ksi	DFN in	EFV ft-lb	ETR %
38.75	1	2	1.9	28.2	15.4	3.0	23.7	3.0	268.1	76.6
39.00	2	2	49.0	28.2	15.3	3.0	23.7	3.0	268.0	76.6
39.10	3	5	52.2	28.2	15.3	1.7	23.7	1.2	272.0	77.7
39.20	4	5	54.0	27.8	14.8	1.4	23.3	1.2	267.5	76.4
39.30	5	5	54.2	27.8	15.1	1.4	23.4	1.2	274.2	78.4
39.40	6	5	54.7	27.7	14.9	1.2	23.2	1.2	270.1	77.2
39.50	7	5	54.4	26.9	14.6	1.2	22.6	1.2	271.3	77.5
39.57	8	7	54.4	26.4	14.4	0.9	22.2	0.9	271.2	77.5
39.64	9	7	53.9	26.6	14.2	0.9	22.4	0.9	269.2	76.9
39.71	10	7	54.1	25.9	15.2	0.9	21.8	0.9	276.1	78.9
39.79	11	7	54.2	26.3	15.8	0.9	22.1	0.9	292.8	83.7
39.86	12	7	54.4	25.8	15.7	0.9	21.7	0.9	284.2	81.2
39.93	13	7	54.5	26.1	15.8	0.9	21.9	0.9	289.7	82.8
40.00	14	7	54.3	26.3	16.7	0.9	22.1	0.9	285.7	81.6
		Average	54.1	26.8	15.2	1.1	22.5	1.0	277.0	79.1
		Std Dev	0.6	0.8	0.7	0.3	0.7	0.2	8.4	2.4
		Maximum	54.7	28.2	16.7	1.7	23.7	1.2	292.8	83.7
		Minimum	52.2	25.8	14.2	0.9	21.7	0.9	267.5	76.4

N-value: 12

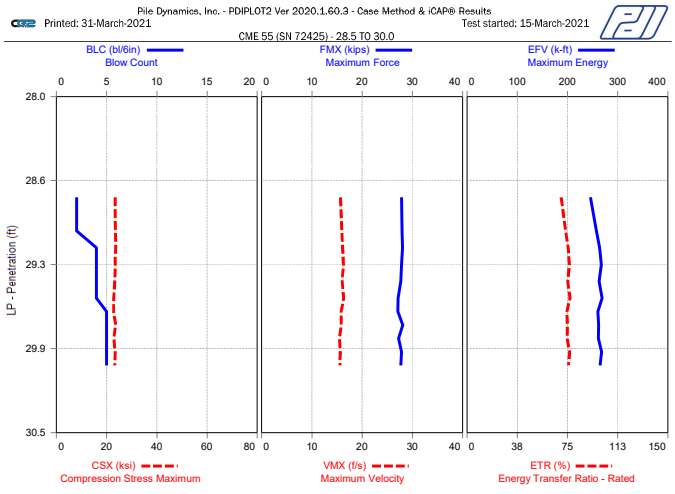
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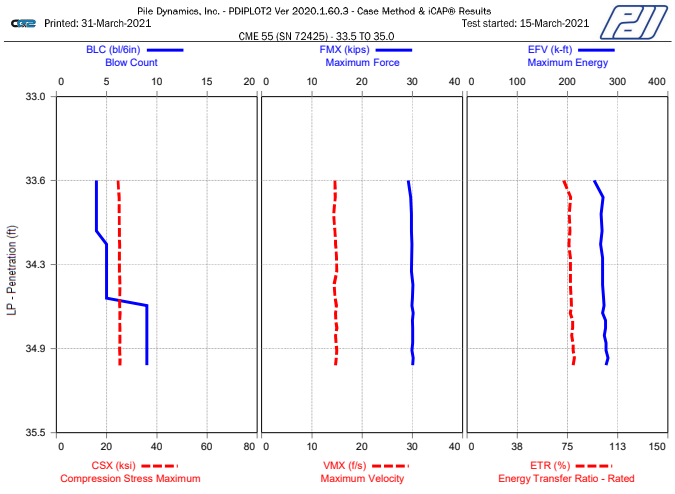
Summary of SPT Test Results

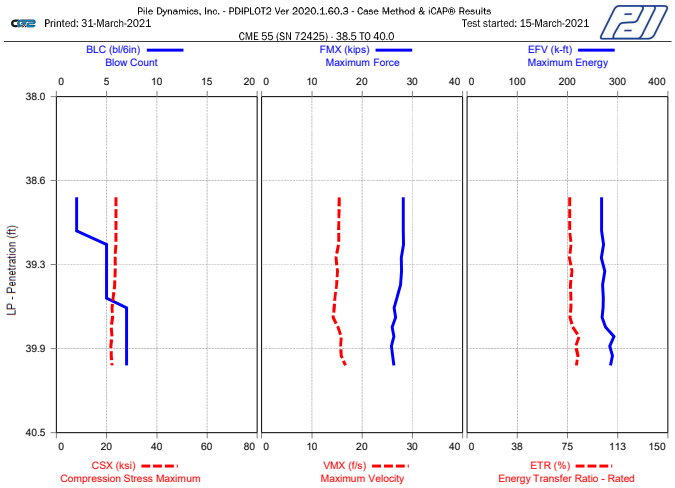
Project: CME 55 (SN 72425), Test Date: 3/15/2021

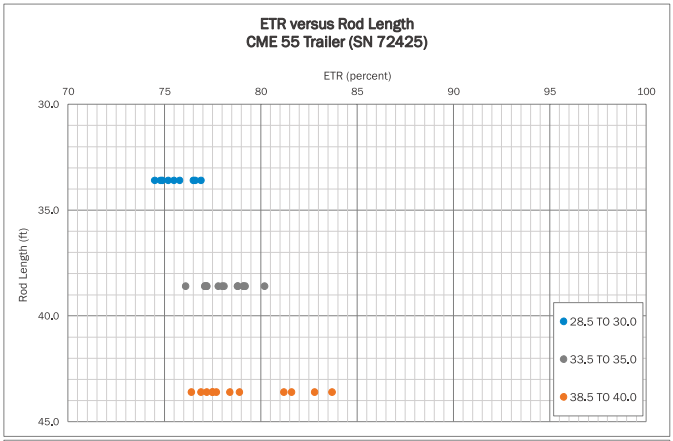
BPM: Blows/Minute
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement
CSX: Compression Stress Maximum
DFN: Final Displacement
EFV: Maximum Energy
ETR: Energy Transfer Ratio - Rated

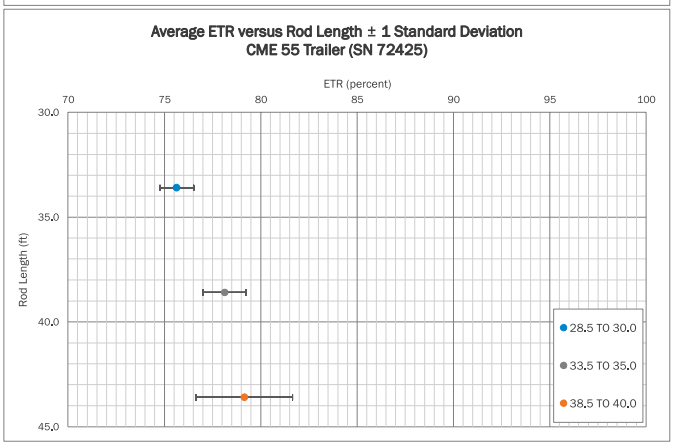
Instr. Length ft	Start Depth ft	Final Depth ft	Blows Applied /6"	N Value	N60 Value	Average BPM bpm	Average FMX kips	Average VMX ft/s	Average DMX in	Average CSX ksi	Average DFN in	Average EFV ft-lb	Average ETR %
33.60	28.50	30.00	**2-4-5**	**9**	**11**	51.0	27.6	15.9	1.5	23.2	1.3	264.7	75.6
38.60	33.50	35.00	**4-5-9**	**14**	**18**	53.0	30.0	14.8	0.9	25.2	0.9	273.4	78.1
43.60	38.50	40.00	**2-5-7**	**12**	**15**	54.1	26.8	15.2	1.1	22.5	1.0	277.0	79.1
					Overall Average Values:	52.9	28.3	15.2	1.1	23.8	1.0	272.4	77.8
					Standard Deviation:	1.4	1.5	0.6	0.3	1.3	0.3	7.4	2.1
					Overall Maximum Value:	54.7	30.2	16.7	2.1	25.4	1.5	292.8	83.7
					Overall Minimum Value:	48.2	25.8	14.2	0.7	21.7	0.7	260.8	74.5











APPENDIX II

SPT Hammer Energy Field Form

Project:	SPT HAMMER ENERGY	**Date:**	3/15/2021
Project No.:	240019016	**Weather:**	40's CLOUDY
Boring No.:	B-2	**Drill Rod Type:**	AWJ

On-site Personnel

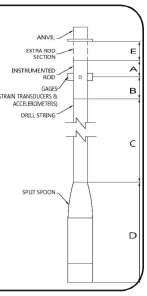
Drilling Company:	BRIDGER DRILLING
Rig Operator:	J. RADFORD
Engr/Geologist:	N/A
Client Rep.:	N/A
Analyzer Oper.:	R. KRAL

Rig/Hammer Info

Drill Rig Make/Model:	CME 55
Carrier Type:	TRAILER
Rig Serial No.:	72425
Hammer Type/Model:	CME
Hammer Serial No.:	N/A
Hammer Drop System:	AUTO
Lubrication Condition:	PER MANUFACTURER
Manufacturer Recommended	
Operation Rate (bpm):	55
Drop Height (in.):	30
Hammer Weight (lbs):	140
Anvil Dimension (in.):	11.5
Drilling Method:	2.25 HSA

Rod Info

(A + E) Impact Surface to Gages Length:	1.69	ft
(B) Instr. Rod Length below Gages:	0.70	ft
(A) + (B) Instr. Rod Length:	2.00	ft
(D) Spoon Length:	2.85	ft
(E) Rod Length Above Instr. Rod (if applicable):	0.39	ft
Instr. Rod S/N:	528AWJ	
Instr. Rod Outside Dia.:	1.75	in.
Instr. Rod Area:	1.20	in^2
PDA Make/Model:	SPT	
PDA Serial No.:	4549 TB	
Calib. Pulse Test (y/n):	Y	



Gage Info

Gage		Serial No.	Calibration No.
Accel.	A3		
	A4	K10960	425.7
Strain	F3	528AWJ-1	205.26
	F4	528AWJ-2	205.86

Date of Test	Test Depth Increment (ft to ft)	Test Time Start / Stop (military)	Length of Drill String (ft) *(C)*	(LE) Length below Gages (ft) *(B) + (C) + (D)*	Avg. Meas. Hammer Rate (BPM)	SPT Blow Counts 6"	12"	18"	N-Value	Drop Height in Tolerance (y/n)	Soil Class.
15-Mar	28.5 TO 30.0	0943/0943	30	33.6	51	2	4	5	9	Y	SA SI
15-Mar	33.5 TO 35.0	0948/0948	35	38.6	52	4	5	9	14	Y	SA SI
15-Mar	38.5 TO 40.0	0955/0955	40	43.6	54	2	5	7	12	Y	SA SI

Notes:
TESTING PERFORMED AT THE THE US 70 AND NC 42 INTERCHANGE IN CLAYTON, NORTH CAROLINA (JOHNSTON COUNTY). THE APPROXIMATE COORDINATES ARE 35.6236774, -78.5119757

NOTE: (1) Note any unusual hammer operating conditions that affect the hammer performance, or changes in operating conditions (e.g. veritcality, weather, or lubrication between trials). (2) Note any changes in rod diameter along drill string and record locations of short rod sections.

Digitally signed by: Robert E. Kral — 3/15/2021

Prepared By (print/signature) — Date



Figure No. 1: Rear View of Drill Rig



Figure No. 2: Side View of Drill Rig



Figure No. 3: Serial Number Plate (missing)



Figure No. 4: Automatic Hammer

APPENDIX III

Certificate of Calibration

Pile Dynamics, Inc. certifies that the

Pile Driving Analyzer®, Model SPT

Serial Number: 4549 TB

was calibrated on 5 February 2021

using a PDA Calibration Box whose output was calibrated with test equipment traceable to NIST.

This certificate is valid for 2 years from above date.

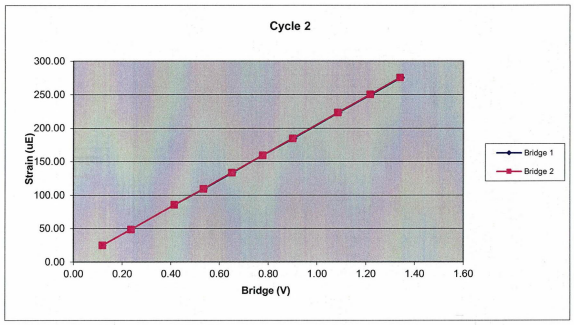
Tested by:

Pile Dynamics, Inc.
30725 Aurora Road
Cleveland, Ohio 44139 USA

528AWJ		Cycle 2		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	905.16	24.61	0.12	0.12
3	1753.20	48.18	0.24	0.24
4	3064.74	84.99	0.42	0.41
5	3947.87	108.99	0.54	0.53
6	4813.36	133.40	0.65	0.65
7	5727.49	159.02	0.78	0.78
8	6643.67	184.17	0.90	0.90
9	8004.82	222.89	1.09	1.09
10	8980.07	249.70	1.22	1.22
11	9885.91	275.04	1.35	1.34

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7340.27**	**Force Calibration (lb/V)**	**7362.32**
Offset	**12.98**	Offset	**13.21**
Correlation	**1.000000**	Correlation	**0.999999**
Strain Calibration (µE/V)	**204.74**	**Strain Calibration (µE/V)**	**205.35**
Offset	**-0.39**	Offset	**-0.39**
Correlation	**0.999993**	Correlation	**0.999995**

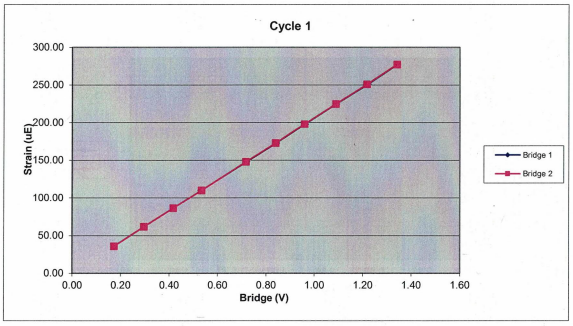
Force Strain Calibration	
EA (Kips)	**35851.72**
Offset	**27.08**
Correlation	**0.999996**



528AWJ		Cycle 1		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	1278.49	35.63	0.17	0.17
3	2188.92	61.59	0.30	0.30
4	3085.11	86.16	0.42	0.42
5	3944.56	110.01	0.53	0.54
6	5284.17	147.69	0.72	0.72
7	6199.57	172.59	0.84	0.84
8	7071.20	197.80	0.96	0.96
9	8023.54	224.47	1.09	1.09
10	8958.62	250.45	1.22	1.22
11	9876.55	276.81	1.34	1.34

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7346.16**	**Force Calibration (lb/V)**	**7359.87**
Offset	9.71	Offset	6.72
Correlation	0.999998	Correlation	0.999999
Strain Calibration (µE/V)	**205.65**	**Strain Calibration (µE/V)**	**206.03**
Offset	0.08	Offset	-0.01
Correlation	0.999990	Correlation	0.999993

Force Strain Calibration	
EA (Kips)	**35721.25**
Offset	7.11
Correlation	0.999990



Bridge Excitation (V) 5
Shunt Resitor (ohm) 60.4k

Calibration Factors	**528AWJ**		
Bridge 1 (µE/V)	**205.26**	**Bridge 2 (µE/V)**	**205.86**
EA Factor (Kips)	**35777.05**	**Area (in^2)**	**1.19**

Calibrated by: _____
Calibrated Date: 1/28/2021

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

Traceable to N.I.S.T.

Accelerometer Calibration Certificate
Pile Dynamics, Inc.

Calibrated by Pile Dynamics, Inc.
Calibration performed on 22Jan2021

Serial No: K10959 **Temperature:** 20.0 °C

Model: PR **Humidity:** 28%

Calibrated on: Channel 3 on 8G 5161 LE

Ref Acc 1: 63479! 1080 g's/volt **Cal on:** 09Sep2020

Ref Acc 2: 65538! 1040 g's/volt **Cal on:** 27Jan2020

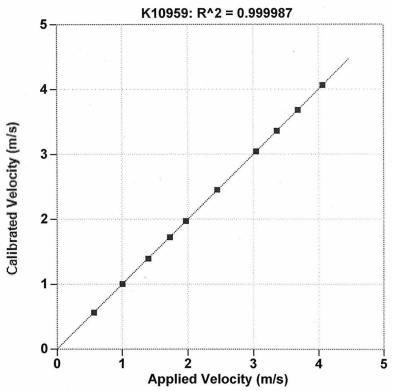
PDA CALIBRATION FACTOR

420.2 mv/5000g
(84.0 µv/g)
R^2: 0.999987 [Chip programmed]

Operator: William Johnson

Signed

Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).



Reference Velocity	S/N K10959 Velocity
m/s	m/s
0.568	0.562
1.006	1.005
1.400	1.393
1.728	1.724
1.969	1.972
2.447	2.453
3.043	3.044
3.359	3.359
3.683	3.682
4.063	4.062

Maximum Acceleration: 889 g's

Date printed: 22Jan2021, version: 2020.30.170 -5.29

Accelerometer Calibration Certificate
Pile Dynamics, Inc.

Calibrated by Pile Dynamics, Inc.
Calibration performed on 22Jan2021

Serial No: K10960 **Temperature:** 20.0 °C

Model: PR **Humidity:** 28%

Calibrated on: Channel 4 on 8G 5161 LE

Ref Acc 1: 63479! 1080 g's/volt **Cal on:** 09Sep2020

Ref Acc 2: 65538! 1040 g's/volt **Cal on:** 27Jan2020

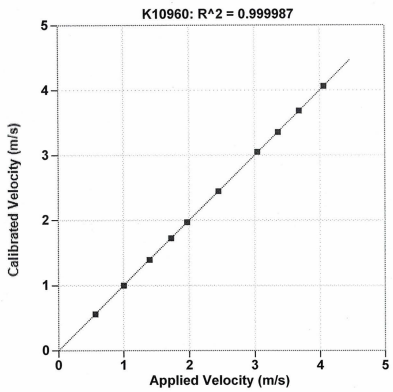
PDA CALIBRATION FACTOR

425.7 mv/5000g
(85.1 µv/g)
R^2: 0.999987 [Chip programmed]

Operator: William Johnson

Signed

Reference accelerometer calibrations are traceable to the United States National Institute of Standards and Technology (NIST).



Reference Velocity	S/N K10960 Velocity
m/s	m/s
0.568	0.564
1.006	1.001
1.400	1.393
1.728	1.726
1.969	1.970
2.447	2.448
3.043	3.051
3.359	3.356
3.683	3.684
4.063	4.062

Maximum Acceleration: 889 g's

Date printed: 22Jan2021, version: 2020.30.170 -6.04

APPENDIX IV

PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

Pile Dynamics, Inc.

This documents that

Robert E. Kral
Carolinas Geotechnical Group

has on May 20, 2016 achieved the rank of

ADVANCED

on the **Dynamic Measurement and Analysis Proficiency Test**.

The individual identified on this document demonstrated to the degree granted above an understanding of theory, data quality evaluation, interpretation and signal matching for high strain dynamic testing of deep foundations. ***It is recommended*** **that Individuals at the Advanced level seek Master or Expert levels through additional study within six years of the date of this document.**

The ability of the individual named to provide appropriate knowledge and advice on a specific project is not implied or warranted by the Pile Driving Contractors Association or Pile Dynamics, Inc. **This certificate can be verified at www.PDAproficiencytest.com.** The Pile Driving Contractors Association or Pile Dynamics, Inc. assumes no liability for foundation testing and analysis work performed by the bearer of this certificate.

Steven A. Hall, Executive Director
Pile Driving Contractors Association

Garland Likins, Senior Partner
Pile Dynamics, Inc.

No. 2072

DRILL RIG SPT HAMMER ENERGY CALIBRATION REPORT

Drill Rig Model CME 45C SN: 288284

February 17, 2021
Terracon Project No. EN175299

Prepared for:
Santee Cooper
Moncks Corner, SC

Prepared by:
Terracon Consultants, Inc.
North Charleston, South Carolina

Offices Nationwide Established in 1965
Employee-Owned terracon.com
Terracon
Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

February 17, 2021

Santee Cooper
1 Riverwood Drive
Moncks Corner, SC 29461

Attn: Mr. John Browning
E: john.browning@santeecooper.com

Re: SPT Hammer Energy Calibration Report
CME 45C, SN:288284
Terracon Project Number: EN215011

Dear Mr. Browning:

The North Charleston office of Terracon Consultants, Inc. has completed the SPT rig calibration for the above reference rig. This report provides the Energy Transfer Ration (ETR) for the SPT hammer found on drill rig model CME 45C (Serial Number 288284) operated by Carolina Drilling Company.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

Ryan Wakeford, E.I.T.
Staff Engineer

Will Botts, P.E.
Project Geotechnical Engineer

Attachments:

Exhibit A-1: Representative Blow
Exhibit A-2: PDA Equipment Calibrations
Exhibit A-3: SPT Calibration Data Plots and Tables
Exhibit A-4: Field Log

Terracon Consultants, Inc. 1450 Fifth Street West North Charleston, South Carolina 29405
P [843] 884 1234 F [843] 884 9234 terracon.com

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

1.0 PROJECT INFORMATION

ITEM	DESCRIPTION
Drill Rig Identification	CME 45C SN: 288284
Drill Rig Owner	Carolina Drilling Company
Drill Rig Operator	M. Radford
Testing Date	February 9, 2021
Testing Location	Conway, SC
Boring Identification	BVB-101
Energy Measurement Depths	40 ft; 45 ft; 50 ft
Hammer Type	Automatic
Boring Method	Mud Rotary
Drill Rods	■AWJ ■1¾" outside diameter ■3/16" wall thickness
SPT Calibration Testing Equipment	■2 foot AWJ rod instrumented w/ 2 strain gauges and 2 accelerometers ■Model PAX Pile Driving Analyzer™ (PDA)
ASTM Methods Used	**ASTM D1586-18** – Standard Test Method for Standard Penetration Test and Split Barrel Sampling of Soils **ASTM D4633-16** – Standard Methods for Energy Measurement for Dynamic Penetrometers
SPT Calibration Personnel	R. Wakeford

2.0 TEST RESULTS

Table 1: SPT Hammer Energy Calibration Testing Summary

Boring	Start Depth[1] (ft)	Rod Length[2] (ft)	Rod Sections[3] 2 ft	5 ft	10 ft	Measured Blow Counts (blows/6 inches) 1st Inc.	2nd Inc.	3rd Inc.	4th Inc.	SPT N_{meas} (bpf)	Soil Type[4]
BVB-101	38.5	43.6	0	0	4	4	4	5	-	9	SP
	43.5	48.6	0	1	4	5	6	5	-	11	SM
	48.5	53.6	0	0	5	4	6	5	-	11	SM

1. Depth from existing ground surface to start of SPT
2. Total rod length from instrumentation to bottom of sampler
3. Two-foot section is instrumented and is located at top of drill rods
4. Soil type provided by Black & Veatch personnel

Drill Rig SPT Hammer Energy Calibration Report
CME 45C, SN: 288284 ■ Conway, SC
February 17, 2021 ■ Terracon Project No. EN215011

Table 2: Energy Measurement and Analysis Summary

Boring	Start Depth[1] (ft)	SPT N_m (bpf)	No. of Blows[2]	EMX[3] (kip-ft) Max.	Min.	Ave.	Std. Dev.	ETR[3] (%) Ave.	Std. Dev.
BVB-101	38.5	9	9	0.30	0.28	0.29	0.007	82.3	2.066
	43.5	11	11	0.29	0.27	0.28	0.005	80.5	1.408
	48.5	11	11	0.30	0.29	0.29	0.004	83.4	1.114
	Average:			**0.30**	**0.28**	**0.29**	**0.005**	**82.1**	**1.529**

1. Boring ID and depth from existing ground surface to start of SPT
2. Number of blows used in energy calibration analysis; limited to measurements recorded during the second and third 6-inch sampling intervals at each depth or during the first increment if refusal were encountered
3. EMX = Maximum Transferred Energy, ETR = Energy Transfer Ratio.

Table 3: Hammer Blow Rate Summary

Boring	Start Depth[1] (ft)	SPT N_{meas} (bpf)	No. of Blows[2]	BPM[3] Max.	Min.	Ave.	Std. Dev.
BVB-101	38.5	9	9	47.5	36.7	46.2	3.345
	43.5	11	11	47.4	47.2	47.3	0.060
	48.5	11	11	47.3	47.1	47.2	0.079
	Average:			**47.4**	**43.7**	**46.9**	**1.161**

1. Boring ID and depth from existing ground surface to start of SPT.
2. Number of blows used in energy calibration analysis. Limited to measurements recorded during the second and third 6-inch sampling intervals at each depth or during the 1st increment if refusal conditions were encountered.
3. BPM = Blows per minute

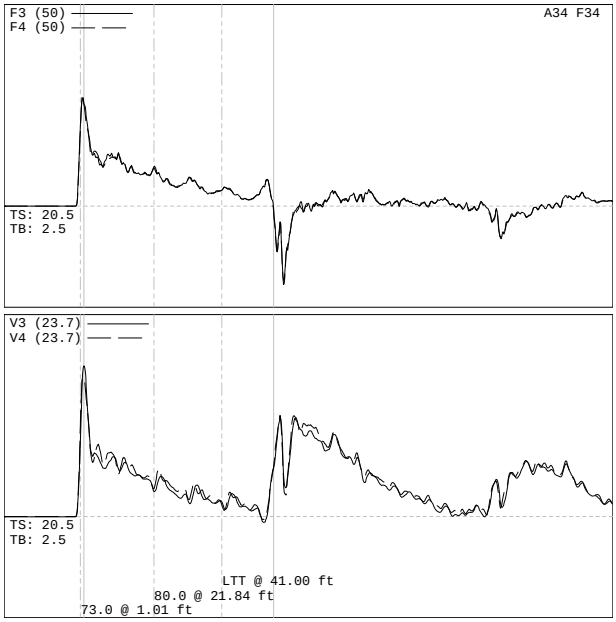
3.0 CONCLUSIONS

3.1 Energy Transfer Ratio (ETR) and Hammer Efficiency Correction (CE)

Based on our testing and subsequent analysis, drill rig CME 45C (Serial No. 288284) has an **ETR** of **82.1% ± 1.53%.** Based on this ETR, the hammer efficiency correction (C_E) is **1.37**.

Exhibit A-1 Representative Blow

HORRY GENERATOR CME 45C 288284 48.5-50



Project Information
PROJECT: HORRY GENERATOR
PILE NAME: CME 45C 288284 48.5-50
DESCR: BVB-101 48.5-50
OPERATOR: RW
FILE: CME 45C 288284_50.W01
2/9/2021 2:13:54 PM
Blow Number 13

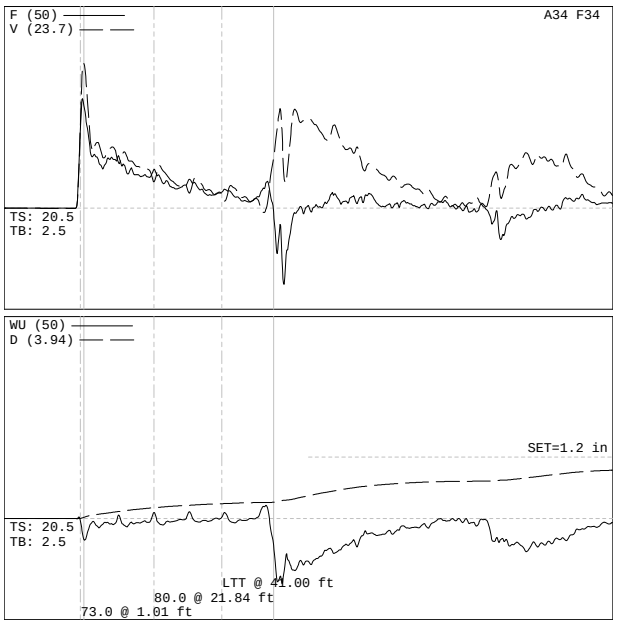
Pile Properties
LE 53.60 ft
AR 1.18 in^2
EM 30000 ksi
SP 0.492 k/ft3
WS 16807.9 f/s
EA/C 2.1 ksec/ft
2L/C 6.38 ms
JC []
LP 49.80 ft

Quantity Results
ETR 82.4 (%)
CSX 23.00 ksi
CSB 0.00 ksi
BPM 47.3 bpm
EMX 0.288 k-ft
DMX 1.20 in
FMX 27 kips
TSX 15.93 ksi
VMX 17.0 f/s

Sensors
F3: [AWJ1] 214.27 (1)
F4: [AWJ2] 213.26 (1)
A3: [K0170] 358 mv/5000g's (1)
A4: [K1845] 352 mv/5000g's (1)
CLIP: OK

Terracon Pile Driving Analyzer ®

HORRY GENERATOR CME 45C 288284 48.5-50



Project Information
PROJECT: HORRY GENERATOR
PILE NAME: CME 45C 288284 48.5-50
DESCR: BVB-101 48.5-50
OPERATOR: RW
FILE: CME 45C 288284_50.W01
2/9/2021 2:13:54 PM
Blow Number 13

Pile Properties
LE 53.60 ft
AR 1.18 in^2
EM 30000 ksi
SP 0.492 k/ft3
WS 16807.9 f/s
EA/C 2.1 ksec/ft
2L/C 6.38 ms
JC []
LP 49.80 ft

Quantity Results
ETR 82.4 (%)
CSX 23.00 ksi
CSB 0.00 ksi
BPM 47.3 bpm
EMX 0.288 k-ft
DMX 1.20 in
FMX 27 kips
TSX 15.93 ksi
VMX 17.0 f/s

Sensors
F3: [AWJ1] 214.27 (1)
F4: [AWJ2] 213.26 (1)
A3: [K0170] 358 mv/5000g's (1)
A4: [K1845] 352 mv/5000g's (1)
CLIP: OK

Version 2016.125

Exhibit A-2 PDA Equipment Calibrations

Responsive ■ Resourceful ■ Reliable

Certificate of Calibration

Pile Dynamics, Inc. certifies that the

Pile Driving Analyzer®, Model PAX

Serial Number: 3799L

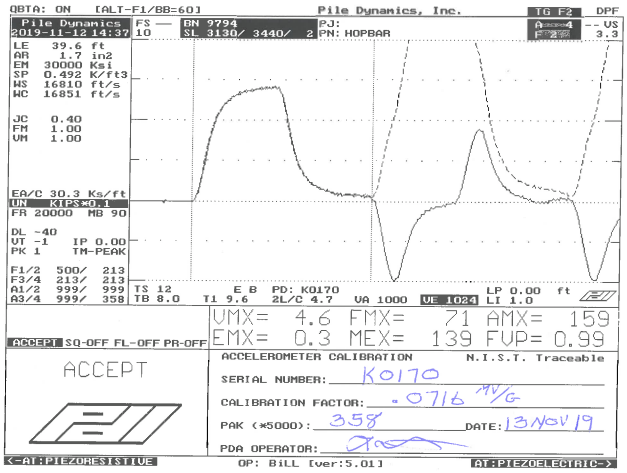
was calibrated on 20 March 2019

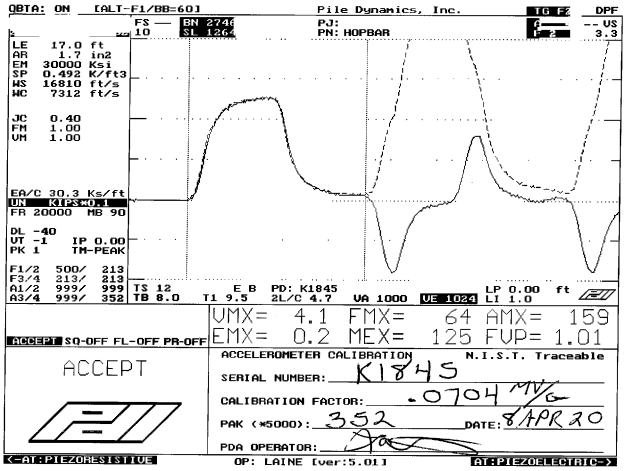
using a PDA Calibration Box whose output was calibrated with test equipment traceable to NIST.

This certificate is valid for 2 years from above date.

Tested by:

Pile Dynamics, Inc.
30725 Aurora Road
Cleveland, Ohio 44139 USA

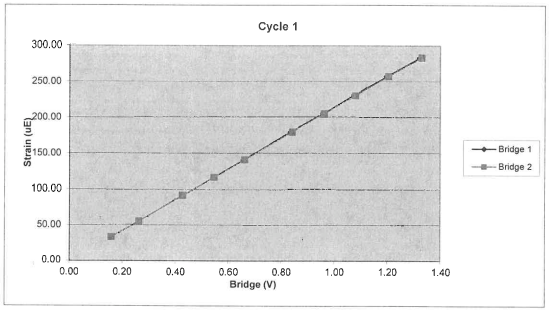




267AWJ		Cycle 1		
Sample	Force (lb)	Strain (µE)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	1185.93	33.46	0.16	0.16
3	1975.70	55.33	0.26	0.26
4	3221.76	91.37	0.43	0.43
5	4126.53	116.53	0.54	0.54
6	5001.62	141.09	0.66	0.66
7	6348.23	179.69	0.84	0.84
8	7281.71	205.20	0.96	0.96
9	8178.08	230.56	1.07	1.08
10	9120.73	257.36	1.20	1.20
11	10066.31	283.31	1.32	1.33

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7619.27	Force Calibration (lb/V)	7576.58
Offset	-16.52	Offset	-5.55
Correlation	0.999999	Correlation	0.999998
Strain Calibration (µE/V)	214.68	Strain Calibration (µE/V)	213.47
Offset	-0.29	Offset	0.02
Correlation	0.999990	Correlation	0.999994

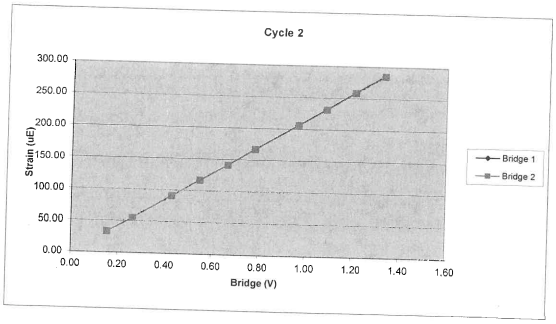
Force Strain Calibration	
EA (Kips)	35491.24
Offset	-6.25
Correlation	0.999991



267AWJ		Cycle 2		
Sample	Force (lb)	Strain (με)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	1165.23	32.98	0.15	0.15
3	1972.96	54.98	0.26	0.26
4	3231.91	90.92	0.43	0.43
5	4136.09	116.35	0.55	0.55
6	5036.96	141.13	0.67	0.67
7	5913.62	166.68	0.78	0.78
8	7318.02	205.91	0.96	0.97
9	8215.76	231.44	1.08	1.09
10	9148.46	258.22	1.21	1.21
11	10113.36	284.77	1.33	1.34

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7594.79	Force Calibration (lb/V)	7569.95
Offset	-10.81	Offset	-4.32
Correlation	0.999999	Correlation	0.999999
Strain Calibration (με/V)	214.25	Strain Calibration (με/V)	213.55
Offset	-0.66	Offset	-0.47
Correlation	0.999990	Correlation	0.999992

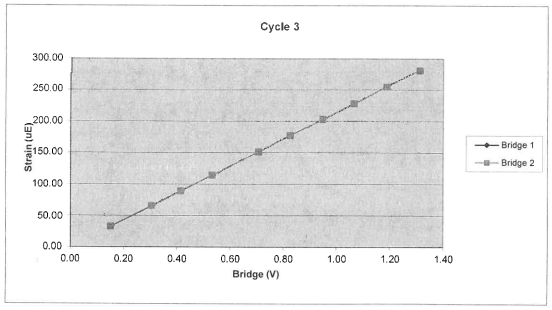
Force Strain Calibration	
EA (Kips)	35447.18
Offset	12.60
Correlation	0.999992



267AWJ		Cycle 3		
Sample	Force (lb)	Strain (με)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	1140.04	32.81	0.15	0.15
3	2309.37	65.61	0.31	0.30
4	3144.05	89.46	0.41	0.41
5	4038.08	114.56	0.53	0.53
6	5354.63	151.41	0.71	0.71
7	6257.05	177.29	0.82	0.82
8	7194.24	203.03	0.95	0.95
9	8086.51	228.12	1.06	1.07
10	9013.74	254.69	1.19	1.19
11	9964.58	280.94	1.31	1.31

Bridge 1		Bridge 2	
Force Calibration (lb/V)	7603.34	Force Calibration (lb/V)	7583.97
Offset	-10.81	Offset	4.25
Correlation	1.000000	Correlation	0.999999
Strain Calibration (με/V)	213.89	Strain Calibration (με/V)	213.35
Offset	0.54	Offset	0.96
Correlation	0.999996	Correlation	0.999997

Force Strain Calibration	
EA (Kips)	35547.12
Offset	-29.92
Correlation	0.999996



Bridge Excitation (V) 5
Shunt Resitor (ohm) 60.4k

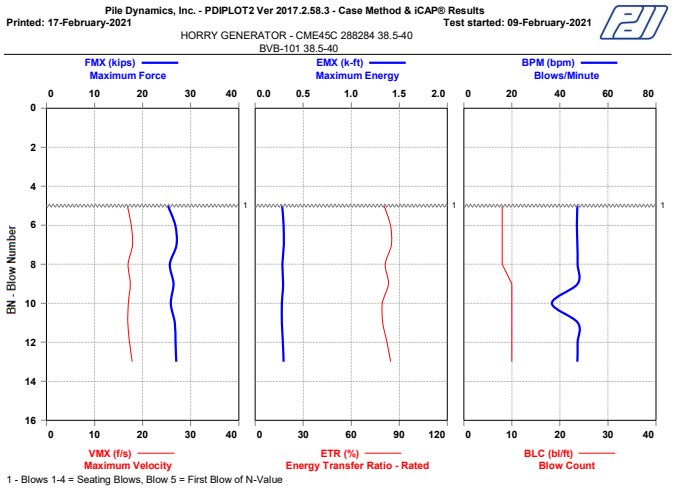
Calibration Factors	267AWJ		
Bridge 1 (με/V)	214.27	Bridge 2 (με/V)	213.46
EA Factor (Kips)	35495.18	Area (in^2)	1.18

Calibrated by: David Rausch
Calibrated Date: 3/18/2019

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

Traceable to N.I.S.T.

Exhibit A-3 SPT Calibration Data Plots and Tables



1 - Blows 1-4 = Seating Blows, Blow 5 = First Blow of N-Value

HORRY GENERATOR - CME45C 288284 38.5-40 BVB-101 38.5-40
OP: RW Date: 09-February-2021
AR: 1.18 in² SP: 0.492 k/ft³
LE: 43.60 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute
DMX: Maximum Displacement
CSX: Compression Stress Maximum

BL#	Depth ft	BLC bl/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
5	39.13	8	25	16.8	0.282	80.484	47.300	1.53	21.4
6	39.25	8	27	17.6	0.296	84.460	47.100	1.57	22.7
7	39.38	8	27	17.9	0.298	85.061	47.300	1.51	22.9
8	39.50	8	26	17.0	0.284	81.226	47.400	1.50	21.8
9	39.60	10	26	17.4	0.291	83.149	47.400	1.28	22.4
10	39.70	10	26	17.0	0.278	79.421	36.700	1.20	21.9
11	39.80	10	27	16.9	0.279	79.606	47.500	1.20	22.6
12	39.90	10	27	17.3	0.288	82.274	47.400	1.20	22.8
13	40.00	10	27	17.8	0.296	84.627	47.300	1.20	22.9
	Average		26	17.3	0.288	82.256	46.156	1.35	22.4
	Std. Dev.		1	0.4	0.007	2.066	3.345	0.16	0.5
	Maximum		27	17.9	0.298	85.061	47.500	1.57	22.9
	Minimum		25	16.8	0.278	79.421	36.700	1.20	21.4

Total number of blows analyzed: 9

BL# Sensors

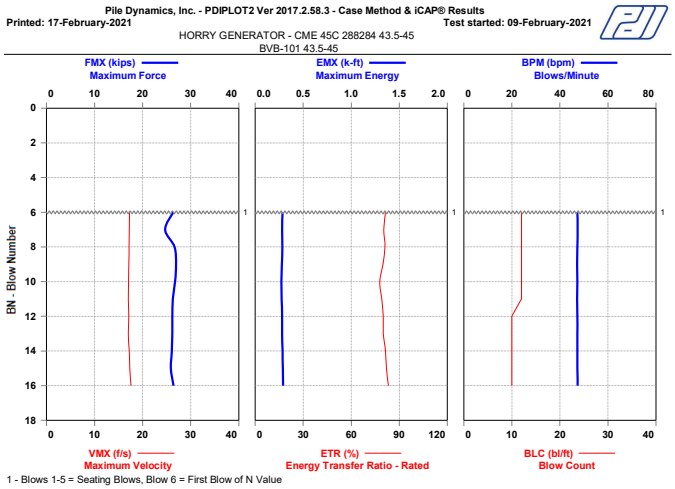
5-13 F3: [AWJ1] 214.3 (1.00); F4: [AWJ2] 213.3 (1.00); A3: [K0170] 358.0 (1.00); A4: [K1845] 352.0 (1.00)

BL# Comments

5 Blows 1-4 = Seating Blows, Blow 5 = First Blow of N-Value

Time Summary

Drive 15 seconds 1:53 PM - 1:53 PM BN 1 - 13



1 - Blows 1-5 = Seating Blows, Blow 6 = First Blow of N Value

HORRY GENERATOR - CME 45C 288284 43.5-45 BVB-101 43.5-45
OP: RW Date: 09-February-2021
AR: 1.18 in² SP: 0.492 k/ft³
LE: 48.60 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.00

FMX: Maximum Force
VMX: Maximum Velocity
EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated
BPM: Blows/Minute
DMX: Maximum Displacement
CSX: Compression Stress Maximum

BL#	Depth ft	BLC bl/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
6	44.08	12	26	17.3	0.285	81.393	47.300	1.12	22.4
7	44.17	12	25	17.2	0.281	80.324	47.400	1.15	20.9
8	44.25	12	27	17.2	0.284	81.053	47.300	1.16	22.6
9	44.33	12	27	17.1	0.279	79.765	47.200	1.08	22.8
10	44.42	12	27	17.1	0.272	77.773	47.300	1.05	22.7
11	44.50	12	26	17.0	0.277	79.000	47.200	1.17	22.3
12	44.60	10	26	17.1	0.280	79.987	47.300	1.20	22.2
13	44.70	10	26	17.0	0.280	80.029	47.300	1.20	22.2
14	44.80	10	26	17.2	0.285	81.303	47.300	1.20	22.1
15	44.90	10	26	17.3	0.287	82.018	47.300	1.20	21.9
16	45.00	10	26	17.6	0.291	83.151	47.400	1.20	22.4
	Average		26	17.2	0.282	80.527	47.300	1.16	22.2
	Std. Dev.		1	0.2	0.005	1.408	0.060	0.05	0.5
	Maximum		27	17.6	0.291	83.151	47.400	1.20	22.8
	Minimum		25	17.0	0.272	77.773	47.200	1.05	20.9

Total number of blows analyzed: 11

BL# Sensors

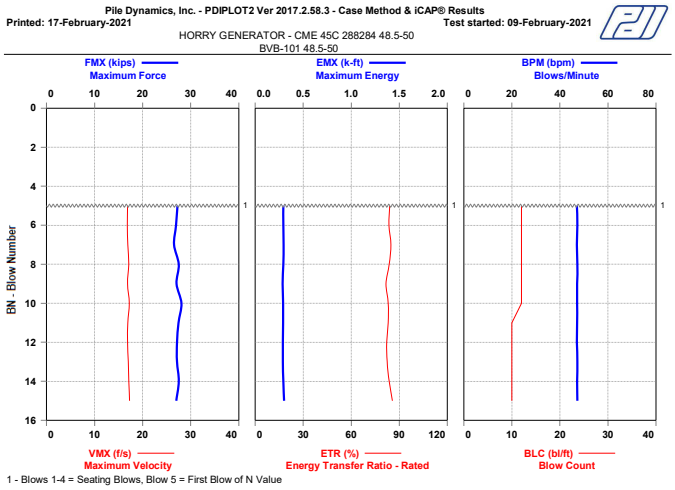
6-16 F3: [AWJ1] 214.3 (1.00); F4: [AWJ2] 213.3 (1.00); A3: [K0170] 358.0 (1.00); A4: [K1845] 352.0 (1.00)

BL# Comments

6 Blows 1-5 = Seating Blows, Blow 6 = First Blow of N Value

Time Summary

Drive 18 seconds 2:01 PM - 2:02 PM BN 1 - 16



Pile Dynamics, Inc. — Page 1
Case Method & iCAP® Results — PDIPLOT2 2017.2.58.3 - Printed 17-February-2021

HORRY GENERATOR - CME 45C 288284 48.5-50 — BVB-101 48.5-50
OP: RW — Date: 09-February-2021
AR: 1.18 in² — SP: 0.492 k/ft³
LE: 53.60 ft — EM: 30,000 ksi
WS: 16,807.9 f/s — JC: 0.00

FMX: Maximum Force — BPM: Blows/Minute
VMX: Maximum Velocity — DMX: Maximum Displacement
EMX: Maximum Energy — CSX: Compression Stress Maximum
ETR: Energy Transfer Ratio - Rated

BL#	Depth ft	BLC bl/ft	FMX kips	VMX f/s	EMX k-ft	ETR (%)	BPM bpm	DMX in	CSX ksi
5	49.08	12	27	16.9	0.294	83.997	47.100	1.17	23.1
6	49.17	12	27	16.8	0.292	83.549	47.300	1.20	22.8
7	49.25	12	27	16.9	0.297	84.782	47.100	1.09	22.5
8	49.33	12	28	17.1	0.293	83.705	47.300	1.09	23.3
9	49.42	12	27	16.8	0.286	81.706	47.200	1.05	22.9
10	49.50	12	28	17.2	0.291	83.098	47.200	1.06	23.8
11	49.60	10	27	16.9	0.290	82.998	47.200	1.20	23.3
12	49.70	10	27	16.8	0.287	82.127	47.100	1.20	23.0
13	49.80	10	27	17.0	0.288	82.396	47.300	1.20	23.0
14	49.90	10	28	17.1	0.293	83.679	47.200	1.20	23.3
15	50.00	10	27	17.3	0.300	85.735	47.300	1.20	22.9
	Average		27	17.0	0.292	83.434	47.209	1.15	23.1
	Std. Dev.		0	0.2	0.004	1.114	0.079	0.06	0.3
	Maximum		28	17.3	0.300	85.735	47.300	1.20	23.8
	Minimum		27	16.8	0.286	81.706	47.100	1.05	22.5

Total number of blows analyzed: 11

BL# Sensors

5-15 F3: [AWJ1] 214.3 (1.00); F4: [AWJ2] 213.3 (1.00); A3: [K0170] 358.0 (1.00); A4: [K1845] 352.0 (1.00)

BL# Comments

5 Blows 1-4 = Seating Blows, Blow 5 = First Blow of N Value

Time Summary

Drive 17 seconds 2:13 PM - 2:13 PM BN 1 - 15

Exhibit A-4 Field Log

Terracon

ARRIVAL TIME: 10:30
DEPART TIME:
TOTAL TRAVEL:
TOTAL TIME:
CLIENT REP:
MILEAGE:

SPT HAMMER CALIBRATION FIELD WORKSHEET

PROJECT NAME: Horry Generator Project
PROJECT NO.: EN215011
BORING NO.: B-101
CLIENT: Carolina Drilling
DATE: 2/9
TERRACON REP: R. Wakeford
PDA MODEL/SN: PAX 3779
TERRACON RIG # DR#: N/A

DRILL RIG DATA

Type/Transport: Track
Manufacturer: CME
Model No.: 45C
Serial No: 288284
Year Built: 1998 10/15/98
Modifications: N/A
Maint. Schedule: N/A

SPT HAMMER DATA

Type: Auto
Manufacturer: CME
Lifting Mechanism: Chain
Model No.: —
Serial No: —
Hammer Weight: 140 lbs
Hammer Operator(s): M. Rafford

PDA INPUT DATA

Operator:	OP	RW	Elastic Modulus (ksi):	EM	3000
Project No./Location:	PJ	EN215011 Conway, SC	Specific Weight (kips/ft³):	SP	0.492
Rig Model & SN:	PN	ME 45C 288284	Wave Speed (ft/sec):	WS	16808
Hammer Type, LM, Rods:	PD	Auto/Cas.	Increment Length (ft):	LI	0.5
Drill Rod Area (in²):	AR	1.18	Sampling Freq. (kHz):	FR	50

TRANSDUCER INFORMATION

Gage	SN	Calibration
F1/F3:	AWJ1	214.27
F2/F4:	AWJ2	213.46
A1/A3:	K0170	358
A2/A4:	K1845	352

NOTES: Instrumentation to Bottom of Rod Length
34.25" Inches — 285' Feet
SPLIT SPOON SAMPLER LENGTH: 34.25" → 2.85'
Guage to Bottom of Cal. Rod length: 10" → 0.83'
¹ LE is Measured from the Center of the Strain Guages to the bottom of Split Spoon Sampler

SPT TESTING INFORMATION

Start Time	Soil	Stick Up Length (ft)	Depth (ft) Start	Depth (ft) End	¹LE (ft)	Rods & Lengths	PDA Blows Start	PDA Blows End	SPT Blows 1st 6"	2nd 6"	3rd 6"	4th 6"
						2ft 5ft 10ft						N
1:36	Silty Sand		28.5	30	33.6	2ft 5ft 3X10ft	1	10	2	4	3	7
1:43	Silty Sand		33.5	35	38.6	2ft 1X5ft 3X10ft	1	11	3	4	3	7
1:53	Sand		38.5	40	43.6	2ft 5ft 4X10ft	1	14	4	4	5	9
2:07	Silty Sand		43.5	45	48.6	2ft 1X5ft 4X10ft	1	17	5	6	5	11
2:13	Silty Sand		48.5	50	53.6	2ft 5ft 5X10ft	1	16	4	6	5	11
						2ft 5ft 10ft						
						2ft 5ft 10ft						
						2ft 5ft 10ft						

Individual pairs of F or V signals versus time shall be very similar for good quality data.
If you see Force goes negative before 2L/C after impact, drill rod joints should be carefully tightened for good quality data

PICTURE NUMBERS AND INFO: Take Photo of Each Rigs, Boring Locations at the Site
Drilling Method: (ie. Hollow Stem Augers, Mud Rotary....)

Terracon SPT Rig Calibration Worksheet.xlsx

APPENDIX B – LABORATORY TEST RESULTS

Exhibit B-1	Laboratory Testing Summary
Exhibit B-2	Laboratory Testing Description
Exhibit B-3	Laboratory Test Results

APPENDIX B

EXHIBIT B-1: LABORATORY TESTING SUMMARY

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LAB SUMMARY-LANDSCAPE_A EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT

SUMMARY OF LABORATORY RESULTS

BORING ID	Depth (Ft.)	Soil Classification USCS & AASHTO	Liquid Limit	Plastic Limit	Plasticity Index	Water Content (%)	% Fines
BS-BULK1	0-4	SILTY SAND(SM) / A-2-4 (0)	NP	NP	NP	13.1	20.7
BS-BULK2	0-4	SILTY SAND(SM) / A-2-4 (0)	NP	NP	NP	10.9	16.4
BS-STB01	13.5-15	SILTY SAND(SM) / A-2-4 (0)	NP	NP	NP	13.1	20.7
BS-STB01	18.5-20	CLAYEY SAND(SC) / A-2-4 (0)	21	12	9	18.5	24.0
BS-STB01	23.5-25	POORLY GRADED SAND with SILT(SP-SM) / A-3 (0)	NP	NP	NP	21.6	5.3
BS-STB01	28.5-30	POORLY GRADED SAND with SILT(SP-SM) / A-3 (0)	NP	NP	NP	18.1	6.4
BS-STB01	38.5-40	POORLY GRADED SAND(SP) / A-3 (0)	NP	NP	NP	20.5	3.5
BS-STB01	48.5-50	CLAYEY SAND(SC) / A-7-6 (5)	54	26	28	47.6	39.1
BS-STB01	58.5-60	CLAYEY SAND(SC) / A-7-6 (10)	59	26	33	41.7	45.2
BS-STB01	63.5-65	SANDY FAT CLAY(CH) / A-7-6 (23)	70	29	41	63.3	59.7
BS-STB01	78.5-80	SILTY SAND(SM) / A-7-5 (7)	64	32	32	51.2	39.2
BS-STB01	83.5-85	ELASTIC SILT(MH) / A-7-5 (68)	106	44	62	74.9	90.3
BS-STB03	13.5-15	SILTY, CLAYEY SAND(SC-SM) / A-4 (0)	22	15	7	29.2	40.2
BS-STB03	18.5-20	SANDY LEAN CLAY(CL) / A-6 (9)	38	17	21	38.9	58.5
BS-STB03	23.5-25	SILTY SAND(SM) / A-2-4 (0)	NP	NP	NP	24.4	18.1
BS-STB03	33.5-35	POORLY GRADED SAND(SP) / A-3 (0)	NP	NP	NP	19.7	4.1
BS-STB03	43.5-45	CLAYEY SAND(SC) / A-2-6 (1)	39	24	15	38.9	25.2
BS-STB03	48.5-50	CLAYEY SAND(SC) / A-7-6 (3)	51	28	23	45.7	36.1
BS-STB03	58.5-60	SANDY FAT CLAY(CH) / A-7-5 (32)	82	31	51	60.1	64.4
BS-STB03	68.5-70	FAT CLAY with SAND(CH) / A-7-5 (32)	74	30	44	57.0	70.1
BS-STB03	73.5-75	SANDY ELASTIC SILT(MH) / A-7-5 (30)	88	42	46	58.8	63.9
BS-STB03	88.5-90	SANDY FAT CLAY(CH) / A-7-6 (28)	77	26	51	53.2	60.4
BS-STB13	6-8	SILTY SAND(SM) / A-2-4 (0)	NP	NP	NP	29.1	12.7
BS-STB13	8-10	POORLY GRADED SAND with SILT(SP-SM) / A-2-4 (0)	NP	NP	NP	26.8	11.7
BS-STB13	18.5-20	POORLY GRADED SAND(SP) / A-3 (0)	NP	NP	NP	29.7	4.3
BS-STB13	28.5-30	CLAYEY SAND(SC) / A-2-6 (1)	39	21	18	37.4	31.0
BS-STB13	38.5-40	CLAYEY SAND(SC) / A-7-6 (5)	46	25	21	43.6	43.0
BS-STB13	48.5-50	SANDY FAT CLAY(CH) / A-7-5 (16)	70	32	38	48.8	52.0

PROJECT: I-95 Bridge Replacements - Jasper County

SITE: Bagshaw Swamp
Hardeeville, SC

Terracon
1450 Fifth St W
North Charleston, SC
PH. 843-884-1234 FAX. 843-884-9234

PROJECT NUMBER: EN175299

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

EXHIBIT: B-1

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LAB SUMMARY-LANDSCAPE_A EN175299 I-95 BRO SC-46 BAGSHAW LAB CPT.GPJ TERRACON_DATATEMPLATE.GDT

SUMMARY OF LABORATORY RESULTS

BORING ID	Depth (Ft.)	Soil Classification USCS & AASHTO	Liquid Limit	Plastic Limit	Plasticity Index	Water Content (%)	% Fines
BS-STB13	53.5-55	ELASTIC SILT with SAND(MH) / A-7-5 (12)	51	37	14	61.8	71.7
BS-STB13	63.5-65	SANDY ELASTIC SILT(MH) / A-7-5 (20)	72	41	31	59.9	62.0
BS-STB13	73.5-75	ELASTIC SILT(MH) / A-7-5 (37)	76	42	34	55.4	87.5
BS-STB13	78.5-80	ELASTIC SILT(MH) / A-7-5 (54)	93	52	41	55.3	97.1
BS-STB13	93.5-95	ELASTIC SILT(MH) / A-7-5 (63)	110	67	43	107.9	98.7

PROJECT: I-95 Bridge Replacements - Jasper County

SITE: Bagshaw Swamp
Hardeeville, SC

Terracon
1450 Fifth St W
North Charleston, SC
PH. 843-884-1234 FAX. 843-884-9234

PROJECT NUMBER: EN175299

CLIENT: Infrastructure Consulting & Engineering, LLC
Columbia, SC

EXHIBIT: B-2

APPENDIX B

EXHIBIT B-2: LABORATORY TESTING DESCRIPTION

Laboratory Testing Procedures

Grain Size Distribution

Grain size distribution testing has been conducted following *ASTM D422 Standard Test Method for ParticleSize Analysis of Soils and D6913 Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.*

Atterberg Limits

Determination of the Atterberg Limits has been conducted following *ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.*

Moisture Content

Moisture content testing has been conducted following *ASTM D2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.*

Consolidated-Undrained Triaxial Test

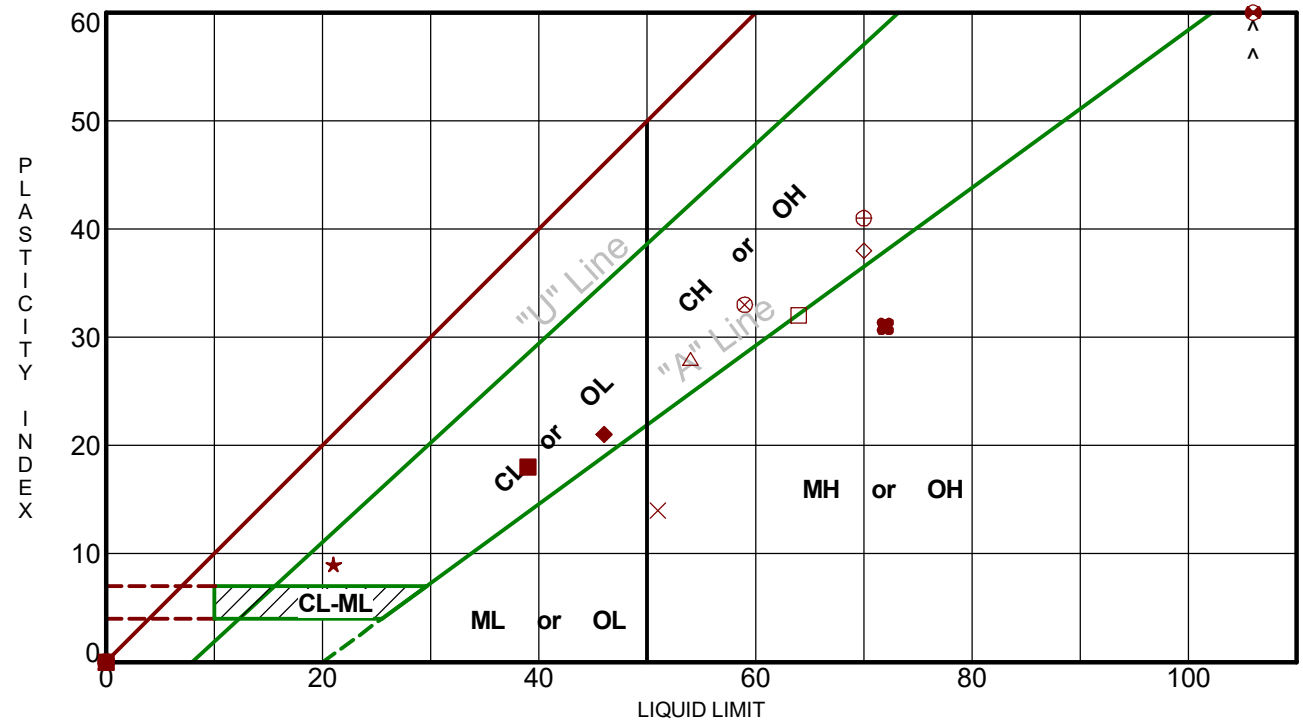
CU testing allows the soil specimen to be consolidated under a confining pressure prior to shear and has been conducted following ASTM D4767 Standard Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils.

APPENDIX B

EXHIBIT B-3: LABORATORY TEST RESULTS

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	AASHTO	Description
BS-BULK1	0 - 4	NP	NP	NP	20.7	A-2-4 (0)	SILTY SAND (SM)
BS-BULK2	0 - 4	NP	NP	NP	16.4	A-2-4 (0)	SILTY SAND (SM)
BS-STB1	13.5 - 15	NP	NP	NP	20.7	A-2-4 (0)	SILTY SAND (SM)
BS-STB1	18.5 - 20	21	12	9	24.0	A-2-4 (0)	CLAYEY SAND (SC)
BS-STB1	23.5 - 25	NP	NP	NP	5.3	A-3 (0)	Poorly graded SAND with silt (SP-SM)
BS-STB1	28.5 - 30	NP	NP	NP	6.4	A-3 (0)	Poorly graded SAND with silt (SP-SM)
BS-STB1	38.5 - 40	NP	NP	NP	3.5	A-3 (0)	Poorly graded SAND (SP-SM)
BS-STB1	48.5 - 50	54	26	28	39.1	A-7-6 (5)	CLAYEY SAND (SC)
BS-STB1	58.5 - 60	59	26	33	45.2	A-7-6 (10)	CLAYEY SAND (SC)
BS-STB1	63.5 - 65	70	29	41	59.7	A-7-6 (23)	SANDY FAT CLAY (CH)
BS-STB1	78.5 - 80	64	32	32	39.2	A-7-5 (7)	SILTY SAND (SM)
BS-STB1	83.5 - 85	106	44	62	90.3	A-7-5 (68)	ELASTIC SILT (MH)
BS-STB13	6 - 8	NP	NP	NP	12.7	A-2-4 (0)	SILTY SAND (SM)
BS-STB13	8 - 10	NP	NP	NP	11.7	A-2-4 (0)	Poorly graded SAND with silt (SP-SM)
BS-STB13	18.5 - 20	NP	NP	NP	4.3	A-3 (0)	Poorly graded SAND (SP-SM)
BS-STB13	28.5 - 30	39	21	18	31.0	A-2-6 (1)	CLAYEY SAND (SC)
BS-STB13	38.5 - 40	46	25	21	43.0	A-7-6 (5)	CLAYEY SAND (SC)
BS-STB13	48.5 - 50	70	32	38	52.0	A-7-5 (16)	SANDY FAT CLAY (CH)
BS-STB13	53.5 - 55	51	37	14	71.7	A-7-5 (12)	ELASTIC SILT with SAND (MH)
BS-STB13	63.5 - 65	72	41	31	62.0	A-7-5 (20)	SANDY ELASTIC SILT (MH)

PROJECT: I-95 Bridge Replacements - Jasper County

SITE: SC 46 and Bagshaw Swamp
Hardeeville, SC

Terracon
1450 Fifth St W
North Charleston, SC

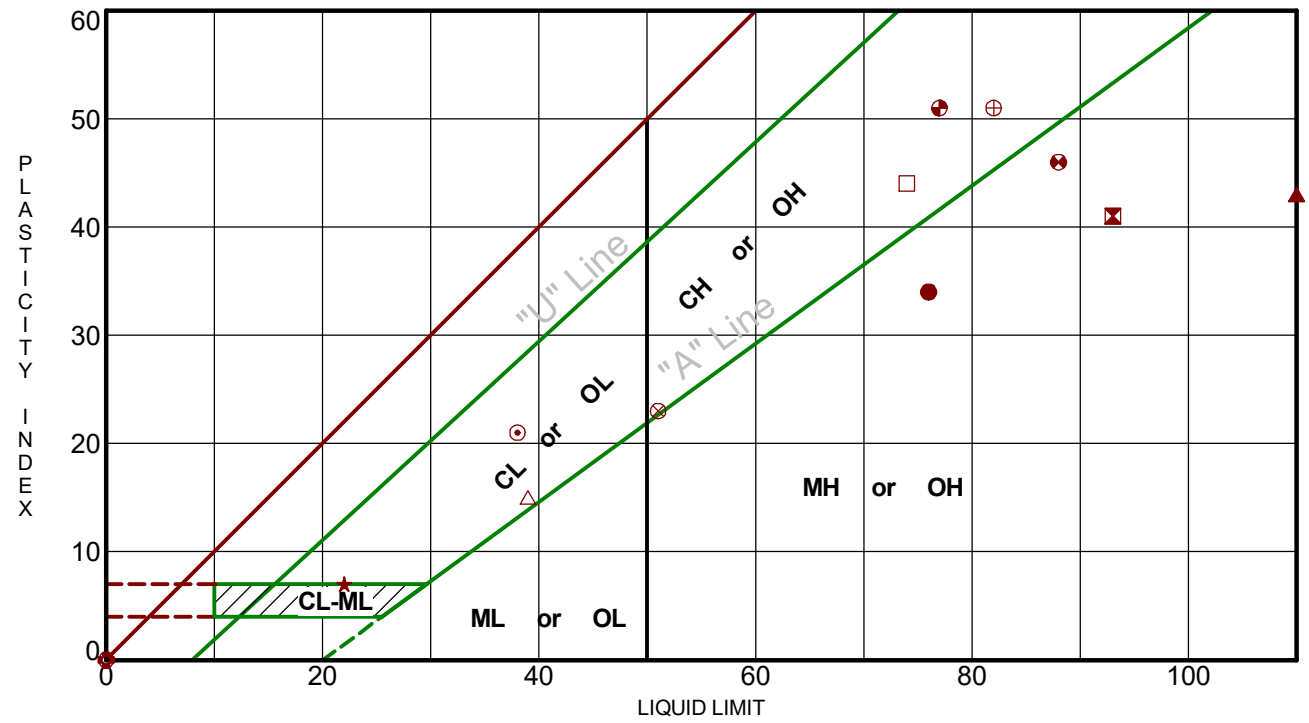
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Columbia, SC

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ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	AASHTO	Description
BS-STB13	73.5 - 75	76	42	34	87.5	A-7-5 (37)	ELASTIC SILT (MH)
BS-STB13	78.5 - 80	93	52	41	97.1	A-7-5 (54)	ELASTIC SILT (MH)
BS-STB13	93.5 - 95	110	67	43	98.7	A-7-5 (63)	ELASTIC SILT (MH)
BS-STB3	13.5 - 15	22	15	7	40.2	A-4 (0)	SILTY, CLAYEY SAND (SC-SM)
BS-STB3	18.5 - 20	38	17	21	58.5	A-6 (9)	SANDY LEAN CLAY (CL)
BS-STB3	23.5 - 25	NP	NP	NP	18.1	A-2-4 (0)	SILTY SAND (SM)
BS-STB3	33.5 - 35	NP	NP	NP	4.1	A-3 (0)	Poorly graded SAND (SP-SM)
BS-STB3	43.5 - 45	39	24	15	25.2	A-2-6 (1)	CLAYEY SAND (SC)
BS-STB3	48.5 - 50	51	28	23	36.1	A-7-6 (3)	CLAYEY SAND (SC)
BS-STB3	58.5 - 60	82	31	51	64.4	A-7-5 (32)	SANDY FAT CLAY (CH)
BS-STB3	68.5 - 70	74	30	44	70.1	A-7-5 (32)	FAT CLAY with SAND (CH)
BS-STB3	73.5 - 75	88	42	46	63.9	A-7-5 (30)	SANDY ELASTIC SILT (MH)
BS-STB3	88.5 - 90	77	26	51	60.4	A-7-6 (28)	SANDY FAT CLAY (CH)

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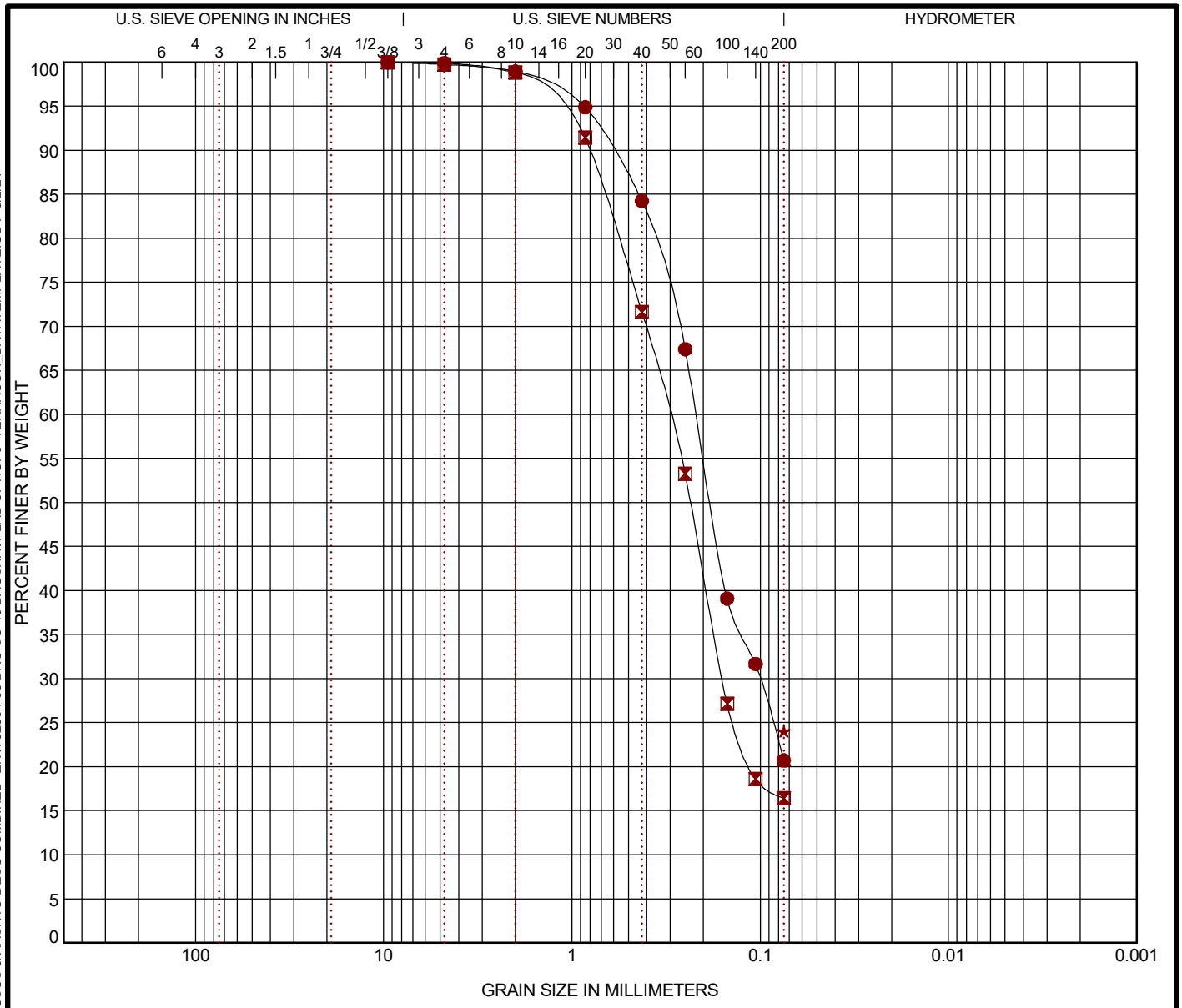
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-BULK1	0 - 4	SILTY SAND (SM)	A-2-4 (0)	13.1	NP	NP	NP		
⊠	BS-BULK2	0 - 4	SILTY SAND (SM)	A-2-4 (0)	10.9	NP	NP	NP		
▲	BS-STB1	13.5 - 15	SILTY SAND (SM)	A-2-4 (0)	13.1	NP	NP	NP		
★	BS-STB1	18.5 - 20	CLAYEY SAND (SC)	A-2-4 (0)	18.5	21	12	9		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-BULK1	0 - 4	9.5	0.219	0.101		0.1	79.2		20.7	
⊠	BS-BULK2	0 - 4	9.5	0.304	0.159		0.2	83.3		16.4	
▲	BS-STB1	13.5 - 15	0.075							20.7	
★	BS-STB1	18.5 - 20	0.075							24.0	

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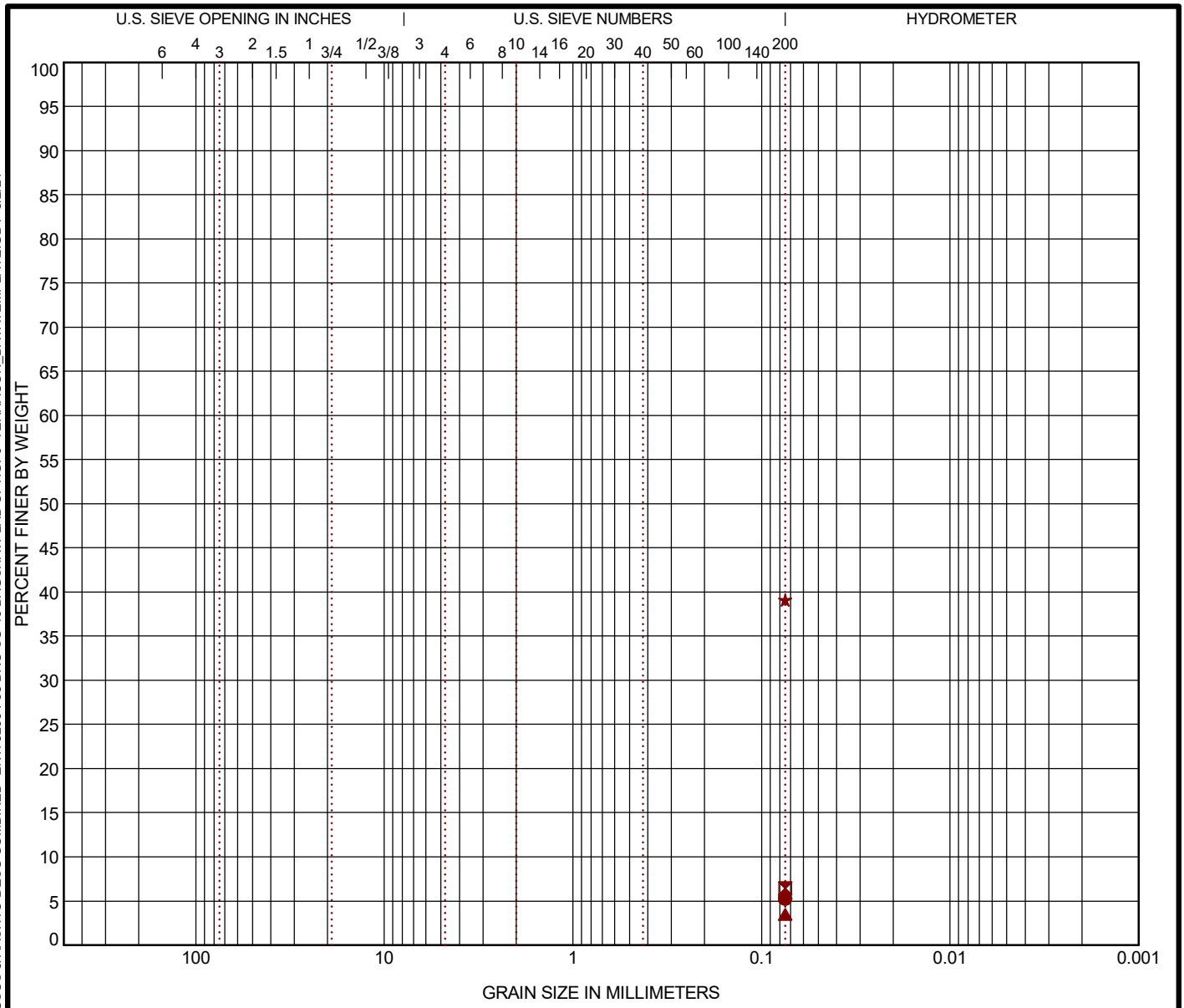
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-STB1	23.5 - 25		A-3 (0)	21.6	NP	NP	NP		
⊠	BS-STB1	28.5 - 30		A-3 (0)	18.1	NP	NP	NP		
▲	BS-STB1	38.5 - 40		A-3 (0)	20.5	NP	NP	NP		
★	BS-STB1	48.5 - 50	CLAYEY SAND (SC)	A-7-6 (5)	47.6	54	26	28		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-STB1	23.5 - 25	0.075							5.3	
⊠	BS-STB1	28.5 - 30	0.075							6.4	
▲	BS-STB1	38.5 - 40	0.075							3.5	
★	BS-STB1	48.5 - 50	0.075							39.1	

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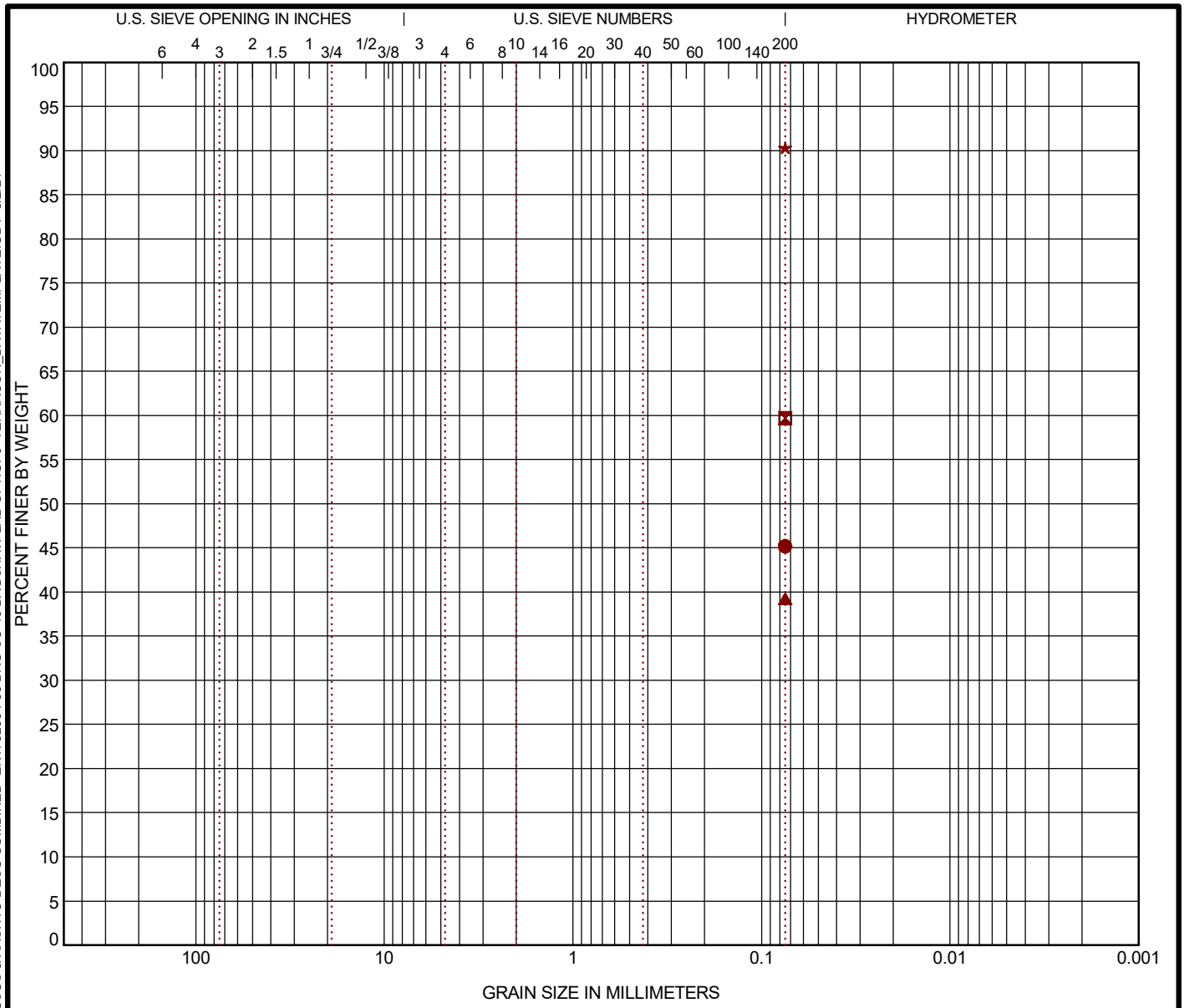
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-STB1	58.5 - 60	CLAYEY SAND (SC)	A-7-6 (10)	41.7	59	26	33		
⊠	BS-STB1	63.5 - 65	SANDY FAT CLAY (CH)	A-7-6 (23)	63.3	70	29	41		
▲	BS-STB1	78.5 - 80	SILTY SAND (SM)	A-7-5 (7)	51.2	64	32	32		
★	BS-STB1	83.5 - 85	ELASTIC SILT (MH)	A-7-5 (68)	74.9	106	44	62		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-STB1	58.5 - 60	0.075							45.2	
⊠	BS-STB1	63.5 - 65	0.075							59.7	
▲	BS-STB1	78.5 - 80	0.075							39.2	
★	BS-STB1	83.5 - 85	0.075							90.3	

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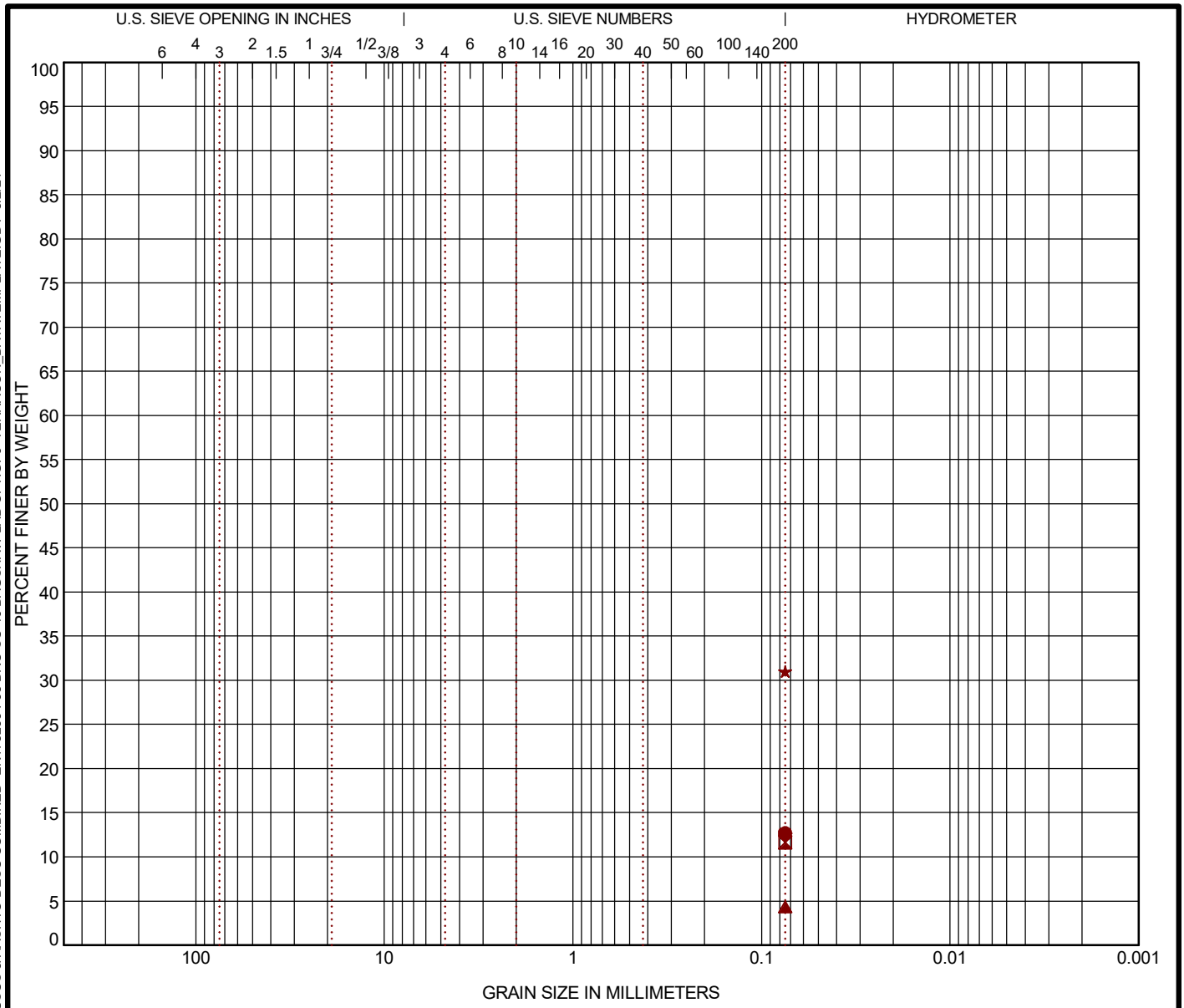
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-STB13	6 - 8	SILTY SAND (SM)	A-2-4 (0)	29.1	NP	NP	NP		
⊠	BS-STB13	8 - 10		A-2-4 (0)	26.8	NP	NP	NP		
▲	BS-STB13	18.5 - 20		A-3 (0)	29.7	NP	NP	NP		
★	BS-STB13	28.5 - 30	CLAYEY SAND (SC)	A-2-6 (1)	37.4	39	21	18		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-STB13	6 - 8	0.075							12.7	
⊠	BS-STB13	8 - 10	0.075							11.7	
▲	BS-STB13	18.5 - 20	0.075							4.3	
★	BS-STB13	28.5 - 30	0.075							31.0	

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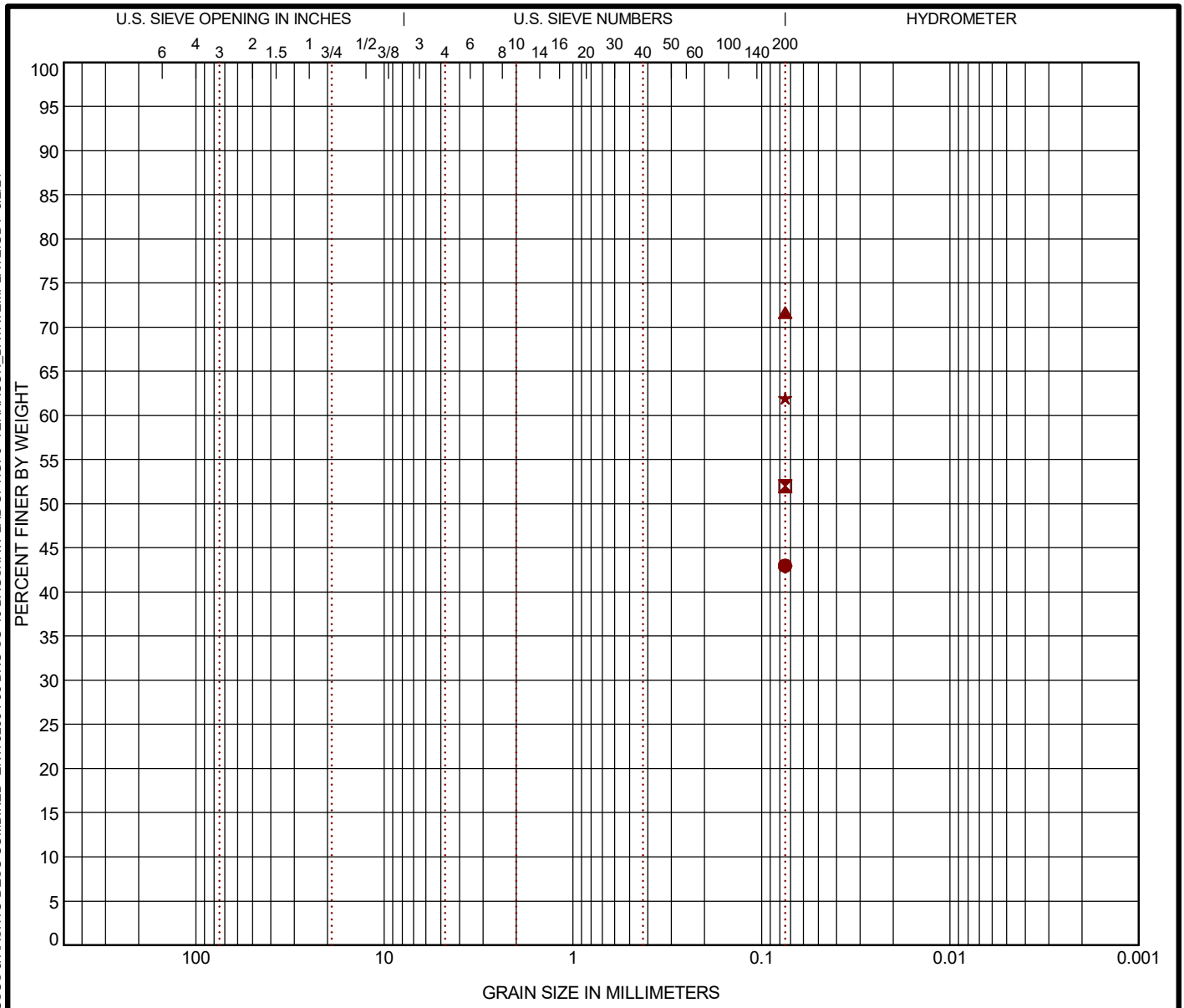
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-STB13	38.5 - 40	CLAYEY SAND (SC)	A-7-6 (5)	43.6	46	25	21		
⊠	BS-STB13	48.5 - 50	SANDY FAT CLAY (CH)	A-7-5 (16)	48.8	70	32	38		
▲	BS-STB13	53.5 - 55	ELASTIC SILT with SAND (MH)	A-7-5 (12)	61.8	51	37	14		
★	BS-STB13	63.5 - 65	SANDY ELASTIC SILT (MH)	A-7-5 (20)	59.9	72	41	31		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-STB13	38.5 - 40	0.075							43.0	
⊠	BS-STB13	48.5 - 50	0.075							52.0	
▲	BS-STB13	53.5 - 55	0.075							71.7	
★	BS-STB13	63.5 - 65	0.075							62.0	

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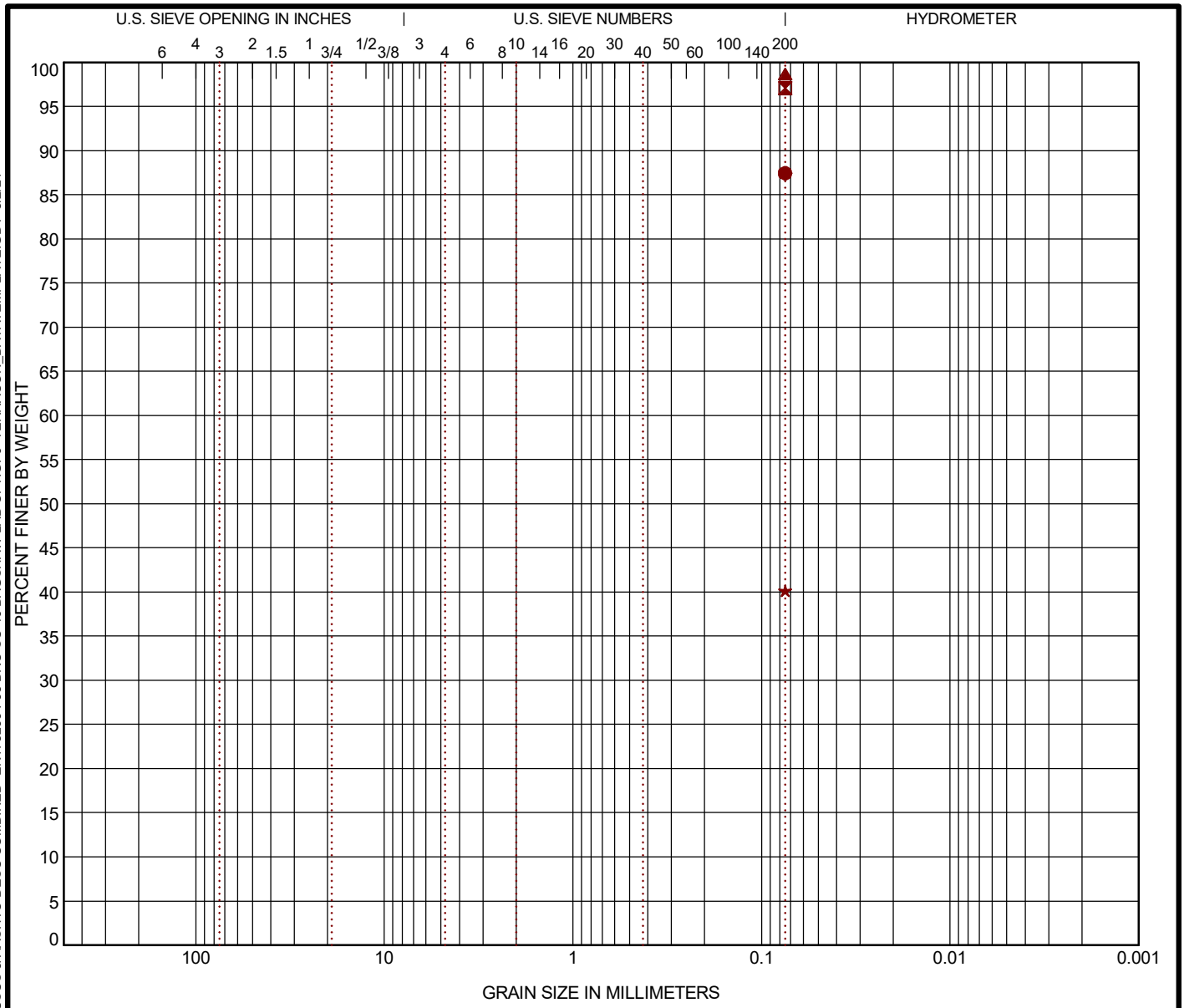
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-STB13	73.5 - 75	ELASTIC SILT (MH)	A-7-5 (37)	55.4	76	42	34		
⊠	BS-STB13	78.5 - 80	ELASTIC SILT (MH)	A-7-5 (54)	55.3	93	52	41		
▲	BS-STB13	93.5 - 95	ELASTIC SILT (MH)	A-7-5 (63)	107.9	110	67	43		
★	BS-STB3	13.5 - 15	SILTY, CLAYEY SAND (SC-SM)	A-4 (0)	29.2	22	15	7		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-STB13	73.5 - 75	0.075							87.5	
⊠	BS-STB13	78.5 - 80	0.075							97.1	
▲	BS-STB13	93.5 - 95	0.075							98.7	
★	BS-STB3	13.5 - 15	0.075							40.2	

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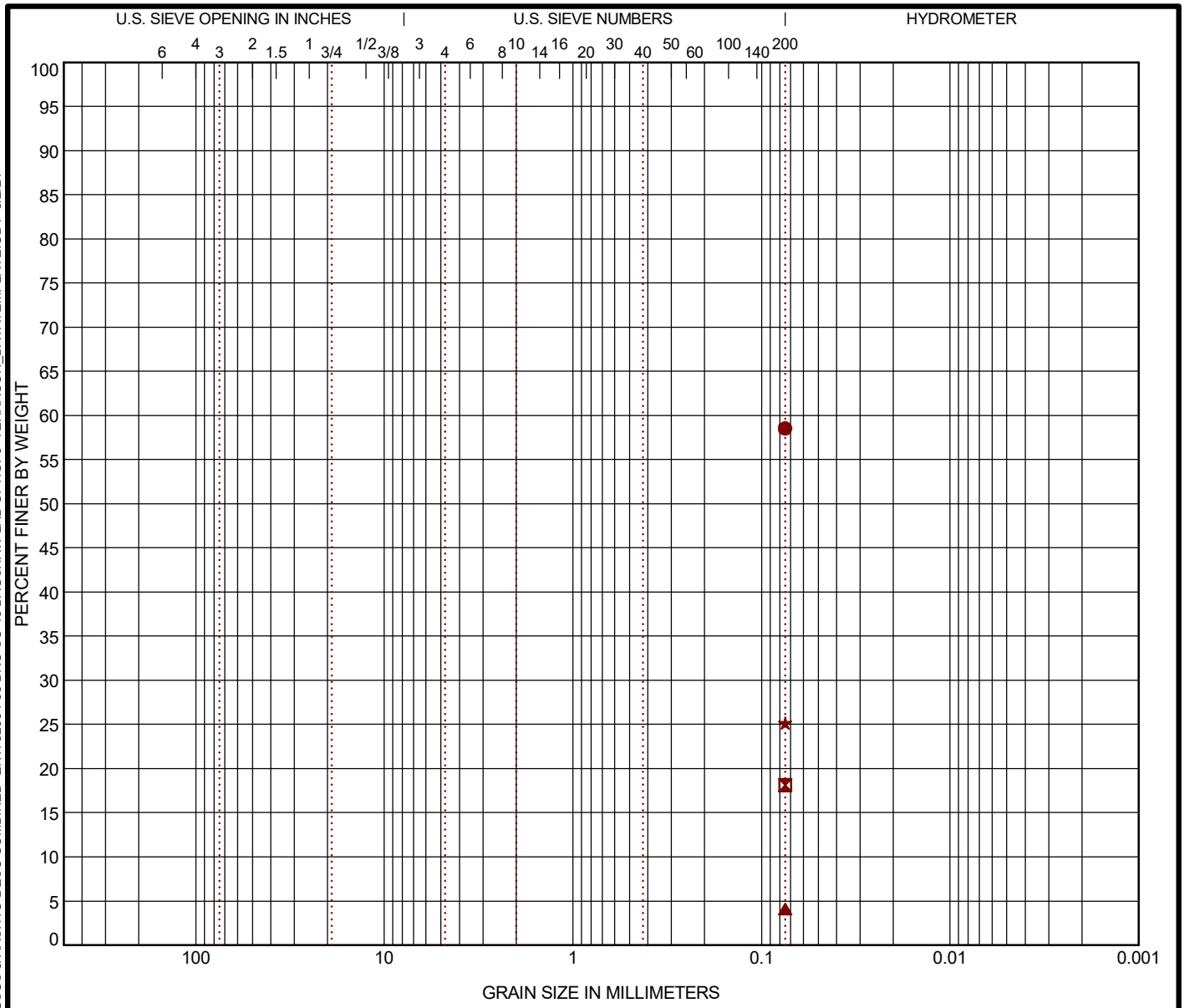
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-STB3	18.5 - 20	SANDY LEAN CLAY (CL)	A-6 (9)	38.9	38	17	21		
⊠	BS-STB3	23.5 - 25	SILTY SAND (SM)	A-2-4 (0)	24.4	NP	NP	NP		
▲	BS-STB3	33.5 - 35		A-3 (0)	19.7	NP	NP	NP		
★	BS-STB3	43.5 - 45	CLAYEY SAND (SC)	A-2-6 (1)	38.9	39	24	15		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-STB3	18.5 - 20	0.075							58.5	
⊠	BS-STB3	23.5 - 25	0.075							18.1	
▲	BS-STB3	33.5 - 35	0.075							4.1	
★	BS-STB3	43.5 - 45	0.075							25.2	

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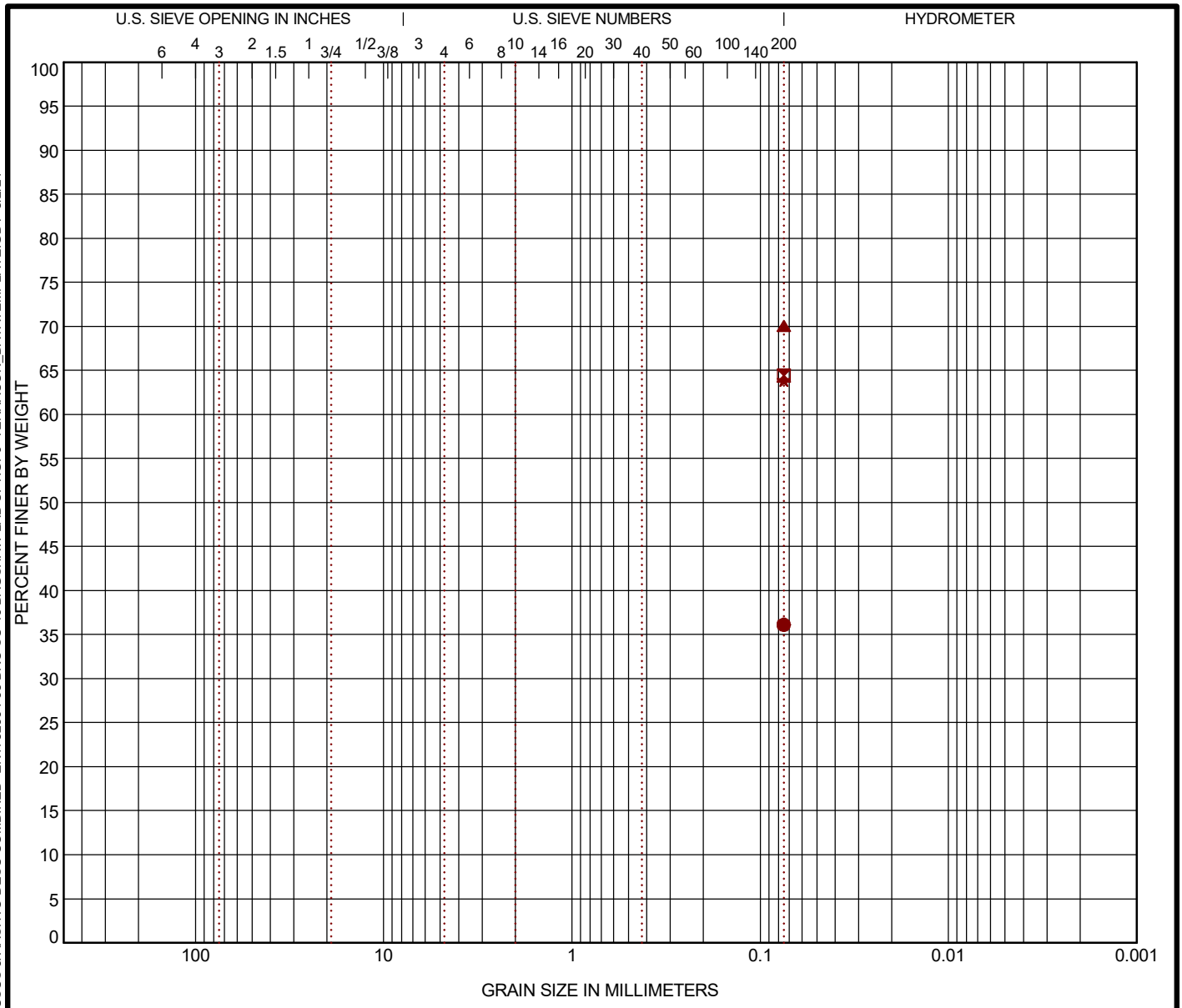
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	BS-STB3	48.5 - 50	CLAYEY SAND (SC)	A-7-6 (3)	45.7	51	28	23		
⊠	BS-STB3	58.5 - 60	SANDY FAT CLAY (CH)	A-7-5 (32)	60.1	82	31	51		
▲	BS-STB3	68.5 - 70	FAT CLAY with SAND (CH)	A-7-5 (32)	57.0	74	30	44		
★	BS-STB3	73.5 - 75	SANDY ELASTIC SILT (MH)	A-7-5 (30)	58.8	88	42	46		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	BS-STB3	48.5 - 50	0.075							36.1	
⊠	BS-STB3	58.5 - 60	0.075							64.4	
▲	BS-STB3	68.5 - 70	0.075							70.1	
★	BS-STB3	73.5 - 75	0.075							63.9	

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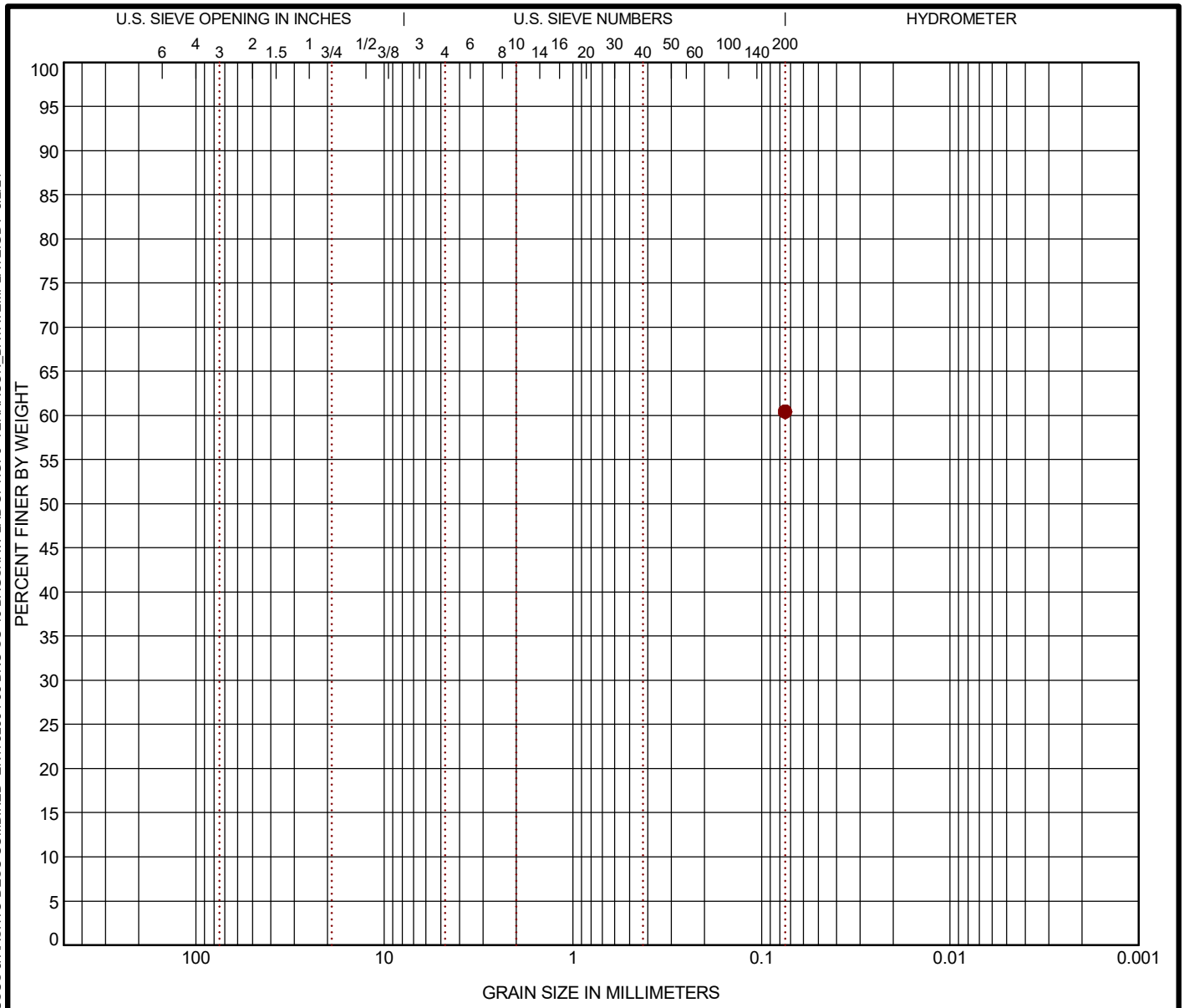
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GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
BS-STB3	88.5 - 90	SANDY FAT CLAY (CH)	A-7-6 (28)	53.2	77	26	51		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
BS-STB3	88.5 - 90	0.075							60.4	

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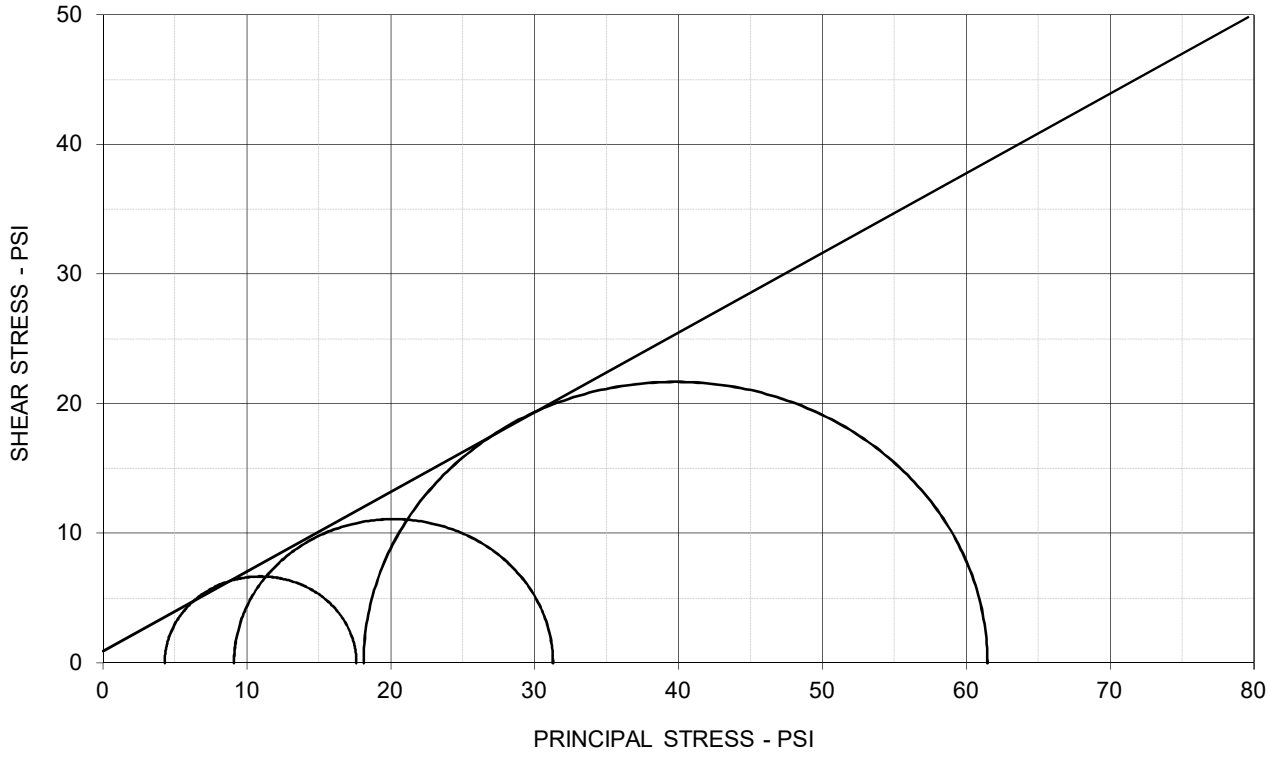
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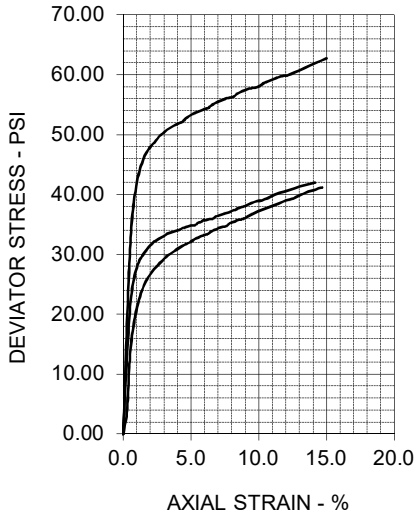
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TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ' = 31.6 deg	c' = 0.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.3	10.3	10.3	
Dry Density - pcf	115.7	115.7	115.7	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	16.2	15.4	14.2	
Dry Density - pcf	115.7	115.9	116.0	
Calculated Diameter (in.)	2.82	2.81	2.82	
Height - inches	6.04	6.04	6.07	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	13.33	22.17	43.36	
Total Pore Pressure - psi	50.7	50.9	51.9	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.5	0.6	1.1	
σ_1' Failure - psi	17.61	31.27	61.47	
σ_3' Failure - psi	4.28	9.10	18.11	

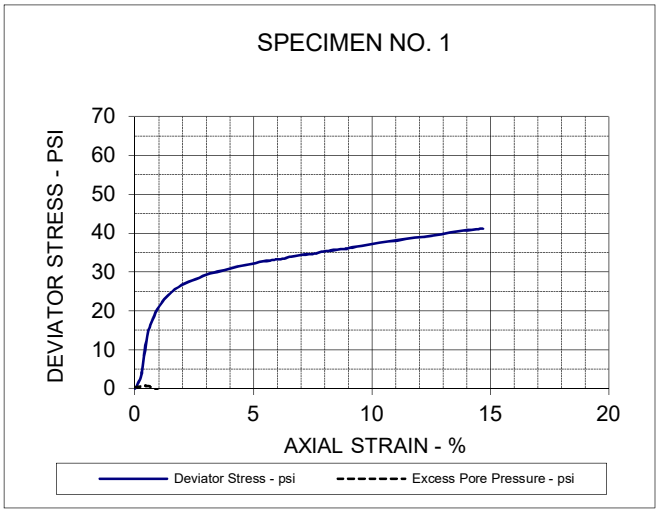
TEST DESCRIPTION

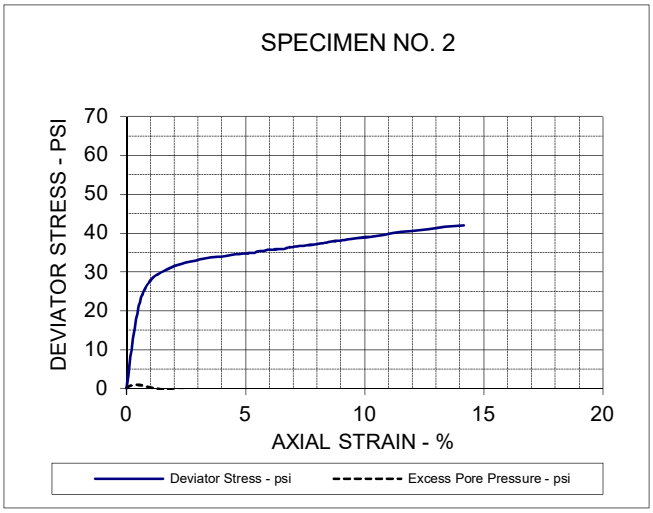
TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk1, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 20.7
REMARKS: Specimens remolded to 95% at opt.

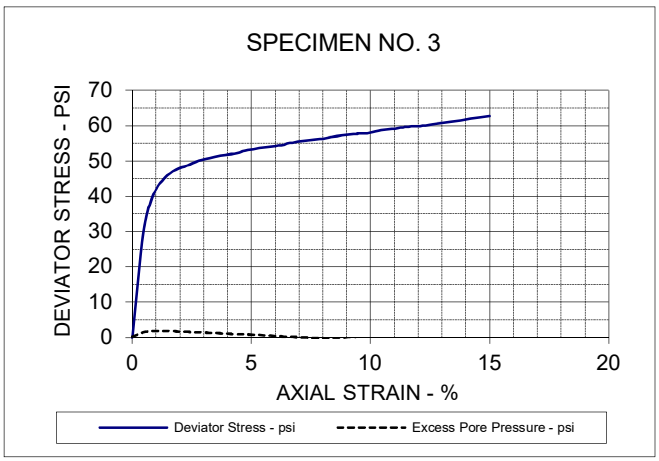
PROJECT INFORMATION

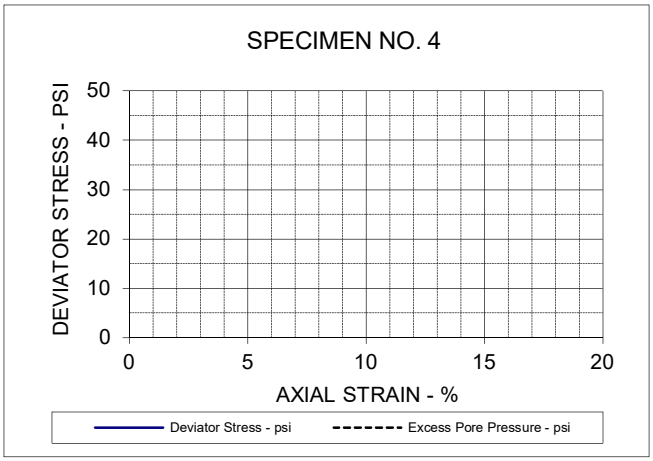
PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

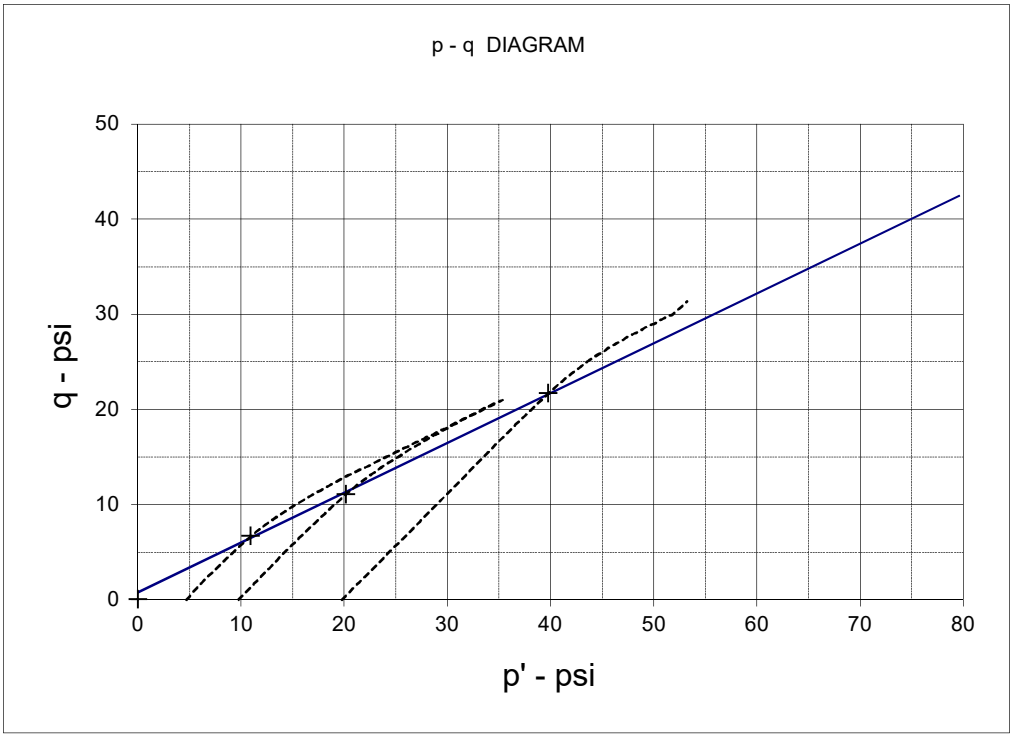
TERRACON









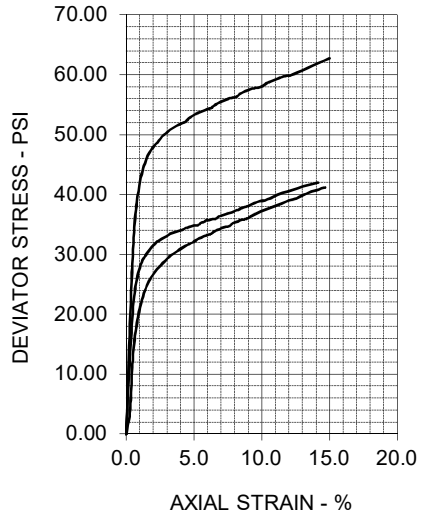


EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.6	a (psi) = 0.8
PROJECT: I-95 Bridge Replacements- Jasper County		TYPE OF TEST & NO: CU with Pore Pressure	
PROJECT NO: EN175299		**TERRACON**	
DESCRIPTION: Silty Sand			

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 30.2 deg	c = 0.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.3	10.3	10.3	
Dry Density - pcf	115.7	115.7	115.7	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	16.2	15.4	14.2	
Dry Density - pcf	115.7	115.9	116.0	
Calculated Diameter (in.)	2.82	2.81	2.82	
Height - inches	6.04	6.04	6.07	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	13.33	22.17	43.36	
Total Pore Pressure - psi	50.7	50.9	51.9	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.5	0.6	1.1	
σ_1 Failure - psi	18.33	32.17	63.36	
σ_3 Failure - psi	5.00	10.00	20.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk1, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 20.7
REMARKS: Specimens remolded to 95% at opt.

PROJECT INFORMATION

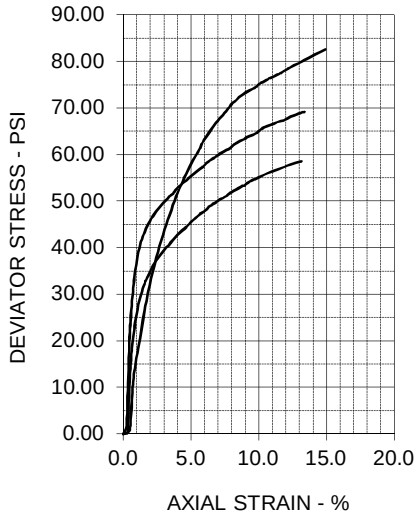
PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

TERRACON

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	f ' = 32.0 deg	c' = 0.2 psi		
SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.5	10.5	10.5	
Dry Density - pcf	117.4	117.4	117.4	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	13.2	12.3	12.8	
Dry Density - pcf	117.4	117.5	117.9	
Calculated Diameter (in.)	2.80	2.81	2.81	
Height - inches	6.01	6.03	6.03	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	11.13	20.56	39.88	
Total Pore Pressure - psi	50.4	51.2	52.7	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.7	0.7	1.2	
S_1' Failure - psi	15.73	29.32	57.20	
S_3' Failure - psi	4.60	8.76	17.32	



TEST DESCRIPTION

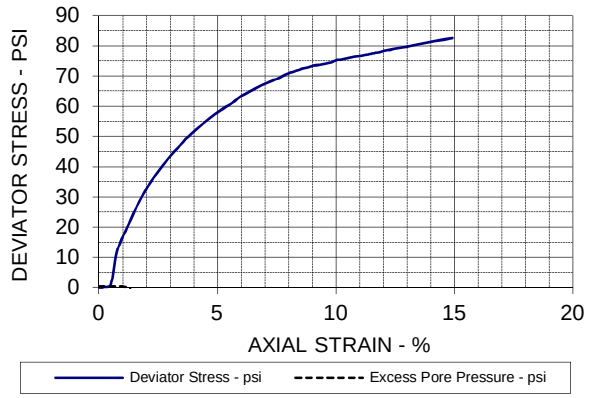
TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk2, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 16.4
REMARKS: Specimens remolded to 95% at opt.

PROJECT INFORMATION

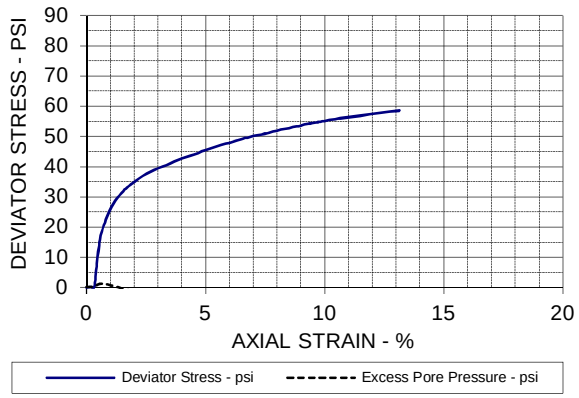
PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

TERRACON

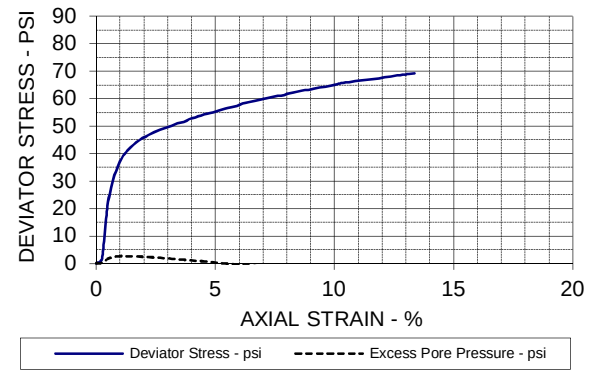
SPECIMEN NO. 1



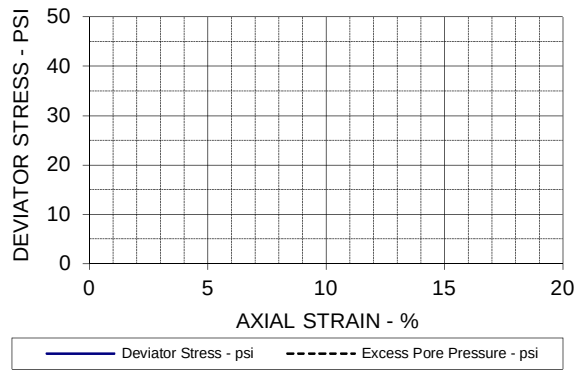
SPECIMEN NO. 2



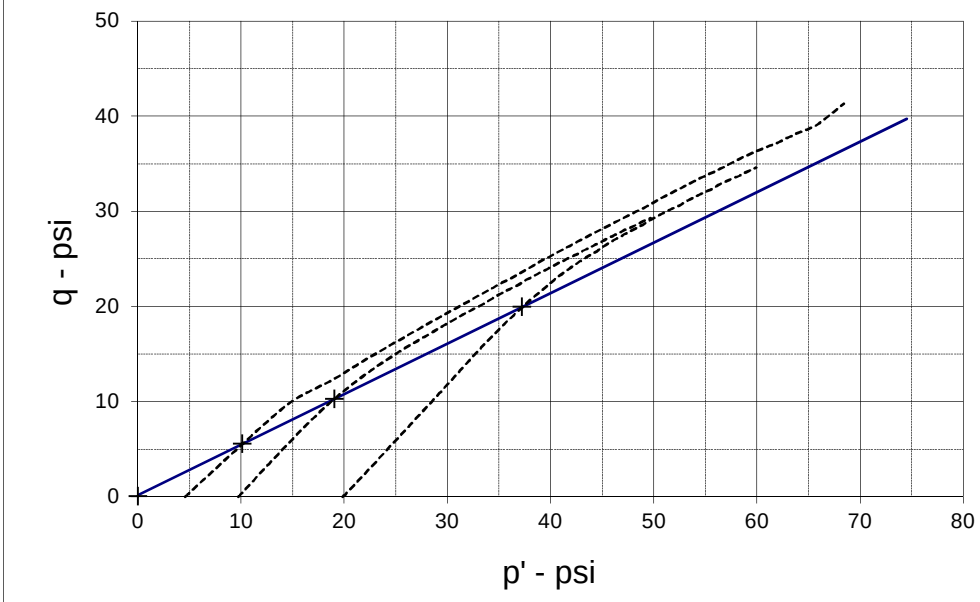
SPECIMEN NO. 3



SPECIMEN NO. 4

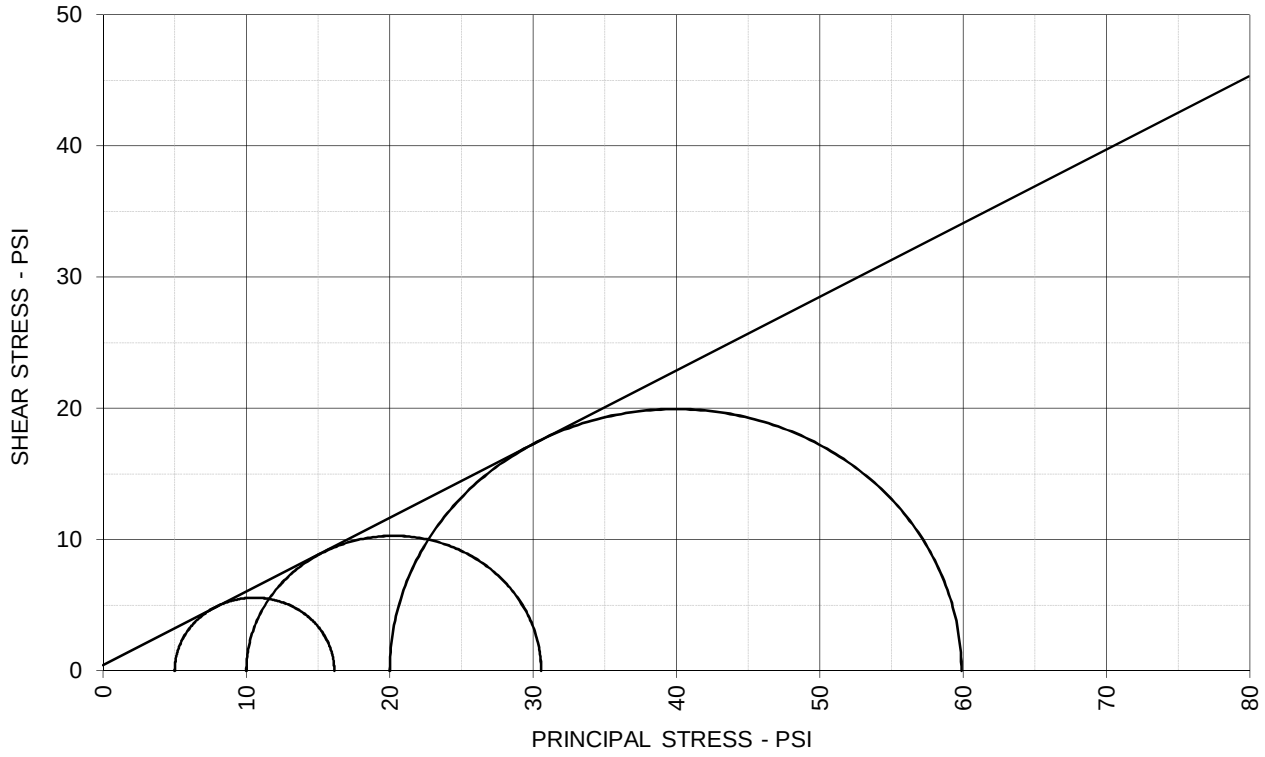


p - q DIAGRAM

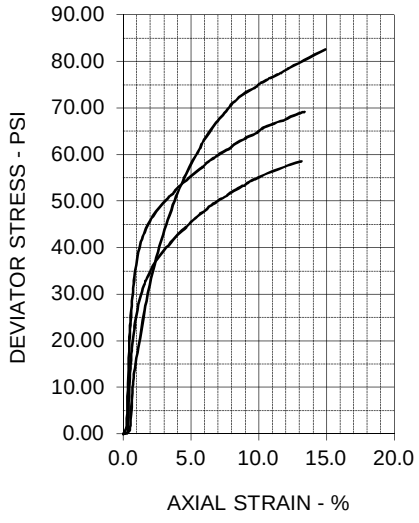


EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	a (deg) = 27.9	a (psi) = 0.2
PROJECT: I-95 Bridge Replacements- Jasper County		TYPE OF TEST & NO: CU with Pore Pressure	
PROJECT NO: EN175299		**TERRACON**	
DESCRIPTION: Silty Sand			

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	f = 29.3 deg	c = 0.4 psi		
SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.5	10.5	10.5	
Dry Density - pcf	117.4	117.4	117.4	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	13.2	12.3	12.8	
Dry Density - pcf	117.4	117.5	117.9	
Calculated Diameter (in.)	2.80	2.81	2.81	
Height - inches	6.01	6.03	6.03	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	11.13	20.56	39.88	
Total Pore Pressure - psi	50.4	51.2	52.7	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.7	0.7	1.2	
S_1 Failure - psi	16.13	30.56	59.88	
S_3 Failure - psi	5.00	10.00	20.00	



TEST DESCRIPTION

TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk2, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 16.4
REMARKS: Specimens remolded to 95% at opt.

PROJECT INFORMATION

PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

TERRACON

APPENDIX C– DESIGN CALCULATIONS

Exhibit C-1	Three-Point ADRS Curves by SCDOT
Exhibit C-2	Soil Shear Strength Loss Susceptibility Analysis
Exhibit C-3	Soil Profile and Parameters
Exhibit C-4	Bridge Loads
Exhibit C-5	Axial Analysis of Foundations
Exhibit C-6	Pile Drivability Analysis
Exhibit C-7	Lateral Analysis of Foundations
Exhibit C-8	Slope Stability Analysis
Exhibit C-9	Embankment Settlement Analysis
Exhibit C-10	Performance Limits

EXHIBIT C-1: THREE-POINT ADRS CURVES BY SCDOT

3-Point Acceleration Design Response Spectrum

SCDOT v3.0 - 05/14/2019

Project ID:	P030260			Latitude:	32.3773
Route:	I-95	County:	27 - Jasper	Longitude:	81.0304
Project:	I-95 Bridge Replacement over Bagshaw Swamp				

Designer:	S. Biswas-Lowcountry RPG
Date:	10/30/2020

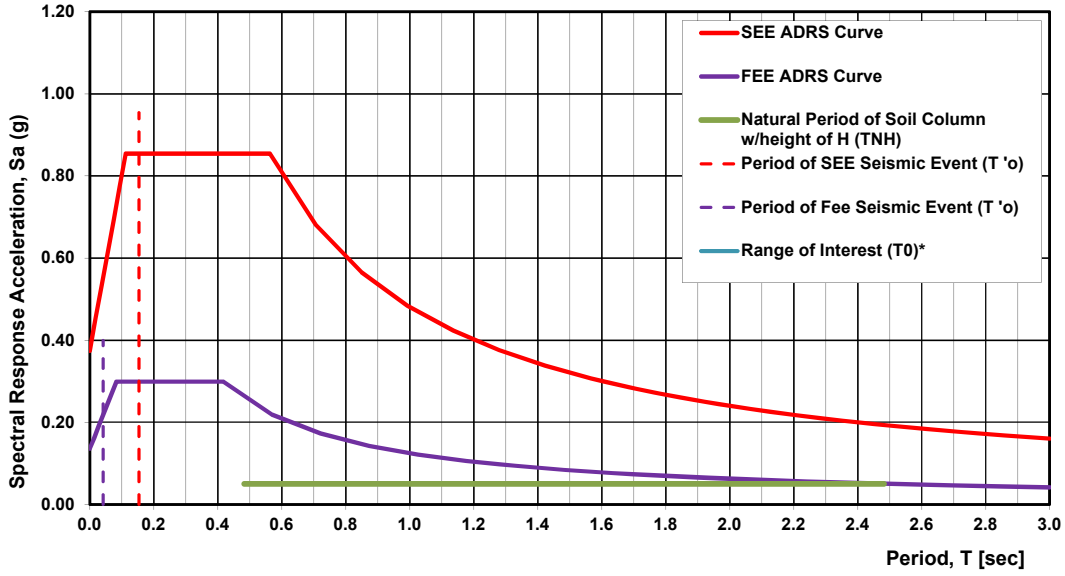
Design EQ	PGA	S_{DS}	S_{D1}	M_W	R	PGV	$D_{s5\text{-}95}$	T'_o
	g	g	g	-	km	inches/sec	sec	sec
FEE	0.14	0.30	0.12	7.30	98.37	4.75	34.52	0.04
SEE	0.37	0.85	0.48	7.30	94.40	18.28	33.88	0.15

Damping:	5%
Geologic Condition:	Geologically Realistic (Q = 100)*
	SCCP
ADRS Location within Soil Column:	At Ground Surface

South Carolina Coastal Plain

Fundamental Period of Structure, T_0^*	Range of Interest* sec		$V^*_{s,H}$	H	T_{NH} sec	
sec	$0.5*T_0$	$2.0*T_0$	ft/sec	ft	$(4*H)/V^*_{s,H}$	$(6*H)/V^*_{s,H}$
0.00	0.00	0.00	1734.69	791.00	0.48	2.48
0.00	0.00	0.00				

SC Seismic ADRS Curve



	FEE Data			SEE Data	
	T	S_a		T	S_a
	0.00	0.135		0.00	0.374
	0.01	0.163		0.02	0.454
	0.03	0.190		0.04	0.534
	0.04	0.217		0.06	0.614
	0.06	0.245		0.08	0.694
	0.07	0.272		0.09	0.774
To	0.08	0.299	To	0.11	0.854
	0.11	0.299		0.15	0.854
	0.14	0.299		0.19	0.854
	0.17	0.299		0.23	0.854
	0.19	0.299		0.26	0.854
	0.22	0.299		0.30	0.854
	0.25	0.299		0.34	0.854
	0.28	0.299		0.38	0.854
	0.31	0.299		0.41	0.854
	0.33	0.299		0.45	0.854
	0.36	0.299		0.49	0.854
	0.39	0.299		0.53	0.854
Ts	0.42	0.299	Ts	0.56	0.854
	0.57	0.219		0.71	0.681
	0.72	0.173		0.85	0.566
	0.87	0.143		0.99	0.484
	1.03	0.122		1.14	0.423
	1.18	0.106		1.28	0.376
	1.33	0.094		1.42	0.338
	1.48	0.084		1.57	0.307
	1.63	0.076		1.71	0.281
	1.78	0.070		1.85	0.260
	1.94	0.064		2.00	0.241
	2.09	0.060		2.14	0.225
	2.24	0.056		2.28	0.211
	2.39	0.052		2.43	0.198
	2.54	0.049		2.57	0.187
	2.70	0.046		2.71	0.177
	2.85	0.044		2.86	0.168
	3.00	0.042		3.00	0.160

*The SEOR is encouraged to check the fundamental period of the structure versus the period of the seismic event and the period of the site. According to LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations, FHWA-NHI-11-032, GEC No. 3 "So, the damage potential of an earthquake ground motion increases when the predominant period of the earthquake motion is close to the resonant period of the site and when the resonant period of the site is close to the fundamental period of the structure. The damage potential of an earthquake ground motion is greatest when all three of the predominat or fundamental periods coincide."

APPENDIX C

EXHIBIT C-2: SOIL SHEAR STRENGTH LOSS SUSCEPTIBILITY ANALYSIS

Project Name: I-95 Bridge Replacement over Bagshaw Swamp
Project Location: Jasper County
SCDOT Project ID: P030260
Location of Analysis: I-95 Bridge over Bagshaw Swamp
Soil Profile and Parameters Used in Analysis: See spreadsheet calculations for each boring and CLiq plots SPT and CPT data used in liquefaction analysis PGA values from SCDOT's 3-Point ADRS Curves • PGA SEE = 0.37; Mw SEE = 7.30 • PGA FEE = 0.14; Mw FEE = 7.30 Liquefaction does not occur above the ground water elevation. Liquefaction is ignored in the hard cohesive layer.
Analysis Methodology: • Idriss and Boulanger 2014 • The Simplified procedure described in SCDOT GDM Chapter 13.
Summary of Analysis Results: See attached summary sheets for FEE and SEE earthquake conditions.
Comparison of Results to Performance Limits: See Exhibit C-10.

FEE 15% Probability of Exceedance in 75 Years

Soil Shear Strength Loss Susceptibility Screening

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299

Hazard Level: FEE

	FEE	SEE
PGA 0.140	0.14	0.37
M_w 7.30	7.3	7.3

Boring	Station	Offset	Location / Roadway Classification	Lateral Displacement Index (ft)	Total Thickness of Limited Liquefaction (ft)	Total Thickness of Clay-like Strength Loss (ft)	Total Thickness of Full Liquefaction (ft)	Max. Depth of Liquefaction (ft)	Liquefaction Settlement (in)	Longitudinal Differential Settlement	Longitudinal Differential Settlement PL	Comment
BS-STB02				0.1	5.3	0.0	0.0	0.0	0.3			
BS-STB10				2.0	0.0	0.0	7.3	14.3	2.5	-		
BS-STB11				0.0	2.0	0.0	0.0	0.0	0.1	-		
BS-STB14				2.0	0.0	0.0	5.3	14.3	2.1	-		
BS-STB15				0.0	0.0	0.0	0.0	0.0	0.0	-		
BS-STB1				3.9	5.0	0.0	10.0	24.3	3.4	-		
BS-STB3				0.1	0.0	0.0	5.0	39.3	0.3	-		
BS-STB13				0.5	0.0	0.0	10.3	19.3	2.7	-		
										-		
										-		
										-		
										-		
										-		
										-		

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	FEE	Unit Weight	115 pcf		
County: JASPER COUNTY	PGA	0.14	Sample Liners Required	No		
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No		
Boring: BS-STB02	Elevation	14.7 ft	C_B	1.00	Table 7-5	
Station:	Water Depth	0.0 ft	C_E	1.17	Eq 7-2	
Offset:	Hammer ER	70.4%	C_S	1.00	Table 7-4	
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11	
			MSF_{Clay}	1.009	Eq 13-12	

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	N-value Correction								SSL Susceptibility Screening					Cyclic Stress						
								Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.7	17	SC	44	17	1.00		0.60	12	115	53	1.70	20.2	5.5	25.7	Y	N	Y	Y	Clay-like	1.004	0.307	0.200	16	Clay	0.198
3.0	11.7	13	SC	44	17	1.00		0.66	10	345	158	1.70	17.1	5.5	22.6	Y	N	Y	Y	Clay-like	0.999	0.306	0.199	48	Clay	0.197
5.0	9.7	21	SC	44	17	1.00		0.72	18	575	263	1.70	30.0	5.5	35.5	N	N	Y	Y	Clay-like	0.994	0.304	0.198	80	Clay	0.196
7.0	7.7	14	SM	30	15	1.00		0.77	13	805	368	1.70	21.4	5.4	26.7	Y	N	Y	Y	Clay-like	0.988	0.302	0.197	111	Clay	0.195
9.0	5.7	17	SP-SM	8	0	1.00		0.81	16	1035	473	1.70	27.4	0.4	27.7	Y	Y	Y	N	Sand-like	0.982	0.300	0.195	142	Sand	0.185
14.3	0.4	11	SP-SM	8	0	1.00		0.89	11	1639	750	1.68	19.2	0.4	19.6	Y	Y	Y	N	Sand-like	0.963	0.295	0.192	221	Sand	0.182
19.3	-4.6	22	SP-SM	8	0	1.00		0.93	24	2214	1013	1.45	34.8	0.4	35.2	N	Y	Y	N	None	0.944	0.289	0.188	292	Sand	0.178
24.3	-9.6	28	SP-SM	8	0	1.00		0.96	32	2789	1276	1.29	40.7	0.4	41.0	N	Y	Y	N	None	0.922	0.282	0.183	360	Sand	0.174
29.3	-14.6	34	SM	30	12	1.00		0.98	39	3364	1539	1.17	45.7	5.4	51.1	N	N	Y	Y	Clay-like	0.899	0.275	0.179	424	Clay	0.177
34.3	-19.6	31	SM	35	12	1.00		0.99	36	3939	1802	1.08	38.9	5.5	44.4	N	N	Y	Y	Clay-like	0.876	0.268	0.174	483	Clay	0.173
39.3	-24.6	69	SM	36	14	1.00		0.99	80	4514	2065	1.01	81.3	5.5	86.8	N	N	Y	Y	Clay-like	0.851	0.260	0.169	538	Clay	0.168
44.3	-29.6	48	MH	70	20	1.00		1.00	56	5089	2328	1.00	56.1	5.5	61.6	N	N	Y	Y	Clay-like	0.826	0.253	0.164	589	Clay	0.163
49.3	-34.6	32	MH	65	28	1.00		1.00	37	5664	2591	1.00	37.5	5.5	43.0	N	N	Y	Y	Clay-like	0.801	0.245	0.159	635	Clay	0.158
54.3	-39.6	42	MH	70	20	1.00		1.00	49	6239	2854	1.00	49.2	5.5	54.7	N	N	Y	Y	Clay-like	0.777	0.238	0.155	679	Clay	0.153
59.3	-44.6	36	MH	55	40	1.00		1.00	42	6814	3117	1.00	42.2	5.5	47.7	N	N	Y	Y	Clay-like	0.753	0.231	0.150	718	Clay	0.149
64.3	-49.6	71	MH	70	20	1.00		1.00	83	7389	3380	1.00	83.3	5.5	88.8	N	N	Y	Y	Clay-like	0.730	0.224	0.145	755	Clay	0.144
69.3	-54.6	30	MH	85	32	1.00		1.00	35	7964	3643	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.708	0.217	0.141	790	Clay	0.140
74.3	-59.6	54	MH	70	20	1.00		1.00	63	8539	3906	1.00	63.3	5.5	68.8	N	N	Y	Y	Clay-like	0.688	0.211	0.137	823	Clay	0.136
79.3	-64.6	100	MH	70	20	1.00		1.00	117	9114	4169	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.669	0.205	0.133	854	Clay	0.132
84.3	-69.6	28	MH	70	20	1.00		1.00	33	9689	4432	1.00	32.9	5.5	38.4	N	N	Y	Y	Clay-like	0.652	0.200	0.130	884	Clay	0.129
89.3	-74.6	100	MH	70	20	1.00		1.00	117	10264	4695	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.637	0.195	0.127	915	Clay	0.126
94.3	-79.6	25	MH	75	24	1.00		1.00	29	10839	4958	1.00	29.3	5.5	34.8	N	N	Y	Y	Clay-like	0.623	0.191	0.124	945	Clay	0.123
99.3	-84.6	27	MH	70	20	1.00		1.00	32	11414	5221	1.00	31.7	5.5	37.2	N	N	Y	Y	Clay-like	0.611	0.187	0.122	977	Clay	0.121
104.3	-89.6	62	MH	70	20	1.00		1.00	73	11989	5484	1.00	72.7	5.5	78.2	N	N	Y	Y	Clay-like	0.602	0.184	0.120	1010	Clay	0.119
109.3	-94.6	30	MH	70	20	1.00		1.00	35	12564	5747	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.595	0.182	0.118	1046	Clay	0.117
114.3	-99.6	42	MH	70	20	1.00		1.00	49	13139	6010	1.00	49.3	5.5	54.8	N	N	Y	Y	Clay-like	0.590	0.180	0.117	1084	Clay	0.116
119.3	-104.6	40	MH	70	20	1.00		1.00	47	13714	6273	1.00	46.9	5.5	52.4	N	N	Y	Y	Clay-like	0.587	0.180	0.117	1126	Clay	0.116
124.3	-109.6	57	MH	70	20	1.00		1.00	67	14289	6536	1.00	66.9	5.5	72.4	N	N	Y	Y	Clay-like	0.586	0.179	0.117	1173	Clay	0.116

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB02
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 0.0 ft

Maximum Depth of Liquefied Layers: 0.0 ft

Total Thickness of Limited Liquefaction: 5.3 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	$1 / (D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	$1 / (D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = $0.8 \cdot \tau_{peak}$)
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	$CSR^*_{eq} / CRR^*_{eq} = (D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	$CSR^*_{eq} / CRR^*_{eq} = (D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.7	SC	44	17	25.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,784	10.0	1.11	1.00	1.11	0.18	5.61	No Loss
3.0	11.7	SC	44	17	22.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,511	10.0	1.11	1.00	1.11	0.18	5.63	No Loss
5.0	9.7	SC	44	17	35.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,650	10.0	1.11	1.00	1.11	0.18	5.66	No Loss
7.0	7.7	SM	30	15	26.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,886	10.0	1.11	1.00	1.11	0.18	5.70	No Loss
9.0	5.7	SP-SM	8	0	27.7	1.10	1.00	0.373	0.410	0.45	2.22	No Liq.	-	-	-	-	-	-	-	-	-
14.3	0.4	SP-SM	8	0	19.6	1.10	1.00	0.201	0.221	0.82	1.22	Limited Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.6	SP-SM	8	0	35.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
24.3	-9.6	SP-SM	8	0	41.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
29.3	-14.6	SM	30	12	51.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,847	10.0	1.11	1.00	1.11	0.16	6.26	No Loss
34.3	-19.6	SM	35	12	44.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,384	10.0	1.11	1.00	1.11	0.16	6.43	No Loss
39.3	-24.6	SM	36	14	86.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	12,051	10.0	1.11	1.00	1.11	0.15	6.61	No Loss
44.3	-29.6	MH	70	20	61.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,411	10.0	1.11	1.00	1.11	0.15	6.81	No Loss
49.3	-34.6	MH	65	28	43.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,618	10.0	1.11	1.00	1.11	0.14	7.02	No Loss
54.3	-39.6	MH	70	20	54.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,381	10.0	1.11	1.00	1.11	0.14	7.25	No Loss
59.3	-44.6	MH	55	40	47.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,331	10.0	1.11	1.00	1.11	0.13	7.47	No Loss
64.3	-49.6	MH	70	20	88.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	12,490	10.0	1.11	1.00	1.11	0.13	7.71	No Loss
69.3	-54.6	MH	85	32	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,279	10.0	1.11	1.00	1.11	0.13	7.93	No Loss
74.3	-59.6	MH	70	20	68.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	9,502	10.0	1.11	1.00	1.11	0.12	8.18	No Loss
79.3	-64.6	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,598	10.0	1.11	1.00	1.11	0.12	8.41	No Loss
84.3	-69.6	MH	70	20	38.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,928	7.2	0.85	1.00	0.85	0.15	6.62	No Loss
89.3	-74.6	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.11	8.84	No Loss
94.3	-79.6	MH	75	24	34.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,400	5.4	0.68	1.00	0.68	0.18	5.53	No Loss
99.3	-84.6	MH	70	20	37.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,752	5.6	0.70	1.00	0.70	0.17	5.77	No Loss
104.3	-89.6	MH	70	20	78.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	10,912	10.0	1.11	1.00	1.11	0.11	9.35	No Loss
109.3	-94.6	MH	70	20	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,280	5.6	0.70	1.00	0.70	0.17	5.99	No Loss
114.3	-99.6	MH	70	20	54.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,392	8.1	0.94	1.00	0.94	0.12	8.09	No Loss
119.3	-104.6	MH	70	20	52.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,040	7.3	0.86	1.00	0.86	0.13	7.42	No Loss
124.3	-109.6	MH	70	20	72.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	10,032	10.0	1.11	1.00	1.11	0.10	9.60	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB02
Station:

Lateral Displacement Index, LDI: 0.10 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 0.34 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.029	0.3	-	-	-	-	0.10
3.0	11.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.029	0.3	-	-	-	-	0.10
5.0	9.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.029	0.3	-	-	-	-	0.10
7.0	7.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.029	0.3	-	-	-	-	0.10
9.0	5.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	0.0%	-	-	-	-	0.029	0.3	74	0.0%	-	-	0.10
14.3	0.4	37.2	0.8	20.0	Partial Loss	-	-	-	-	-	-	-	37.2	0.166	1.9%	0.539	0.005	5.25	0.029	0.029	0.3	62	1.9%	5.25	0.10	0.10
19.3	-4.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-49.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-54.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-59.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-64.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-69.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-74.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-79.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-84.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-89.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-94.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-99.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-104.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-109.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB10
Station:
Offset:

Hazard Level	FEE
PGA	0.14
M_W	7.30
Elevation	14.6 ft
Water Depth	0.0 ft
Hammer ER	70.4%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.17	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.6	6	CL	70	20	1.00		0.60	4	115	53	1.00	4.2	5.5	9.7	Y	N	Y	Y	Clay-like	1.004	0.307	0.200	16	Clay	0.198
3.0	11.6	11	CL	70	20	1.00		0.66	9	345	158	1.00	8.5	5.5	14.0	Y	N	Y	Y	Clay-like	0.999	0.306	0.199	48	Clay	0.197
5.0	9.6	10	CL	68	15	1.00		0.72	8	575	263	1.00	8.4	5.5	13.9	Y	N	Y	Y	Clay-like	0.994	0.304	0.198	80	Clay	0.196
7.0	7.6	17	SP	3	0	1.00		0.77	15	805	368	1.70	26.0	0.0	26.0	Y	Y	Y	N	Sand-like	0.988	0.302	0.197	111	Sand	0.186
9.0	5.6	6	SC-SM	40	7	1.00		0.81	6	1035	473	1.70	9.7	5.5	15.2	Y	Y	Y	N	Sand-like	0.982	0.300	0.195	142	Sand	0.185
14.3	0.3	4	SC-SM	40	7	1.00		0.89	4	1639	750	1.68	7.0	5.5	12.5	Y	Y	Y	N	Sand-like	0.963	0.295	0.192	221	Sand	0.182
19.3	-4.7	22	SM	30	15	1.00		0.93	24	2214	1013	1.45	34.8	5.4	40.2	N	N	Y	Y	Clay-like	0.944	0.289	0.188	292	Clay	0.186
24.3	-9.7	18	SM	30	15	1.00		0.96	20	2789	1276	1.29	26.1	5.4	31.5	N	N	Y	Y	Clay-like	0.922	0.282	0.183	360	Clay	0.182
29.3	-14.7	29	SM	33	15	1.00		0.98	33	3364	1539	1.17	39.0	5.5	44.5	N	N	Y	Y	Clay-like	0.899	0.275	0.179	424	Clay	0.177
34.3	-19.7	44	MH	70	20	1.00		0.99	51	3939	1802	1.00	50.9	5.5	56.4	N	N	Y	Y	Clay-like	0.876	0.268	0.174	483	Clay	0.173
39.3	-24.7	36	MH	70	20	1.00		0.99	42	4514	2065	1.00	41.9	5.5	47.4	N	N	Y	Y	Clay-like	0.851	0.260	0.169	538	Clay	0.168
44.3	-29.7	29	MH	70	20	1.00		1.00	34	5089	2328	1.00	33.9	5.5	39.4	N	N	Y	Y	Clay-like	0.826	0.253	0.164	589	Clay	0.163
49.3	-34.7	30	MH	70	20	1.00		1.00	35	5664	2591	1.00	35.1	5.5	40.6	N	N	Y	Y	Clay-like	0.801	0.245	0.159	635	Clay	0.158
54.3	-39.7	47	MH	70	20	1.00		1.00	55	6239	2854	1.00	55.1	5.5	60.6	N	N	Y	Y	Clay-like	0.777	0.238	0.155	679	Clay	0.153
59.3	-44.7	50	MH	70	20	1.00		1.00	59	6814	3117	1.00	58.6	5.5	64.1	N	N	Y	Y	Clay-like	0.753	0.231	0.150	718	Clay	0.149

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB10
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 7.3 ft

Maximum Depth of Liquefied Layers: 14.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.6	CL	70	20	9.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	630	10.0	1.11	1.00	1.11	0.18	5.61	No Loss
3.0	11.6	CL	70	20	14.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,279	10.0	1.11	1.00	1.11	0.18	5.63	No Loss
5.0	9.6	CL	68	15	13.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,262	10.0	1.11	1.00	1.11	0.18	5.66	No Loss
7.0	7.6	SP	3	0	26.0	1.10	1.00	0.315	0.346	0.54	1.86	No Liq.	-	-	-	-	-	-	-	-	-
9.0	5.6	SC-SM	40	7	15.2	1.10	1.00	0.157	0.173	1.07	0.94	Full Liq.	-	-	-	-	-	-	-	-	-
14.3	0.3	SC-SM	40	7	12.5	1.09	1.00	0.136	0.148	1.23	0.81	Full Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.7	SM	30	15	40.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,612	10.0	1.11	1.00	1.11	0.17	5.97	No Loss
24.3	-9.7	SM	30	15	31.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,044	10.0	1.11	1.00	1.11	0.16	6.10	No Loss
29.3	-14.7	SM	33	15	44.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,987	10.0	1.11	1.00	1.11	0.16	6.26	No Loss
34.3	-19.7	MH	70	20	56.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,641	10.0	1.11	1.00	1.11	0.16	6.43	No Loss
39.3	-24.7	MH	70	20	47.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,287	10.0	1.11	1.00	1.11	0.15	6.61	No Loss
44.3	-29.7	MH	70	20	39.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,081	10.0	1.11	1.00	1.11	0.15	6.81	No Loss
49.3	-34.7	MH	70	20	40.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,266	10.0	1.11	1.00	1.11	0.14	7.02	No Loss
54.3	-39.7	MH	70	20	60.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,260	10.0	1.11	1.00	1.11	0.14	7.25	No Loss
59.3	-44.7	MH	70	20	64.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,793	10.0	1.11	1.00	1.11	0.13	7.47	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB10
Station:

Lateral Displacement Index, LDI: 1.99 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 2.47 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.206	2.5	-	-	-	-	1.99
3.0	11.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.206	2.5	-	-	-	-	1.99
5.0	9.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.206	2.5	-	-	-	-	1.99
7.0	7.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.206	2.5	71	#VALUE!	-	-	1.99
9.0	5.6	32.2	3.2	12.9	Full Residual	133.9	0.14	0.11	68	52	8.1	6.3	-	0.270	5.0%	0.748	0.018	2.00	0.036	0.206	2.5	55	5.0%	2.00	0.10	1.99
14.3	0.3	30.4	3.2	10.2	Full Residual	124.5	0.10	0.09	76	69	5.8	5.3	-	0.361	36.1%	0.847	0.032	5.25	0.170	0.170	2.0	49	36.1%	5.25	1.89	1.89
19.3	-4.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	FEE	Unit Weight	115 pcf		
County: JASPER COUNTY	PGA	0.14	Sample Liners Required	No		
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No		
Boring: BS-STB11	Elevation	14.2 ft	C_B	1.00	Table 7-5	
Station:	Water Depth	0.0 ft	C_E	1.17	Eq 7-2	
Offset:	Hammer ER	70.4%	C_S	1.00	Table 7-4	
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11	
			MSF_{Clay}	1.009	Eq 13-12	

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like		Clay-like	Sections 13.6.1, 13.6.2, 13.6.3		Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.2	9	CL	70	20	1.00		0.60	6	115	53	1.00	6.3	5.5	11.8	Y	N	Y	Y	Clay-like	1.004	0.307	0.200	16	Clay	0.198
3.0	11.2	12	CL	70	20	1.00		0.66	9	345	158	1.00	9.3	5.5	14.8	Y	N	Y	Y	Clay-like	0.999	0.306	0.199	48	Clay	0.197
5.0	9.2	15	CL	70	20	1.00		0.72	13	575	263	1.00	12.6	5.5	18.1	Y	N	Y	Y	Clay-like	0.994	0.304	0.198	80	Clay	0.196
7.0	7.2	14	SM	21	0	1.00		0.77	13	805	368	1.70	21.4	4.6	26.0	Y	Y	Y	N	Sand-like	0.988	0.302	0.197	111	Sand	0.186
9.0	5.2	12	SP-SM	9	0	1.00		0.81	11	1035	473	1.70	19.3	0.7	20.0	Y	Y	Y	N	Sand-like	0.982	0.300	0.195	142	Sand	0.185
14.3	0.0	18	SP-SM	9	0	1.00		0.89	19	1639	750	1.68	31.5	0.7	32.2	N	Y	Y	N	None	0.963	0.295	0.192	221	Sand	0.182
19.3	-5.0	24	SP-SM	9	0	1.00		0.93	26	2214	1013	1.45	38.0	0.7	38.7	N	Y	Y	N	None	0.944	0.289	0.188	292	Sand	0.178
24.3	-10.0	18	SP	3	0	1.00		0.96	20	2789	1276	1.29	26.1	0.0	26.1	Y	Y	Y	N	Sand-like	0.922	0.282	0.183	360	Sand	0.174
29.3	-15.0	31	SM	30	12	1.00		0.98	36	3364	1539	1.17	41.7	5.4	47.0	N	N	Y	Y	Clay-like	0.899	0.275	0.179	424	Clay	0.177
34.3	-20.0	20	MH	70	20	1.00		0.99	23	3939	1802	1.00	23.2	5.5	28.7	Y	N	Y	Y	Clay-like	0.876	0.268	0.174	483	Clay	0.173
39.3	-25.0	30	MH	70	20	1.00		0.99	35	4514	2065	1.00	34.9	5.5	40.4	N	N	Y	Y	Clay-like	0.851	0.260	0.169	538	Clay	0.168
44.3	-30.0	28	MH	70	20	1.00		1.00	33	5089	2328	1.00	32.7	5.5	38.2	N	N	Y	Y	Clay-like	0.826	0.253	0.164	589	Clay	0.163
49.3	-35.0	21	MH	62	30	1.00		1.00	25	5664	2591	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.801	0.245	0.159	635	Clay	0.158
54.3	-40.0	27	MH	70	20	1.00		1.00	32	6239	2854	1.00	31.6	5.5	37.1	N	N	Y	Y	Clay-like	0.777	0.238	0.155	679	Clay	0.153
59.3	-45.0	43	MH	70	20	1.00		1.00	50	6814	3117	1.00	50.4	5.5	55.9	N	N	Y	Y	Clay-like	0.753	0.231	0.150	718	Clay	0.149
64.3	-50.0	86	MH	70	20	1.00		1.00	101	7389	3380	1.00	100.9	5.5	106.4	N	N	Y	Y	Clay-like	0.730	0.224	0.145	755	Clay	0.144
69.3	-55.0	23	MH	75	34	1.00		1.00	27	7964	3643	1.00	27.0	5.5	32.5	N	N	Y	Y	Clay-like	0.708	0.217	0.141	790	Clay	0.140
74.3	-60.0	60	MH	70	20	1.00		1.00	70	8539	3906	1.00	70.4	5.5	75.9	N	N	Y	Y	Clay-like	0.688	0.211	0.137	823	Clay	0.136
79.3	-65.0	100	MH	70	20	1.00		1.00	117	9114	4169	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.669	0.205	0.133	854	Clay	0.132
84.3	-70.0	100	MH	70	20	1.00		1.00	117	9689	4432	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.652	0.200	0.130	884	Clay	0.129
89.3	-75.0	100	MH	70	20	1.00		1.00	117	10264	4695	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.637	0.195	0.127	915	Clay	0.126
94.3	-80.0	27	MH	90	42	1.00		1.00	32	10839	4958	1.00	31.7	5.5	37.2	N	N	Y	Y	Clay-like	0.623	0.191	0.124	945	Clay	0.123
99.3	-85.0	27	MH	70	20	1.00		1.00	32	11414	5221	1.00	31.7	5.5	37.2	N	N	Y	Y	Clay-like	0.611	0.187	0.122	977	Clay	0.121
104.3	-90.0	56	MH	70	20	1.00		1.00	66	11989	5484	1.00	65.7	5.5	71.2	N	N	Y	Y	Clay-like	0.602	0.184	0.120	1010	Clay	0.119
109.3	-95.0	31	MH	70	20	1.00		1.00	36	12564	5747	1.00	36.4	5.5	41.9	N	N	Y	Y	Clay-like	0.595	0.182	0.118	1046	Clay	0.117
114.3	-100.0	29	MH	70	20	1.00		1.00	34	13139	6010	1.00	34.0	5.5	39.5	N	N	Y	Y	Clay-like	0.590	0.180	0.117	1084	Clay	0.116
119.3	-105.0	46	MH	70	20	1.00		1.00	54	13714	6273	1.00	54.0	5.5	59.5	N	N	Y	Y	Clay-like	0.587	0.180	0.117	1126	Clay	0.116
124.3	-110.0	52	MH	70	20	1.00		1.00	61	14289	6536	1.00	61.0	5.5	66.5	N	N	Y	Y	Clay-like	0.586	0.179	0.117	1173	Clay	0.116

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB11
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 0.0 ft

Maximum Depth of Liquefied Layers: 0.0 ft

Total Thickness of Limited Liquefaction: 2.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)								Clay-like Cyclic Resistance and (D/C)							
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)		User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$		Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.2	CL	70	20	11.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	945	10.0	1.11	1.00	1.11	0.18	5.61	No Loss
3.0	11.2	CL	70	20	14.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	1,395	10.0	1.11	1.00	1.11	0.18	5.63	No Loss
5.0	9.2	CL	70	20	18.1	-	-	-	-	-	-	No Liq.		Eq 7-33,34	1,893	10.0	1.11	1.00	1.11	0.18	5.66	No Loss
7.0	7.2	SM	21	0	26.0	1.10	1.00	0.316	0.348	0.54	1.87	No Liq.		-	-	-	-	-	-	-	-	-
9.0	5.2	SP-SM	9	0	20.0	1.10	1.00	0.206	0.227	0.82	1.23	Limited Liq.		-	-	-	-	-	-	-	-	-
14.3	0.0	SP-SM	9	0	32.2	-	-	-	-	-	-	No Liq.		-	-	-	-	-	-	-	-	-
19.3	-5.0	SP-SM	9	0	38.7	-	-	-	-	-	-	No Liq.		-	-	-	-	-	-	-	-	-
24.3	-10.0	SP	3	0	26.1	1.09	1.00	0.320	0.347	0.50	2.00	No Liq.		-	-	-	-	-	-	-	-	-
29.3	-15.0	SM	30	12	47.0	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,331	10.0	1.11	1.00	1.11	0.16	6.26	No Loss
34.3	-20.0	MH	70	20	28.7	-	-	-	-	-	-	No Liq.		Eq 7-33,34	3,473	10.0	1.11	1.00	1.11	0.16	6.43	No Loss
39.3	-25.0	MH	70	20	40.4	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,240	10.0	1.11	1.00	1.11	0.15	6.61	No Loss
44.3	-30.0	MH	70	20	38.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,906	10.0	1.11	1.00	1.11	0.15	6.81	No Loss
49.3	-35.0	MH	62	30	30.1	-	-	-	-	-	-	No Liq.		Eq 7-33,34	3,687	9.8	1.09	1.00	1.09	0.15	6.89	No Loss
54.3	-40.0	MH	70	20	37.1	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,745	10.0	1.11	1.00	1.11	0.14	7.25	No Loss
59.3	-45.0	MH	70	20	55.9	-	-	-	-	-	-	No Liq.		Eq 7-33,34	7,562	10.0	1.11	1.00	1.11	0.13	7.47	No Loss
64.3	-50.0	MH	70	20	106.4	-	-	-	-	-	-	No Liq.		Eq 7-33,34	15,129	10.0	1.11	1.00	1.11	0.13	7.71	No Loss
69.3	-55.0	MH	75	34	32.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,047	7.2	0.85	1.00	0.85	0.16	6.08	No Loss
74.3	-60.0	MH	70	20	75.9	-	-	-	-	-	-	No Liq.		Eq 7-33,34	10,558	10.0	1.11	1.00	1.11	0.12	8.18	No Loss
79.3	-65.0	MH	70	20	122.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	17,598	10.0	1.11	1.00	1.11	0.12	8.41	No Loss
84.3	-70.0	MH	70	20	122.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.12	8.63	No Loss
89.3	-75.0	MH	70	20	122.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.11	8.84	No Loss
94.3	-80.0	MH	90	42	37.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,752	6.0	0.73	1.00	0.73	0.17	5.97	No Loss
99.3	-85.0	MH	70	20	37.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,752	5.6	0.70	1.00	0.70	0.17	5.77	No Loss
104.3	-90.0	MH	70	20	71.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	9,856	10.0	1.11	1.00	1.11	0.11	9.35	No Loss
109.3	-95.0	MH	70	20	41.9	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,456	5.9	0.73	1.00	0.73	0.16	6.19	No Loss
114.3	-100.0	MH	70	20	39.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,104	5.1	0.65	1.00	0.65	0.18	5.59	No Loss
119.3	-105.0	MH	70	20	59.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	8,096	8.6	0.99	1.00	0.99	0.12	8.53	No Loss
124.3	-110.0	MH	70	20	66.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	9,152	9.6	1.07	1.00	1.07	0.11	9.27	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB11
Station:

Lateral Displacement Index, LDI: 0.04 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 0.13 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011	0.1	-	-	-	-	0.04
3.0	11.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011	0.1	-	-	-	-	0.04
5.0	9.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011	0.1	-	-	-	-	0.04
7.0	7.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.011	0.1	71	#VALUE!	-	-	0.04
9.0	5.2	37.2	0.9	20.2	Partial Loss	-	-	-	-	-	-	-	37.2	0.158	1.9%	0.516	0.005	2.00	0.011	0.011	0.1	63	1.9%	2.00	0.04	0.04
14.3	0.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
19.3	-5.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-10.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.000	0.0	72	#VALUE!	-	-	0.00
29.3	-15.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-20.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-25.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-30.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-35.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-40.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-45.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-50.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-55.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-60.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-65.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-70.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-75.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-80.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-85.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-90.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-95.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-100.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-105.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-110.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB14
Station:
Offset:

Hazard Level	FEE
PGA	0.14
M_W	7.30
Elevation	15.5 ft
Water Depth	0.0 ft
Hammer ER	70.4%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.17	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	14.5	9	CH	65	50	1.00		0.60	6	115	53	1.00	6.3	5.5	11.8	Y	N	Y	Y	Clay-like	1.004	0.307	0.200	16	Clay	0.198
3.0	12.5	20	CH	64	52	1.00		0.66	15	345	158	1.00	15.5	5.5	21.0	Y	N	Y	Y	Clay-like	0.999	0.306	0.199	48	Clay	0.197
5.0	10.5	21	SM	25	0	1.00		0.72	18	575	263	1.70	30.0	5.1	35.1	N	Y	Y	N	None	0.994	0.304	0.198	80	Clay	0.196
7.0	8.5	17	SM	25	0	1.00		0.77	15	805	368	1.70	26.0	5.1	31.0	N	Y	Y	N	None	0.988	0.302	0.197	111	Clay	0.195
9.0	6.5	21	SM	25	0	1.00		0.81	20	1035	473	1.70	33.8	5.1	38.9	N	Y	Y	N	None	0.982	0.300	0.195	142	Clay	0.194
14.3	1.3	4	SC	27	8	1.00		0.89	4	1639	750	1.68	7.0	5.2	12.2	Y	Y	Y	N	Sand-like	0.963	0.295	0.192	221	Sand	0.182
19.3	-3.7	23	SM	25	0	1.00		0.93	25	2214	1013	1.45	36.4	5.1	41.5	N	Y	Y	N	None	0.944	0.289	0.188	292	Clay	0.186
24.3	-8.7	18	SP-SM	6	0	1.00		0.96	20	2789	1276	1.29	26.1	0.0	26.2	Y	Y	Y	N	Sand-like	0.922	0.282	0.183	360	Sand	0.174
29.3	-13.7	37	SC	22	18	1.00		0.98	42	3364	1539	1.17	49.8	4.8	54.5	N	N	Y	Y	Clay-like	0.899	0.275	0.179	424	Clay	0.177
34.3	-18.7	34	MH	70	20	1.00		0.99	39	3939	1802	1.00	39.4	5.5	44.9	N	N	Y	Y	Clay-like	0.876	0.268	0.174	483	Clay	0.173
39.3	-23.7	49	MH	70	20	1.00		0.99	57	4514	2065	1.00	57.1	5.5	62.6	N	N	Y	Y	Clay-like	0.851	0.260	0.169	538	Clay	0.168
44.3	-28.7	54	MH	70	20	1.00		1.00	63	5089	2328	1.00	63.1	5.5	68.6	N	N	Y	Y	Clay-like	0.826	0.253	0.164	589	Clay	0.163
49.3	-33.7	28	SC	40	34	1.00		1.00	33	5664	2591	0.90	29.6	5.5	35.1	N	N	Y	Y	Clay-like	0.801	0.245	0.159	635	Clay	0.158
54.3	-38.7	63	MH	70	20	1.00		1.00	74	6239	2854	1.00	73.8	5.5	79.3	N	N	Y	Y	Clay-like	0.777	0.238	0.155	679	Clay	0.153
59.3	-43.7	25	MH	70	20	1.00		1.00	29	6814	3117	1.00	29.3	5.5	34.8	N	N	Y	Y	Clay-like	0.753	0.231	0.150	718	Clay	0.149
64.3	-48.7	100	MH	70	20	1.00		1.00	117	7389	3380	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.730	0.224	0.145	755	Clay	0.144
69.3	-53.7	29	MH	70	20	1.00		1.00	34	7964	3643	1.00	34.0	5.5	39.5	N	N	Y	Y	Clay-like	0.708	0.217	0.141	790	Clay	0.140
74.3	-58.7	67	CH	79	27	1.00		1.00	79	8539	3906	1.00	78.6	5.5	84.1	N	N	Y	Y	Clay-like	0.688	0.211	0.137	823	Clay	0.136
79.3	-63.7	31	MH	70	20	1.00		1.00	36	9114	4169	1.00	36.4	5.5	41.9	N	N	Y	Y	Clay-like	0.669	0.205	0.133	854	Clay	0.132
84.3	-68.7	39	MH	70	20	1.00		1.00	46	9689	4432	1.00	45.8	5.5	51.3	N	N	Y	Y	Clay-like	0.652	0.200	0.130	884	Clay	0.129
89.3	-73.7	100	MH	70	20	1.00		1.00	117	10264	4695	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.637	0.195	0.127	915	Clay	0.126
94.3	-78.7	22	MH	68	31	1.00		1.00	26	10839	4958	1.00	25.8	5.5	31.3	N	N	Y	Y	Clay-like	0.623	0.191	0.124	945	Clay	0.123
99.3	-83.7	30	MH	70	20	1.00		1.00	35	11414	5221	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.611	0.187	0.122	977	Clay	0.121
104.3	-88.7	48	MH	70	20	1.00		1.00	56	11989	5484	1.00	56.3	5.5	61.8	N	N	Y	Y	Clay-like	0.602	0.184	0.120	1010	Clay	0.119
109.3	-93.7	30	MH	70	20	1.00		1.00	35	12564	5747	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.595	0.182	0.118	1046	Clay	0.117
114.3	-98.7	28	MH	70	20	1.00		1.00	33	13139	6010	1.00	32.9	5.5	38.4	N	N	Y	Y	Clay-like	0.590	0.180	0.117	1084	Clay	0.116
119.3	-103.7	48	MH	70	20	1.00		1.00	56	13714	6273	1.00	56.3	5.5	61.8	N	N	Y	Y	Clay-like	0.587	0.180	0.117	1126	Clay	0.116
124.3	-108.7	44	MH	70	20	1.00		1.00	52	14289	6536	1.00	51.6	5.5	57.1	N	N	Y	Y	Clay-like	0.586	0.179	0.117	1173	Clay	0.116

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB14
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 5.3 ft

Maximum Depth of Liquefied Layers: 14.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	14.5	CH	65	50	11.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	945	10.0	1.11	1.00	1.11	0.18	5.61	No Loss
3.0	12.5	CH	64	52	21.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,325	10.0	1.11	1.00	1.11	0.18	5.63	No Loss
5.0	10.5	SM	25	0	35.1	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
7.0	8.5	SM	25	0	31.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
9.0	6.5	SM	25	0	38.9	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	1.3	SC	27	8	12.2	1.09	1.00	0.134	0.145	1.25	0.80	Full Liq.	-	-	-	-	-	-	-	-	-
19.3	-3.7	SM	25	0	41.5	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
24.3	-8.7	SP-SM	6	0	26.2	1.09	1.00	0.320	0.348	0.50	2.00	No Liq.	-	-	-	-	-	-	-	-	-
29.3	-13.7	SC	22	18	54.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,363	10.0	1.11	1.00	1.11	0.16	6.26	No Loss
34.3	-18.7	MH	70	20	44.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,905	10.0	1.11	1.00	1.11	0.16	6.43	No Loss
39.3	-23.7	MH	70	20	62.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,558	10.0	1.11	1.00	1.11	0.15	6.61	No Loss
44.3	-28.7	MH	70	20	68.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	9,462	10.0	1.11	1.00	1.11	0.15	6.81	No Loss
49.3	-33.7	SC	40	34	35.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,915	10.0	1.11	1.00	1.11	0.14	7.02	No Loss
54.3	-38.7	MH	70	20	79.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	11,072	10.0	1.11	1.00	1.11	0.14	7.25	No Loss
59.3	-43.7	MH	70	20	34.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,396	9.7	1.08	1.00	1.08	0.14	7.27	No Loss
64.3	-48.7	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,591	10.0	1.11	1.00	1.11	0.13	7.71	No Loss
69.3	-53.7	MH	70	20	39.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,103	9.6	1.07	1.00	1.07	0.13	7.67	No Loss
74.3	-58.7	CH	79	27	84.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	11,790	10.0	1.11	1.00	1.11	0.12	8.18	No Loss
79.3	-63.7	MH	70	20	41.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,455	8.8	1.00	1.00	1.00	0.13	7.59	No Loss
84.3	-68.7	MH	70	20	51.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,864	10.0	1.11	1.00	1.11	0.12	8.63	No Loss
89.3	-73.7	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.11	8.84	No Loss
94.3	-78.7	MH	68	31	31.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,872	4.6	0.60	1.00	0.60	0.21	4.86	No Loss
99.3	-83.7	MH	70	20	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,280	6.4	0.77	1.00	0.77	0.16	6.42	No Loss
104.3	-88.7	MH	70	20	61.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,448	10.0	1.11	1.00	1.11	0.11	9.35	No Loss
109.3	-93.7	MH	70	20	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,280	5.6	0.70	1.00	0.70	0.17	5.99	No Loss
114.3	-98.7	MH	70	20	38.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,928	4.9	0.63	1.00	0.63	0.19	5.40	No Loss
119.3	-103.7	MH	70	20	61.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,448	9.1	1.03	1.00	1.03	0.11	8.90	No Loss
124.3	-108.7	MH	70	20	57.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,744	7.8	0.91	1.00	0.91	0.13	7.84	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB14
Station:

Lateral Displacement Index, LDI: 1.95 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 2.08 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	14.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.173	2.1	-	-	-	-	1.95
3.0	12.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.173	2.1	-	-	-	-	1.95
5.0	10.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.173	2.1	-	-	-	-	1.95
7.0	8.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.173	2.1	-	-	-	-	1.95
9.0	6.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.173	2.1	-	-	-	-	1.95
14.3	1.3	30.4	2.2	9.2	Full Residual	124.5	0.09	0.09	68	64	5.2	4.9	-	0.372	37.2%	0.856	0.033	5.25	0.173	0.173	2.1	49	37.2%	5.25	1.95	1.95
19.3	-3.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-8.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	0.0%	-	-	-	-	0.000	0.0	72	0.0%	-	-	0.00
29.3	-13.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-18.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-23.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-28.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-33.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-38.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-43.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-48.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-53.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-58.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-63.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-68.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-73.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-78.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-83.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-88.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-93.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-98.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-103.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-108.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB15
Station:
Offset:

Hazard Level	FEE
PGA	0.14
M_W	7.30
Elevation	14.9 ft
Water Depth	0.0 ft
Hammer ER	70.4%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.17	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	N-value Correction							SSL Susceptibility Screening					Cyclic Stress					
								Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.9	4	CH	65	50	1.00		0.60	3	115	53	1.00	2.8	5.5	8.3	Y	N	Y	Y	Clay-like	1.004	0.307	0.200	16	Clay	0.198
3.0	11.9	17	CH	65	50	1.00		0.66	13	345	158	1.00	13.2	5.5	18.7	Y	N	Y	Y	Clay-like	0.999	0.306	0.199	48	Clay	0.197
5.0	9.9	21	SC	27	10	1.00		0.72	18	575	263	1.70	30.0	5.2	35.2	N	Y	Y	N	None	0.994	0.304	0.198	80	Clay	0.196
7.0	7.9	18	SM	19	3	1.00		0.77	16	805	368	1.70	27.5	4.3	31.8	N	Y	Y	N	None	0.988	0.302	0.197	111	Sand	0.186
9.0	5.9	16	SC	21	5	1.00		0.81	15	1035	473	1.70	25.8	4.6	30.4	N	Y	Y	N	None	0.982	0.300	0.195	142	Clay	0.194
14.3	0.6	24	SP-SM	12	0	1.00		0.89	25	1639	750	1.68	42.0	2.1	44.0	N	Y	Y	N	None	0.963	0.295	0.192	221	Sand	0.182
19.3	-4.4	29	SP-SM	12	0	1.00		0.93	32	2214	1013	1.45	45.9	2.1	48.0	N	Y	Y	N	None	0.944	0.289	0.188	292	Sand	0.178
24.3	-9.4	26	SP	3	0	1.00		0.96	29	2789	1276	1.29	37.8	0.0	37.8	N	Y	Y	N	None	0.922	0.282	0.183	360	Sand	0.174
29.3	-14.4	36	MH	70	20	1.00		0.98	41	3364	1539	1.00	41.3	5.5	46.8	N	N	Y	Y	Clay-like	0.899	0.275	0.179	424	Clay	0.177
34.3	-19.4	51	MH	70	20	1.00		0.99	59	3939	1802	1.00	59.0	5.5	64.5	N	N	Y	Y	Clay-like	0.876	0.268	0.174	483	Clay	0.173
39.3	-24.4	49	MH	70	20	1.00		0.99	57	4514	2065	1.00	57.1	5.5	62.6	N	N	Y	Y	Clay-like	0.851	0.260	0.169	538	Clay	0.168
44.3	-29.4	39	MH	70	20	1.00		1.00	46	5089	2328	1.00	45.6	5.5	51.1	N	N	Y	Y	Clay-like	0.826	0.253	0.164	589	Clay	0.163
49.3	-34.4	62	MH	70	20	1.00		1.00	73	5664	2591	1.00	72.6	5.5	78.1	N	N	Y	Y	Clay-like	0.801	0.245	0.159	635	Clay	0.158
54.3	-39.4	100	MH	70	20	1.00		1.00	117	6239	2854	1.00	117.2	5.5	122.7	N	N	Y	Y	Clay-like	0.777	0.238	0.155	679	Clay	0.153
59.3	-44.4	47	MH	70	20	1.00		1.00	55	6814	3117	1.00	55.1	5.5	60.6	N	N	Y	Y	Clay-like	0.753	0.231	0.150	718	Clay	0.149

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB15
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 0.0 ft

Maximum Depth of Liquefied Layers: 0.0 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	$1 / (D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	$1 / (D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = $0.8 \cdot \tau_{peak}$)
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	$CSR^*_{eq} / CRR^*_{eq} = (D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	$CSR^*_{eq} / CRR^*_{eq} = (D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.9	CH	65	50	8.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	420	10.0	1.11	1.00	1.11	0.18	5.61	No Loss
3.0	11.9	CH	65	50	18.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,976	10.0	1.11	1.00	1.11	0.18	5.63	No Loss
5.0	9.9	SC	27	10	35.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
7.0	7.9	SM	19	3	31.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
9.0	5.9	SC	21	5	30.4	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	0.6	SP-SM	12	0	44.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.4	SP-SM	12	0	48.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
24.3	-9.4	SP	3	0	37.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
29.3	-14.4	MH	70	20	46.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,191	10.0	1.11	1.00	1.11	0.16	6.26	No Loss
34.3	-19.4	MH	70	20	64.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,857	10.0	1.11	1.00	1.11	0.16	6.43	No Loss
39.3	-24.4	MH	70	20	62.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,558	10.0	1.11	1.00	1.11	0.15	6.61	No Loss
44.3	-29.4	MH	70	20	51.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,834	10.0	1.11	1.00	1.11	0.15	6.81	No Loss
49.3	-34.4	MH	70	20	78.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	10,884	10.0	1.11	1.00	1.11	0.14	7.02	No Loss
54.3	-39.4	MH	70	20	122.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,574	10.0	1.11	1.00	1.11	0.14	7.25	No Loss
59.3	-44.4	MH	70	20	60.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,265	10.0	1.11	1.00	1.11	0.13	7.47	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB15
Station:

Lateral Displacement Index, LDI: 0.00 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 0.00 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
3.0	11.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
5.0	9.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
7.0	7.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
9.0	5.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
14.3	0.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
19.3	-4.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	FEE	Unit Weight	115 pcf		
County: JASPER COUNTY	PGA	0.14	Sample Liners Required	No		
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No		
Boring: BS-STB1	Elevation	27.8 ft	C_B	1.00	Table 7-5	
Station:	Water Depth	16.3 ft	C_E	1.30	Eq 7-2	
Offset:	Hammer ER	77.8%	C_S	1.00	Table 7-4	
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11	
			MSF_{Clay}	1.009	Eq 13-12	

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
2.2	25.6	9	SM	30	5	1.00		0.64	7	253	253	1.70	12.6	5.4	18.0	Y	Y	N	N	None	1.001	0.140	0.091	35	Clay	0.090
4.2	23.6	22	SM	30	5	1.00		0.70	20	483	483	1.70	33.7	5.4	39.1	N	Y	N	N	None	0.996	0.139	0.091	67	Clay	0.090
6.2	21.6	6	SM	30	5	1.00		0.75	6	713	713	1.70	9.9	5.4	15.2	Y	Y	N	N	None	0.990	0.139	0.090	99	Clay	0.089
8.2	19.6	12	SM	30	5	1.00		0.79	12	943	943	1.50	18.4	5.4	23.8	Y	Y	N	N	None	0.984	0.138	0.090	130	Clay	0.089
10.2	17.6	4	ML	60	5	1.00		0.83	4	1173	1173	1.00	4.3	5.5	9.8	Y	Y	N	N	None	0.978	0.137	0.089	161	Clay	0.088
14.3	13.6	15	SM	21	0	1.00		0.89	17	1639	1639	1.14	19.6	4.6	24.2	Y	Y	N	N	None	0.963	0.135	0.088	221	Clay	0.087
19.3	8.6	2	SC	24	9	1.00		0.93	2	2214	2030	1.02	2.5	5.0	7.5	Y	Y	Y	N	Sand-like	0.944	0.144	0.094	292	Sand	0.089
24.3	3.6	5	SP-SM	5	0	1.00		0.96	6	2789	2293	0.96	6.0	0.0	6.0	Y	Y	Y	N	Sand-like	0.922	0.157	0.102	360	Sand	0.097
29.3	-1.5	14	SP-SM	6	0	1.00		0.98	18	3364	2556	0.91	16.1	0.0	16.2	Y	Y	Y	N	Sand-like	0.899	0.166	0.108	424	Sand	0.102
34.3	-6.5	21	SP-SM	5	0	1.00		0.99	27	3939	2819	0.87	23.3	0.0	23.3	Y	Y	Y	N	Sand-like	0.876	0.171	0.111	483	Sand	0.106
39.3	-11.5	12	SP	3	0	1.00		0.99	15	4514	3082	0.83	12.8	0.0	12.8	Y	Y	Y	N	Sand-like	0.851	0.175	0.113	538	Sand	0.108
44.3	-16.5	18	SC	30	25	1.00		1.00	23	5089	3345	0.80	18.5	5.4	23.8	Y	N	Y	Y	Clay-like	0.826	0.176	0.114	589	Clay	0.113
49.3	-21.5	20	SC	39	28	1.00		1.00	26	5664	3608	0.77	19.8	5.5	25.3	Y	N	Y	Y	Clay-like	0.801	0.176	0.114	635	Clay	0.114
54.3	-26.5	22	SC	30	25	1.00		1.00	28	6239	3871	0.74	21.1	5.4	26.4	Y	N	Y	Y	Clay-like	0.777	0.175	0.114	679	Clay	0.113
59.3	-31.5	27	SC	45	33	1.00		1.00	35	6814	4134	0.72	25.0	5.5	30.5	N	N	Y	Y	Clay-like	0.753	0.174	0.113	718	Clay	0.112
64.3	-36.5	19	CH	60	41	1.00		1.00	25	7389	4397	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.730	0.172	0.112	755	Clay	0.111
69.3	-41.5	19	CH	60	40	1.00		1.00	25	7964	4660	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.708	0.170	0.110	790	Clay	0.109
74.3	-46.5	17	CH	60	40	1.00		1.00	22	8539	4923	1.00	22.0	5.5	27.5	Y	N	Y	Y	Clay-like	0.688	0.167	0.109	823	Clay	0.108
79.3	-51.5	35	SM	39	32	1.00		1.00	45	9114	5186	0.64	29.0	5.5	34.5	N	N	Y	Y	Clay-like	0.669	0.165	0.107	854	Clay	0.106
84.3	-56.5	17	MH	90	62	1.00		1.00	22	9689	5449	1.00	22.0	5.5	27.5	Y	N	Y	Y	Clay-like	0.652	0.162	0.105	884	Clay	0.105
89.3	-61.5	46	MH	70	40	1.00		1.00	60	10264	5712	1.00	59.6	5.5	65.1	N	N	Y	Y	Clay-like	0.637	0.160	0.104	915	Clay	0.103
93.6	-65.8	100	MH	70	40	1.00		1.00	130	10764	5940	1.00	129.7	5.5	135.2	N	N	Y	Y	Clay-like	0.625	0.158	0.103	941	Clay	0.102
99.3	-71.5	11	MH	70	40	1.00		1.00	14	11414	6238	1.00	14.3	5.5	19.8	Y	N	Y	Y	Clay-like	0.611	0.157	0.102	977	Clay	0.101

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB1
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 10.0 ft

Maximum Depth of Liquefied Layers: 24.3 ft

Total Thickness of Limited Liquefaction: 5.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
2.2	25.6	SM	30	5	18.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
4.2	23.6	SM	30	5	39.1	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
6.2	21.6	SM	30	5	15.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
8.2	19.6	SM	30	5	23.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
10.2	17.6	ML	60	5	9.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	13.6	SM	21	0	24.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
19.3	8.6	SC	24	9	7.5	1.00	1.00	0.101	0.101	0.88	1.14	Full Liq.	-	-	-	-	-	-	-	-	-
24.3	3.6	SP-SM	5	0	6.0	0.99	1.00	0.092	0.091	1.06	0.94	Full Liq.	-	-	-	-	-	-	-	-	-
29.3	-1.5	SP-SM	6	0	16.2	0.98	1.00	0.166	0.163	0.63	1.59	No Liq.	-	-	-	-	-	-	-	-	-
34.3	-6.5	SP-SM	5	0	23.3	0.96	1.00	0.254	0.243	0.43	2.30	No Liq.	-	-	-	-	-	-	-	-	-
39.3	-11.5	SP	3	0	12.8	0.96	1.00	0.138	0.133	0.81	1.24	Limited Liq.	-	-	-	-	-	-	-	-	-
44.3	-16.5	SC	30	25	23.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,485	6.6	0.80	1.00	0.80	0.14	7.03	No Loss
49.3	-21.5	SC	39	28	25.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,880	6.9	0.82	1.00	0.82	0.14	7.25	No Loss
54.3	-26.5	SC	30	25	26.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,273	7.1	0.84	1.00	0.84	0.13	7.48	No Loss
59.3	-31.5	SC	45	33	30.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,247	8.5	0.97	1.00	0.97	0.12	8.67	No Loss
64.3	-36.5	CH	60	41	30.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,694	5.0	0.64	1.00	0.64	0.17	5.81	No Loss
69.3	-41.5	CH	60	40	30.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,694	4.7	0.61	1.00	0.61	0.18	5.55	No Loss
74.3	-46.5	CH	60	40	27.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,306	3.8	0.51	1.00	0.51	0.21	4.77	No Loss
79.3	-51.5	SM	39	32	34.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,807	8.8	1.00	1.00	1.00	0.11	9.47	No Loss
84.3	-56.5	MH	90	62	27.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,306	3.4	0.46	1.00	0.46	0.23	4.44	No Loss
89.3	-61.5	MH	70	40	65.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,947	10.0	1.11	1.00	1.11	0.09	10.76	No Loss
93.6	-65.8	MH	70	40	135.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	19,450	10.0	1.11	1.00	1.11	0.09	10.87	No Loss
99.3	-71.5	MH	70	40	19.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,139	1.6	0.26	1.00	0.26	0.38	2.60	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB1
Station:

Lateral Displacement Index, LDI: 3.85 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 3.44 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
2.2	25.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.287	3.4	-	-	-	-	3.85
4.2	23.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.287	3.4	-	-	-	-	3.85
6.2	21.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.287	3.4	-	-	-	-	3.85
8.2	19.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.287	3.4	-	-	-	-	3.85
10.2	17.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.287	3.4	-	-	-	-	3.85
14.3	13.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.287	3.4	-	-	-	-	3.85
19.3	8.6	26.2	1.9	4.4	Full Residual	126.4	0.06	0.06	114	113	3.2	3.2	-	0.631	0.8%	0.947	0.004	5.00	0.022	0.287	3.4	38	0.8%	5.00	0.04	3.85
24.3	3.6	29.6	0.5	6.5	Full Residual	197.9	0.07	0.07	160	156	4.0	3.9	-	0.751	75.1%	0.948	0.049	5.00	0.243	0.264	3.2	34	75.1%	5.00	3.76	3.81
29.3	-1.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.022	0.3	56	#VALUE!	-	-	0.05
34.3	-6.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	0.0%	-	-	-	-	0.022	0.3	68	0.0%	-	-	0.05
39.3	-11.5	34.0	0.3	13.1	Partial Loss	-	-	-	-	-	-	-	34.0	0.349	1.1%	0.837	0.004	5.00	0.022	0.022	0.3	50	1.1%	5.00	0.05	0.05
44.3	-16.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-21.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-26.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-31.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-36.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-41.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-46.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-51.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-56.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-61.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
93.6	-65.8	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-71.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB3
Station:
Offset:

Hazard Level	FEE
PGA	0.14
M_W	7.30
Elevation	26.9 ft
Water Depth	16.3 ft
Hammer ER	77.8%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.30	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
2.2	24.7	3	SM	30	6	1.00		0.64	2	253	253	1.70	4.2	5.4	9.6	Y	Y	N	N	None	1.001	0.140	0.091	35	Clay	0.090
4.2	22.7	3	SM	30	6	1.00		0.70	3	483	483	1.70	4.6	5.4	10.0	Y	Y	N	N	None	0.996	0.139	0.091	67	Clay	0.090
6.2	20.7	11	SM	30	6	1.00		0.75	11	713	713	1.70	18.1	5.4	23.5	Y	Y	N	N	None	0.990	0.139	0.090	99	Clay	0.089
8.2	18.7	14	SM	30	6	1.00		0.79	14	943	943	1.50	21.5	5.4	26.9	Y	Y	N	N	None	0.984	0.138	0.090	130	Clay	0.089
10.2	16.7	8	SC-SM	30	6	1.00		0.83	9	1173	1173	1.34	11.5	5.4	16.9	Y	Y	N	N	None	0.978	0.137	0.089	161	Clay	0.088
14.3	12.7	3	SC-SM	40	7	1.00		0.89	3	1639	1639	1.14	3.9	5.5	9.4	Y	Y	N	N	None	0.963	0.135	0.088	221	Clay	0.087
19.3	7.7	11	CL	59	21	1.00		0.93	13	2214	2030	1.00	13.3	5.5	18.8	Y	N	Y	Y	Clay-like	0.944	0.144	0.094	292	Clay	0.093
24.3	2.7	15	SM	18	0	1.00		0.96	19	2789	2293	0.96	18.0	4.1	22.0	Y	Y	Y	N	Sand-like	0.922	0.157	0.102	360	Sand	0.097
29.3	-2.4	20	SM	30	5	1.00		0.98	25	3364	2556	0.91	23.1	5.4	28.4	Y	Y	Y	N	Sand-like	0.899	0.166	0.108	424	Sand	0.102
34.3	-7.4	15	SP	4	0	1.00		0.99	19	3939	2819	0.87	16.6	0.0	16.6	Y	Y	Y	N	Sand-like	0.876	0.171	0.111	483	Sand	0.106
39.3	-12.4	11	SP	5	0	1.00		0.99	14	4514	3082	0.83	11.7	0.0	11.7	Y	Y	Y	N	Sand-like	0.851	0.175	0.113	538	Sand	0.108
44.3	-17.4	23	SC	25	15	1.00		1.00	30	5089	3345	0.80	23.6	5.1	28.7	Y	N	Y	Y	Clay-like	0.826	0.176	0.114	589	Clay	0.113
49.3	-22.4	17	SC	36	23	1.00		1.00	22	5664	3608	0.77	16.8	5.5	22.3	Y	N	Y	Y	Clay-like	0.801	0.176	0.114	635	Clay	0.114
54.3	-27.4	21	SC	30	20	1.00		1.00	27	6239	3871	0.74	20.1	5.4	25.5	Y	N	Y	Y	Clay-like	0.777	0.175	0.114	679	Clay	0.113
59.3	-32.4	16	CH	64	51	1.00		1.00	21	6814	4134	1.00	20.7	5.5	26.2	Y	N	Y	Y	Clay-like	0.753	0.174	0.113	718	Clay	0.112
64.3	-37.4	14	CH	75	20	1.00		1.00	18	7389	4397	1.00	18.1	5.5	23.6	Y	N	Y	Y	Clay-like	0.730	0.172	0.112	755	Clay	0.111
69.3	-42.4	13	CH	70	44	1.00		1.00	17	7964	4660	1.00	16.9	5.5	22.4	Y	N	Y	Y	Clay-like	0.708	0.170	0.110	790	Clay	0.109
74.3	-47.4	22	MH	64	46	1.00		1.00	29	8539	4923	1.00	28.5	5.5	34.0	N	N	Y	Y	Clay-like	0.688	0.167	0.109	823	Clay	0.108
79.3	-52.4	12	MH	70	20	1.00		1.00	16	9114	5186	1.00	15.6	5.5	21.1	Y	N	Y	Y	Clay-like	0.669	0.165	0.107	854	Clay	0.106
84.3	-57.4	25	MH	70	20	1.00		1.00	32	9689	5449	1.00	32.4	5.5	37.9	N	N	Y	Y	Clay-like	0.652	0.162	0.105	884	Clay	0.105
89.3	-62.4	28	CH	60	51	1.00		1.00	36	10264	5712	1.00	36.3	5.5	41.8	N	N	Y	Y	Clay-like	0.637	0.160	0.104	915	Clay	0.103
94.3	-67.4	23	CH	70	40	1.00		1.00	30	10839	5975	1.00	29.8	5.5	35.3	N	N	Y	Y	Clay-like	0.623	0.158	0.103	945	Clay	0.102
99.3	-72.4	13	CH	70	40	1.00		1.00	17	11414	6238	1.00	16.9	5.5	22.4	Y	N	Y	Y	Clay-like	0.611	0.157	0.102	977	Clay	0.101
103.7	-76.8	100	CH	70	40	1.00		1.00	130	11926	6472	1.00	129.7	5.5	135.2	N	N	Y	Y	Clay-like	0.603	0.156	0.101	1007	Clay	0.100
109.3	-82.4	15	CH	70	40	1.00		1.00	19	12564	6764	1.00	19.4	5.5	24.9	Y	N	Y	Y	Clay-like	0.595	0.155	0.101	1046	Clay	0.100

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB3
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 5.0 ft

Maximum Depth of Liquefied Layers: 39.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
2.2	24.7	SM	30	6	9.6	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
4.2	22.7	SM	30	6	10.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
6.2	20.7	SM	30	6	23.5	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
8.2	18.7	SM	30	6	26.9	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
10.2	16.7	SC-SM	30	6	16.9	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	12.7	SC-SM	40	7	9.4	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
19.3	7.7	CL	59	21	18.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,996	6.1	0.75	1.00	0.75	0.12	8.10	No Loss
24.3	2.7	SM	18	0	22.0	0.99	1.00	0.234	0.231	0.42	2.39	No Liq.	-	-	-	-	-	-	-	-	-
29.3	-2.4	SM	30	5	28.4	0.97	1.00	0.402	0.390	0.26	3.82	No Liq.	-	-	-	-	-	-	-	-	-
34.3	-7.4	SP	4	0	16.6	0.97	1.00	0.170	0.165	0.64	1.56	No Liq.	-	-	-	-	-	-	-	-	-
39.3	-12.4	SP	5	0	11.7	0.96	1.00	0.130	0.126	0.86	1.17	Full Liq.	-	-	-	-	-	-	-	-	-
44.3	-17.4	SC	25	15	28.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,454	9.0	1.02	1.00	1.02	0.11	8.98	No Loss
49.3	-22.4	SC	36	23	22.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,298	5.6	0.70	1.00	0.70	0.16	6.16	No Loss
54.3	-27.4	SC	30	20	25.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,078	6.7	0.81	1.00	0.81	0.14	7.14	No Loss
59.3	-32.4	CH	64	51	26.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,109	4.4	0.58	1.00	0.58	0.19	5.14	No Loss
64.3	-37.4	CH	75	20	23.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,722	3.4	0.47	1.00	0.47	0.23	4.28	No Loss
69.3	-42.4	CH	70	44	22.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,528	2.9	0.42	1.00	0.42	0.26	3.80	No Loss
74.3	-47.4	MH	64	46	34.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,278	5.3	0.67	1.00	0.67	0.16	6.18	No Loss
79.3	-52.4	MH	70	20	21.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,334	2.3	0.34	1.00	0.34	0.31	3.25	No Loss
84.3	-57.4	MH	70	20	37.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,862	5.4	0.68	1.00	0.68	0.15	6.53	No Loss
89.3	-62.4	CH	60	51	41.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,446	5.9	0.73	1.00	0.73	0.14	7.07	No Loss
94.3	-67.4	CH	70	40	35.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,473	4.4	0.57	1.00	0.57	0.18	5.62	No Loss
99.3	-72.4	CH	70	40	22.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,528	2.0	0.31	1.00	0.31	0.33	3.07	No Loss
103.7	-76.8	CH	70	40	135.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	19,450	10.0	1.11	1.00	1.11	0.09	11.08	No Loss
109.3	-82.4	CH	70	40	24.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,917	2.2	0.33	1.00	0.33	0.30	3.31	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB3
Station:

Lateral Displacement Index, LDI: 0.06 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 0.32 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
2.2	24.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.3	-	-	-	-	0.06
4.2	22.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.3	-	-	-	-	0.06
6.2	20.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.3	-	-	-	-	0.06
8.2	18.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.3	-	-	-	-	0.06
10.2	16.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.3	-	-	-	-	0.06
14.3	12.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.3	-	-	-	-	0.06
19.3	7.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027	0.3	-	-	-	-	0.06
24.3	2.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	0.0%	-	-	-	-	0.027	0.3	66	0.0%	-	-	0.06
29.3	-2.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	0.0%	-	-	-	-	0.027	0.3	75	0.0%	-	-	0.06
34.3	-7.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.027	0.3	57	#VALUE!	-	-	0.06
39.3	-12.4	33.4	0.5	12.2	Full Residual	435.7	0.13	0.11	400	328	7.4	6.1	-	0.392	1.3%	0.870	0.005	5.00	0.027	0.027	0.3	48	1.3%	5.00	0.06	0.06
44.3	-17.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-22.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-27.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-32.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-37.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-42.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-47.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-52.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-57.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-62.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-67.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-72.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
103.7	-76.8	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-82.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	FEE	Unit Weight	115 pcf		
County: JASPER COUNTY	PGA	0.14	Sample Liners Required	No		
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No		
Boring: BS-STB13	Elevation	14.4 ft	C_B	1.00	Table 7-5	
Station:	Water Depth	3.4 ft	C_E	1.37	Eq 7-2	
Offset:	Hammer ER	82.1%	C_S	1.00	Table 7-4	
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11	
			MSF_{Clay}	1.009	Eq 13-12	

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.4	6	SC	30	15	1.00		0.60	5	116	116	1.70	8.3	5.4	13.7	Y	N	N	Y	Clay-like	1.004	0.141	0.091	16	Clay	0.091
3.0	11.4	6	SC	30	15	1.00		0.66	5	345	345	1.70	9.2	5.4	14.6	Y	N	N	Y	Clay-like	0.999	0.140	0.091	48	Clay	0.090
5.0	9.4	10	CL	60	15	1.00		0.72	10	575	475	1.00	9.8	5.5	15.3	Y	N	Y	Y	Clay-like	0.994	0.168	0.109	80	Clay	0.109
7.0	7.4	11	SM	13	0	1.00		0.77	12	805	580	1.70	19.6	2.5	22.1	Y	Y	Y	N	Sand-like	0.988	0.192	0.125	111	Sand	0.118
9.0	5.4	9	SP-SM	12	0	1.00		0.81	10	1035	686	1.70	16.9	2.1	19.0	Y	Y	Y	N	Sand-like	0.982	0.207	0.135	142	Sand	0.128
14.3	0.2	4	SC	15	15	1.00		0.89	5	1639	962	1.48	7.2	3.3	10.5	Y	Y	Y	N	Sand-like	0.963	0.230	0.149	221	Sand	0.142
19.3	-4.9	9	SP	4	0	1.00		0.93	11	2214	1225	1.31	15.1	0.0	15.1	Y	Y	Y	N	Sand-like	0.944	0.239	0.155	292	Sand	0.147
24.3	-9.9	12	SC	30	10	1.00		0.96	16	2789	1488	1.19	18.8	5.4	24.2	Y	Y	Y	N	Sand-like	0.922	0.242	0.157	360	Sand	0.149
29.3	-14.9	22	SC	31	18	1.00		0.98	29	3364	1751	1.10	32.3	5.4	37.7	N	N	Y	Y	Clay-like	0.899	0.242	0.157	424	Clay	0.156
34.3	-19.9	18	SC	30	20	1.00		0.99	24	3939	2014	1.03	24.9	5.4	30.3	N	N	Y	Y	Clay-like	0.876	0.240	0.156	483	Clay	0.155
39.3	-24.9	22	SC	43	21	1.00		0.99	30	4514	2277	0.96	28.8	5.5	34.3	N	N	Y	Y	Clay-like	0.851	0.236	0.154	538	Clay	0.152
44.3	-29.9	22	CH	60	20	1.00		1.00	30	5089	2540	1.00	30.0	5.5	35.5	N	N	Y	Y	Clay-like	0.826	0.232	0.151	589	Clay	0.149
49.3	-34.9	30	CH	52	38	1.00		1.00	41	5664	2803	1.00	40.9	5.5	46.4	N	N	Y	Y	Clay-like	0.801	0.227	0.147	635	Clay	0.146
54.3	-39.9	12	MH	72	14	1.00		1.00	16	6239	3066	1.00	16.4	5.5	21.9	Y	N	Y	Y	Clay-like	0.777	0.221	0.144	679	Clay	0.143
59.3	-44.9	27	MH	70	12	1.00		1.00	37	6814	3329	1.00	36.9	5.5	42.4	N	N	Y	Y	Clay-like	0.753	0.216	0.140	718	Clay	0.139
64.3	-49.9	23	MH	62	31	1.00		1.00	31	7389	3592	1.00	31.5	5.5	37.0	N	N	Y	Y	Clay-like	0.730	0.210	0.137	755	Clay	0.136
69.3	-54.9	28	MH	70	20	1.00		1.00	38	7964	3855	1.00	38.3	5.5	43.8	N	N	Y	Y	Clay-like	0.708	0.205	0.133	790	Clay	0.132
74.3	-59.9	16	MH	87	34	1.00		1.00	22	8539	4118	1.00	21.9	5.5	27.4	Y	N	Y	Y	Clay-like	0.688	0.200	0.130	823	Clay	0.129
79.3	-64.9	65	MH	97	41	1.00		1.00	89	9114	4381	1.00	88.9	5.5	94.4	N	N	Y	Y	Clay-like	0.669	0.195	0.127	854	Clay	0.126
83.6	-69.2	100	MH	70	30	1.00		1.00	137	9614	4610	1.00	136.8	5.5	142.3	N	N	Y	Y	Clay-like	0.654	0.191	0.124	880	Clay	0.123
89.3	-74.9	69	MH	70	30	1.00		1.00	94	10264	4907	1.00	94.4	5.5	99.9	N	N	Y	Y	Clay-like	0.637	0.186	0.121	915	Clay	0.120
94.3	-79.9	15	MH	99	43	1.00		1.00	21	10839	5170	1.00	20.5	5.5	26.0	Y	N	Y	Y	Clay-like	0.623	0.183	0.119	945	Clay	0.118
99.3	-84.9	100	MH	70	30	1.00		1.00	137	11414	5433	1.00	136.8	5.5	142.3	N	N	Y	Y	Clay-like	0.611	0.180	0.117	977	Clay	0.116
104.3	-89.9	18	MH	70	30	1.00		1.00	25	11989	5696	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.602	0.177	0.115	1010	Clay	0.114
108.6	-94.2	100	MH	70	30	1.00		1.00	137	12483	5922	1.00	136.8	5.5	142.3	N	N	Y	Y	Clay-like	0.596	0.176	0.114	1041	Clay	0.113
114.3	-99.9	27	MH	70	30	1.00		1.00	37	13139	6222	1.00	36.9	5.5	42.4	N	N	Y	Y	Clay-like	0.590	0.174	0.113	1084	Clay	0.112
119.3	-104.9	16	MH	70	30	1.00		1.00	22	13714	6485	1.00	21.9	5.5	27.4	Y	N	Y	Y	Clay-like	0.587	0.174	0.113	1126	Clay	0.112
124.3	-109.9	20	MH	70	30	1.00		1.00	27	14289	6748	1.00	27.4	5.5	32.9	N	N	Y	Y	Clay-like	0.586	0.174	0.113	1173	Clay	0.112

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB13
Station:

Resistance Factors:		By Table 9-10 SEE
$\phi_{SL\text{-}Sand}$	0.85	0.90
$\phi_{SL\text{-}Clay}$	0.85	0.90

Total Thickness of Liquefied Layers: 10.3 ft

Maximum Depth of Liquefied Layers: 19.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.4	SC	30	15	13.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	735	10.0	1.11	1.00	1.11	0.08	12.26	No Loss
3.0	11.4	SC	30	15	14.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	813	10.0	1.11	1.00	1.11	0.08	12.32	No Loss
5.0	9.4	CL	60	15	15.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,471	10.0	1.11	1.00	1.11	0.10	10.23	No Loss
7.0	7.4	SM	13	0	22.1	1.10	1.00	0.235	0.258	0.46	2.18	No Liq.	-	-	-	-	-	-	-	-	-
9.0	5.4	SP-SM	12	0	19.0	1.10	1.00	0.194	0.213	0.60	1.67	No Liq.	-	-	-	-	-	-	-	-	-
14.3	0.2	SC	15	15	10.5	1.07	1.00	0.121	0.129	1.10	0.91	Full Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.9	SP	4	0	15.1	1.06	1.00	0.157	0.167	0.88	1.13	Full Liq.	-	-	-	-	-	-	-	-	-
24.3	-9.9	SC	30	10	24.2	1.04	1.00	0.272	0.284	0.53	1.90	No Liq.	-	-	-	-	-	-	-	-	-
29.3	-14.9	SC	31	18	37.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,412	10.0	1.11	1.00	1.11	0.14	7.12	No Loss
34.3	-19.9	SC	30	20	30.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,646	10.0	1.11	1.00	1.11	0.14	7.19	No Loss
39.3	-24.9	SC	43	21	34.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,481	10.0	1.11	1.00	1.11	0.14	7.29	No Loss
44.3	-29.9	CH	60	20	35.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,496	10.0	1.11	1.00	1.11	0.13	7.43	No Loss
49.3	-34.9	CH	52	38	46.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,142	10.0	1.11	1.00	1.11	0.13	7.60	No Loss
54.3	-39.9	MH	72	14	21.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,459	4.8	0.61	1.00	0.61	0.23	4.30	No Loss
59.3	-44.9	MH	70	12	42.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,537	10.0	1.11	1.00	1.11	0.13	7.98	No Loss
64.3	-49.9	MH	62	31	37.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,718	8.8	1.01	1.00	1.01	0.13	7.42	No Loss
69.3	-54.9	MH	70	20	43.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,745	10.0	1.11	1.00	1.11	0.12	8.41	No Loss
74.3	-59.9	MH	87	34	27.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,283	4.7	0.61	1.00	0.61	0.21	4.74	No Loss
79.3	-64.9	MH	97	41	94.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	13,340	10.0	1.11	1.00	1.11	0.11	8.84	No Loss
83.6	-69.2	MH	70	30	142.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	20,524	10.0	1.11	1.00	1.11	0.11	9.02	No Loss
89.3	-74.9	MH	70	30	99.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	14,162	10.0	1.11	1.00	1.11	0.11	9.24	No Loss
94.3	-79.9	MH	99	43	26.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,079	3.3	0.46	1.00	0.46	0.26	3.87	No Loss
99.3	-84.9	MH	70	30	142.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	20,525	10.0	1.11	1.00	1.11	0.10	9.58	No Loss
104.3	-89.9	MH	70	30	30.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,694	3.7	0.50	1.00	0.50	0.23	4.34	No Loss
108.6	-94.2	MH	70	30	142.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	20,525	10.0	1.11	1.00	1.11	0.10	9.80	No Loss
114.3	-99.9	MH	70	30	42.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,542	5.4	0.68	1.00	0.68	0.16	6.07	No Loss
119.3	-104.9	MH	70	30	27.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,284	2.7	0.39	1.00	0.39	0.29	3.46	No Loss
124.3	-109.9	MH	70	30	32.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,105	3.4	0.47	1.00	0.47	0.24	4.16	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB13
Station:

Lateral Displacement Index, LDI: 0.52 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 2.71 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.226	2.7	-	-	-	-	0.52
3.0	11.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.226	2.7	-	-	-	-	0.52
5.0	9.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.226	2.7	-	-	-	-	0.52
7.0	7.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	0.0%	-	-	-	-	0.226	2.7	66	0.0%	-	-	0.52
9.0	5.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.226	2.7	61	#VALUE!	-	-	0.52
14.3	0.2	30.5	1.3	8.5	Full Residual	143.9	0.09	0.08	82	78	4.9	4.6	-	0.450	8.0%	0.904	0.036	5.25	0.191	0.226	2.7	45	8.0%	5.25	0.42	0.52
19.3	-4.9	35.3	0.4	15.5	Full Residual	384.6	0.25	0.13	300	161	13.8	7.5	-	0.272	2.0%	0.750	0.007	5.00	0.036	0.036	0.4	54	2.0%	5.00	0.10	0.10
24.3	-9.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.000	0.0	69	#VALUE!	-	-	0.00
29.3	-14.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-49.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-54.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-59.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-64.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
83.6	-69.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-74.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-79.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-84.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-89.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
108.6	-94.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-99.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-104.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-109.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

SEE 3% Probability of Exceedance in 75 Years

Soil Shear Strength Loss Susceptibility Screening

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299

Hazard Level:	FEE	SEE
PGA 0.370	0.14	0.37
M_w 7.30	7.3	7.3

Boring	Station	Offset	Location / Roadway Classification	Lateral Displacement Index (ft)	Total Thickness of Limited Liquefaction (ft)	Total Thickness of Clay-like Strength Loss (ft)	Total Thickness of Full Liquefaction (ft)	Max. Depth of Liquefaction (ft)	Liquefaction Settlement (in)	Longitudinal Differential Settlement	Longitudinal Differential Settlement PL	Comment
BS-STB02			400psf, 10 deg.	1.0	0.0	0.0	7.3	6.3 - -1	14.3	1.7	500psf, 10 deg.	
BS-STB10				2.6	0.0	0.0	9.3	8.3 -6 6 - -1	14.3	3.1	700psf, 16 deg.	
BS-STB11			1300psf, 16 deg.	0.8	0.0	0.0	9.0	24.3	1.8	-	125psf, 6 deg.	
BS-STB14				2.3	0.0	0.0	10.3	3 - -2 5 - -10.3	24.3	2.9	-	125psf, 5 deg.
BS-STB15				0.0	0.0	0.0	0.0	0.0	0.0	-	1300psf, 17 deg.	
BS-STB1			700psf, 9 deg.	10.1	0.0	5.7	25.0	9 - 0 0 - -12	39.3	9.8	-	150psf, 3 deg.
BS-STB3			500psf, 6 deg.	3.3	0.0	0.0	15.0	39.3	4.3	-	800psf, 8 deg.	
BS-STB13				4.4	0.0	0.0	19.3	9 - -10	24.3	6.0	-	
											-	
											-	
											-	
											-	
											-	
											-	

300psf, 7 deg.

SSL Summary:

Elev.	Residual tau,rl	Residual phi',rl
9 - 6	125psf	3 deg.
6 - 2	125psf	6 deg.
2 - -2	125psf	5 deg.
-5 - -10	300psf	7 deg.
-10 - -12	800psf	8 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	SEE	Unit Weight	115 pcf	
County: JASPER COUNTY	PGA	0.37	Sample Liners Required	No	
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No	
Boring: BS-STB02	Elevation	14.7 ft	C_B	1.00	Table 7-5
Station:	Water Depth	0.0 ft	C_E	1.17	Eq 7-2
Offset:	Hammer ER	70.4%	C_S	1.00	Table 7-4
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11
			MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.7	17	SC	44	17	1.00		0.60	12	115	53	1.70	20.2	5.5	25.7	Y	N	Y	Y	Clay-like	1.004	0.812	0.528	43	Clay	0.524
3.0	11.7	13	SC	44	17	1.00		0.66	10	345	158	1.70	17.1	5.5	22.6	Y	N	Y	Y	Clay-like	0.999	0.808	0.525	128	Clay	0.521
5.0	9.7	21	SC	44	17	1.00		0.72	18	575	263	1.70	30.0	5.5	35.5	N	N	Y	Y	Clay-like	0.994	0.804	0.523	211	Clay	0.518
7.0	7.7	14	SM	30	15	1.00		0.77	13	805	368	1.70	21.4	5.4	26.7	Y	N	Y	Y	Clay-like	0.988	0.799	0.519	294	Clay	0.515
9.0	5.7	17	SP-SM	8	0	1.00		0.81	16	1035	473	1.70	27.4	0.4	27.7	Y	Y	Y	N	Sand-like	0.982	0.794	0.516	376	Sand	0.490
14.3	0.4	11	SP-SM	8	0	1.00		0.89	11	1639	750	1.68	19.2	0.4	19.6	Y	Y	Y	N	Sand-like	0.963	0.779	0.506	584	Sand	0.480
19.3	-4.6	22	SP-SM	8	0	1.00		0.93	24	2214	1013	1.45	34.8	0.4	35.2	N	Y	Y	N	None	0.944	0.763	0.496	773	Sand	0.471
24.3	-9.6	28	SP-SM	8	0	1.00		0.96	32	2789	1276	1.29	40.7	0.4	41.0	N	Y	Y	N	None	0.922	0.746	0.485	952	Sand	0.460
29.3	-14.6	34	SM	30	12	1.00		0.98	39	3364	1539	1.17	45.7	5.4	51.1	N	N	Y	Y	Clay-like	0.899	0.728	0.473	1119	Clay	0.469
34.3	-19.6	31	SM	35	12	1.00		0.99	36	3939	1802	1.08	38.9	5.5	44.4	N	N	Y	Y	Clay-like	0.876	0.708	0.460	1276	Clay	0.456
39.3	-24.6	69	SM	36	14	1.00		0.99	80	4514	2065	1.01	81.3	5.5	86.8	N	N	Y	Y	Clay-like	0.851	0.688	0.447	1421	Clay	0.444
44.3	-29.6	48	MH	70	20	1.00		1.00	56	5089	2328	1.00	56.1	5.5	61.6	N	N	Y	Y	Clay-like	0.826	0.668	0.434	1556	Clay	0.431
49.3	-34.6	32	MH	65	28	1.00		1.00	37	5664	2591	1.00	37.5	5.5	43.0	N	N	Y	Y	Clay-like	0.801	0.648	0.421	1679	Clay	0.418
54.3	-39.6	42	MH	70	20	1.00		1.00	49	6239	2854	1.00	49.2	5.5	54.7	N	N	Y	Y	Clay-like	0.777	0.629	0.409	1793	Clay	0.405
59.3	-44.6	36	MH	55	40	1.00		1.00	42	6814	3117	1.00	42.2	5.5	47.7	N	N	Y	Y	Clay-like	0.753	0.609	0.396	1899	Clay	0.393
64.3	-49.6	71	MH	70	20	1.00		1.00	83	7389	3380	1.00	83.3	5.5	88.8	N	N	Y	Y	Clay-like	0.730	0.591	0.384	1996	Clay	0.381
69.3	-54.6	30	MH	85	32	1.00		1.00	35	7964	3643	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.708	0.573	0.373	2088	Clay	0.369
74.3	-59.6	54	MH	70	20	1.00		1.00	63	8539	3906	1.00	63.3	5.5	68.8	N	N	Y	Y	Clay-like	0.688	0.557	0.362	2174	Clay	0.359
79.3	-64.6	100	MH	70	20	1.00		1.00	117	9114	4169	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.669	0.541	0.352	2257	Clay	0.349
84.3	-69.6	28	MH	70	20	1.00		1.00	33	9689	4432	1.00	32.9	5.5	38.4	N	N	Y	Y	Clay-like	0.652	0.527	0.343	2337	Clay	0.340
89.3	-74.6	100	MH	70	20	1.00		1.00	117	10264	4695	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.637	0.515	0.335	2417	Clay	0.332
94.3	-79.6	25	MH	75	24	1.00		1.00	29	10839	4958	1.00	29.3	5.5	34.8	N	N	Y	Y	Clay-like	0.623	0.504	0.328	2498	Clay	0.325
99.3	-84.6	27	MH	70	20	1.00		1.00	32	11414	5221	1.00	31.7	5.5	37.2	N	N	Y	Y	Clay-like	0.611	0.495	0.321	2582	Clay	0.319
104.3	-89.6	62	MH	70	20	1.00		1.00	73	11989	5484	1.00	72.7	5.5	78.2	N	N	Y	Y	Clay-like	0.602	0.487	0.317	2670	Clay	0.314
109.3	-94.6	30	MH	70	20	1.00		1.00	35	12564	5747	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.595	0.481	0.313	2764	Clay	0.310
114.3	-99.6	42	MH	70	20	1.00		1.00	49	13139	6010	1.00	49.3	5.5	54.8	N	N	Y	Y	Clay-like	0.590	0.477	0.310	2866	Clay	0.307
119.3	-104.6	40	MH	70	20	1.00		1.00	47	13714	6273	1.00	46.9	5.5	52.4	N	N	Y	Y	Clay-like	0.587	0.475	0.309	2977	Clay	0.306
124.3	-109.6	57	MH	70	20	1.00		1.00	67	14289	6536	1.00	66.9	5.5	72.4	N	N	Y	Y	Clay-like	0.586	0.474	0.308	3099	Clay	0.306

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB02
Station:

Resistance Factors:		By Table 9-10 SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 7.3 ft

Maximum Depth of Liquefied Layers: 14.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.7	SC	44	17	25.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,784	10.0	1.11	1.00	1.11	0.47	2.12	No Loss
3.0	11.7	SC	44	17	22.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,511	10.0	1.11	1.00	1.11	0.47	2.13	No Loss
5.0	9.7	SC	44	17	35.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,650	10.0	1.11	1.00	1.11	0.47	2.14	No Loss
7.0	7.7	SM	30	15	26.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,886	10.0	1.11	1.00	1.11	0.46	2.16	No Loss
9.0	5.7	SP-SM	8	0	27.7	1.10	1.00	0.373	0.410	1.19	0.84	Full Liq.	-	-	-	-	-	-	-	-	-
14.3	0.4	SP-SM	8	0	19.6	1.10	1.00	0.201	0.221	2.17	0.46	Full Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.6	SP-SM	8	0	35.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
24.3	-9.6	SP-SM	8	0	41.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
29.3	-14.6	SM	30	12	51.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,847	10.0	1.11	1.00	1.11	0.42	2.37	No Loss
34.3	-19.6	SM	35	12	44.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,384	10.0	1.11	1.00	1.11	0.41	2.43	No Loss
39.3	-24.6	SM	36	14	86.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	12,051	10.0	1.11	1.00	1.11	0.40	2.50	No Loss
44.3	-29.6	MH	70	20	61.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,411	10.0	1.11	1.00	1.11	0.39	2.58	No Loss
49.3	-34.6	MH	65	28	43.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,618	10.0	1.11	1.00	1.11	0.38	2.66	No Loss
54.3	-39.6	MH	70	20	54.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,381	10.0	1.11	1.00	1.11	0.36	2.74	No Loss
59.3	-44.6	MH	55	40	47.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,331	10.0	1.11	1.00	1.11	0.35	2.83	No Loss
64.3	-49.6	MH	70	20	88.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	12,490	10.0	1.11	1.00	1.11	0.34	2.92	No Loss
69.3	-54.6	MH	85	32	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,279	10.0	1.11	1.00	1.11	0.33	3.00	No Loss
74.3	-59.6	MH	70	20	68.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	9,502	10.0	1.11	1.00	1.11	0.32	3.10	No Loss
79.3	-64.6	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,598	10.0	1.11	1.00	1.11	0.31	3.18	No Loss
84.3	-69.6	MH	70	20	38.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,928	7.2	0.85	1.00	0.85	0.40	2.50	No Loss
89.3	-74.6	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.30	3.35	No Loss
94.3	-79.6	MH	75	24	34.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,400	5.4	0.68	1.00	0.68	0.48	2.09	No Loss
99.3	-84.6	MH	70	20	37.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,752	5.6	0.70	1.00	0.70	0.46	2.19	No Loss
104.3	-89.6	MH	70	20	78.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	10,912	10.0	1.11	1.00	1.11	0.28	3.54	No Loss
109.3	-94.6	MH	70	20	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,280	5.6	0.70	1.00	0.70	0.44	2.27	No Loss
114.3	-99.6	MH	70	20	54.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,392	8.1	0.94	1.00	0.94	0.33	3.06	No Loss
119.3	-104.6	MH	70	20	52.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,040	7.3	0.86	1.00	0.86	0.36	2.81	No Loss
124.3	-109.6	MH	70	20	72.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	10,032	10.0	1.11	1.00	1.11	0.28	3.63	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

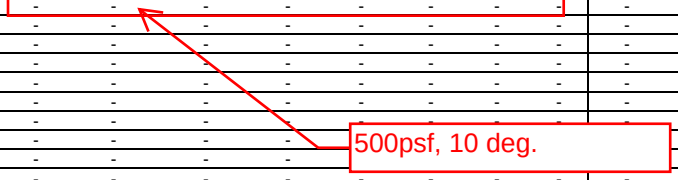
SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB02
Station:

Lateral Displacement Index, LDI: 0.97 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 1.72 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
3.0	11.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
5.0	9.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
7.0	7.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
9.0	5.7	40.5	0.8	28.2	Full Residual	922.6	0.85	0.35	405	166	40.5	19.3	-	0.063	4.9%	0.060	0.011	2.00	0.021	0.144	1.7	74	4.9%	2.00	0.10	0.97
14.3	0.4	37.2	0.8	20.0	Full Residual	472.5	0.46	0.18	344	131	24.7	9.9	-	0.166	16.6%	0.539	0.023	5.25	0.123	0.123	1.5	62	16.6%	5.25	0.87	0.87
19.3	-4.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-49.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-54.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-59.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-64.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-69.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-74.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-79.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-84.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-89.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-94.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-99.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-104.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-109.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00



STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB10
Station:
Offset:

Hazard Level	SEE
PGA	0.37
M_W	7.30
Elevation	14.6 ft
Water Depth	0.0 ft
Hammer ER	70.4%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.17	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	N-value Correction							SSL Susceptibility Screening					Cyclic Stress					
								Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.6	6	CL	70	20	1.00		0.60	4	115	53	1.00	4.2	5.5	9.7	Y	N	Y	Y	Clay-like	1.004	0.812	0.528	43	Clay	0.524
3.0	11.6	11	CL	70	20	1.00		0.66	9	345	158	1.00	8.5	5.5	14.0	Y	N	Y	Y	Clay-like	0.999	0.808	0.525	128	Clay	0.521
5.0	9.6	10	CL	68	15	1.00		0.72	8	575	263	1.00	8.4	5.5	13.9	Y	N	Y	Y	Clay-like	0.994	0.804	0.523	211	Clay	0.518
7.0	7.6	17	SP	3	0	1.00		0.77	15	805	368	1.70	26.0	0.0	26.0	Y	Y	Y	N	Sand-like	0.988	0.799	0.519	294	Sand	0.493
9.0	5.6	6	SC-SM	40	7	1.00		0.81	6	1035	473	1.70	9.7	5.5	15.2	Y	Y	Y	N	Sand-like	0.982	0.794	0.516	376	Sand	0.490
14.3	0.3	4	SC-SM	40	7	1.00		0.89	4	1639	750	1.68	7.0	5.5	12.5	Y	Y	Y	N	Sand-like	0.963	0.779	0.506	584	Sand	0.480
19.3	-4.7	22	SM	30	15	1.00		0.93	24	2214	1013	1.45	34.8	5.4	40.2	N	N	Y	Y	Clay-like	0.944	0.763	0.496	773	Clay	0.492
24.3	-9.7	18	SM	30	15	1.00		0.96	20	2789	1276	1.29	26.1	5.4	31.5	N	N	Y	Y	Clay-like	0.922	0.746	0.485	952	Clay	0.481
29.3	-14.7	29	SM	33	15	1.00		0.98	33	3364	1539	1.17	39.0	5.5	44.5	N	N	Y	Y	Clay-like	0.899	0.728	0.473	1119	Clay	0.469
34.3	-19.7	44	MH	70	20	1.00		0.99	51	3939	1802	1.00	50.9	5.5	56.4	N	N	Y	Y	Clay-like	0.876	0.708	0.460	1276	Clay	0.456
39.3	-24.7	36	MH	70	20	1.00		0.99	42	4514	2065	1.00	41.9	5.5	47.4	N	N	Y	Y	Clay-like	0.851	0.688	0.447	1421	Clay	0.444
44.3	-29.7	29	MH	70	20	1.00		1.00	34	5089	2328	1.00	33.9	5.5	39.4	N	N	Y	Y	Clay-like	0.826	0.668	0.434	1556	Clay	0.431
49.3	-34.7	30	MH	70	20	1.00		1.00	35	5664	2591	1.00	35.1	5.5	40.6	N	N	Y	Y	Clay-like	0.801	0.648	0.421	1679	Clay	0.418
54.3	-39.7	47	MH	70	20	1.00		1.00	55	6239	2854	1.00	55.1	5.5	60.6	N	N	Y	Y	Clay-like	0.777	0.629	0.409	1793	Clay	0.405
59.3	-44.7	50	MH	70	20	1.00		1.00	59	6814	3117	1.00	58.6	5.5	64.1	N	N	Y	Y	Clay-like	0.753	0.609	0.396	1899	Clay	0.393

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB10
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 9.3 ft

Maximum Depth of Liquefied Layers: 14.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.6	CL	70	20	9.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	630	10.0	1.11	1.00	1.11	0.47	2.12	No Loss
3.0	11.6	CL	70	20	14.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,279	10.0	1.11	1.00	1.11	0.47	2.13	No Loss
5.0	9.6	CL	68	15	13.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,262	10.0	1.11	1.00	1.11	0.47	2.14	No Loss
7.0	7.6	SP	3	0	26.0	1.10	1.00	0.315	0.346	1.42	0.70	Full Liq.	-	-	-	-	-	-	-	-	-
9.0	5.6	SC-SM	40	7	15.2	1.10	1.00	0.157	0.173	2.83	0.35	Full Liq.	-	-	-	-	-	-	-	-	-
14.3	0.3	SC-SM	40	7	12.5	1.09	1.00	0.136	0.148	3.25	0.31	Full Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.7	SM	30	15	40.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,612	10.0	1.11	1.00	1.11	0.44	2.26	No Loss
24.3	-9.7	SM	30	15	31.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,044	10.0	1.11	1.00	1.11	0.43	2.31	No Loss
29.3	-14.7	SM	33	15	44.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,987	10.0	1.11	1.00	1.11	0.42	2.37	No Loss
34.3	-19.7	MH	70	20	56.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,641	10.0	1.11	1.00	1.11	0.41	2.43	No Loss
39.3	-24.7	MH	70	20	47.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,287	10.0	1.11	1.00	1.11	0.40	2.50	No Loss
44.3	-29.7	MH	70	20	39.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,081	10.0	1.11	1.00	1.11	0.39	2.58	No Loss
49.3	-34.7	MH	70	20	40.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,266	10.0	1.11	1.00	1.11	0.38	2.66	No Loss
54.3	-39.7	MH	70	20	60.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,260	10.0	1.11	1.00	1.11	0.36	2.74	No Loss
59.3	-44.7	MH	70	20	64.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,793	10.0	1.11	1.00	1.11	0.35	2.83	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB10
Station:

Lateral Displacement Index, LDI: 2.58 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 3.12 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

	Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.260	3.1	-	-	-	-	2.58
3.0	11.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.260	3.1	-	-	-	-	2.58
5.0	9.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.260	3.1	-	-	-	-	2.58
7.0	7.6	40.0	0.3	26.3	Full Residual	705.6	0.75	0.29	278	106	37.0	16.1	-	0.079	7.1%	0.173	0.016	2.00	0.032	0.260	3.1	71	7.1%	2.00	0.14	2.58
9.0	5.6	32.2	3.2	12.9	Full Residual	133.9	0.14	0.11	68	52	8.1	6.3	-	0.270	27.0%	0.748	0.028	2.00	0.057	0.227	2.7	55	27.0%	2.00	0.54	2.43
14.3	0.3	30.4	3.2	10.2	Full Residual	124.5	0.10	0.09	76	69	5.8	5.3	-	0.361	36.1%	0.847	0.032	5.25	0.170	0.170	2.0	49	36.1%	5.25	1.89	1.89
19.3	-4.7	-	-	-	No Loss									-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

700psf, 16 deg.

125psf, 6 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	SEE	Unit Weight	115 pcf	
County: JASPER COUNTY	PGA	0.37	Sample Liners Required	No	
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No	
Boring: BS-STB11	Elevation	14.2 ft	C_B	1.00	Table 7-5
Station:	Water Depth	0.0 ft	C_E	1.17	Eq 7-2
Offset:	Hammer ER	70.4%	C_S	1.00	Table 7-4
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11
			MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.2	9	CL	70	20	1.00		0.60	6	115	53	1.00	6.3	5.5	11.8	Y	N	Y	Y	Clay-like	1.004	0.812	0.528	43	Clay	0.524
3.0	11.2	12	CL	70	20	1.00		0.66	9	345	158	1.00	9.3	5.5	14.8	Y	N	Y	Y	Clay-like	0.999	0.808	0.525	128	Clay	0.521
5.0	9.2	15	CL	70	20	1.00		0.72	13	575	263	1.00	12.6	5.5	18.1	Y	N	Y	Y	Clay-like	0.994	0.804	0.523	211	Clay	0.518
7.0	7.2	14	SM	21	0	1.00		0.77	13	805	368	1.70	21.4	4.6	26.0	Y	Y	Y	N	Sand-like	0.988	0.799	0.519	294	Sand	0.493
9.0	5.2	12	SP-SM	9	0	1.00		0.81	11	1035	473	1.70	19.3	0.7	20.0	Y	Y	Y	N	Sand-like	0.982	0.794	0.516	376	Sand	0.490
14.3	0.0	18	SP-SM	9	0	1.00		0.89	19	1639	750	1.68	31.5	0.7	32.2	N	Y	Y	N	None	0.963	0.779	0.506	584	Sand	0.480
19.3	-5.0	24	SP-SM	9	0	1.00		0.93	26	2214	1013	1.45	38.0	0.7	38.7	N	Y	Y	N	None	0.944	0.763	0.496	773	Sand	0.471
24.3	-10.0	18	SP	3	0	1.00		0.96	20	2789	1276	1.29	26.1	0.0	26.1	Y	Y	Y	N	Sand-like	0.922	0.746	0.485	952	Sand	0.460
29.3	-15.0	31	SM	30	12	1.00		0.98	36	3364	1539	1.17	41.7	5.4	47.0	N	N	Y	Y	Clay-like	0.899	0.728	0.473	1119	Clay	0.469
34.3	-20.0	20	MH	70	20	1.00		0.99	23	3939	1802	1.00	23.2	5.5	28.7	Y	N	Y	Y	Clay-like	0.876	0.708	0.460	1276	Clay	0.456
39.3	-25.0	30	MH	70	20	1.00		0.99	35	4514	2065	1.00	34.9	5.5	40.4	N	N	Y	Y	Clay-like	0.851	0.688	0.447	1421	Clay	0.444
44.3	-30.0	28	MH	70	20	1.00		1.00	33	5089	2328	1.00	32.7	5.5	38.2	N	N	Y	Y	Clay-like	0.826	0.668	0.434	1556	Clay	0.431
49.3	-35.0	21	MH	62	30	1.00		1.00	25	5664	2591	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.801	0.648	0.421	1679	Clay	0.418
54.3	-40.0	27	MH	70	20	1.00		1.00	32	6239	2854	1.00	31.6	5.5	37.1	N	N	Y	Y	Clay-like	0.777	0.629	0.409	1793	Clay	0.405
59.3	-45.0	43	MH	70	20	1.00		1.00	50	6814	3117	1.00	50.4	5.5	55.9	N	N	Y	Y	Clay-like	0.753	0.609	0.396	1899	Clay	0.393
64.3	-50.0	86	MH	70	20	1.00		1.00	101	7389	3380	1.00	100.9	5.5	106.4	N	N	Y	Y	Clay-like	0.730	0.591	0.384	1996	Clay	0.381
69.3	-55.0	23	MH	75	34	1.00		1.00	27	7964	3643	1.00	27.0	5.5	32.5	N	N	Y	Y	Clay-like	0.708	0.573	0.373	2088	Clay	0.369
74.3	-60.0	60	MH	70	20	1.00		1.00	70	8539	3906	1.00	70.4	5.5	75.9	N	N	Y	Y	Clay-like	0.688	0.557	0.362	2174	Clay	0.359
79.3	-65.0	100	MH	70	20	1.00		1.00	117	9114	4169	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.669	0.541	0.352	2257	Clay	0.349
84.3	-70.0	100	MH	70	20	1.00		1.00	117	9689	4432	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.652	0.527	0.343	2337	Clay	0.340
89.3	-75.0	100	MH	70	20	1.00		1.00	117	10264	4695	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.637	0.515	0.335	2417	Clay	0.332
94.3	-80.0	27	MH	90	42	1.00		1.00	32	10839	4958	1.00	31.7	5.5	37.2	N	N	Y	Y	Clay-like	0.623	0.504	0.328	2498	Clay	0.325
99.3	-85.0	27	MH	70	20	1.00		1.00	32	11414	5221	1.00	31.7	5.5	37.2	N	N	Y	Y	Clay-like	0.611	0.495	0.321	2582	Clay	0.319
104.3	-90.0	56	MH	70	20	1.00		1.00	66	11989	5484	1.00	65.7	5.5	71.2	N	N	Y	Y	Clay-like	0.602	0.487	0.317	2670	Clay	0.314
109.3	-95.0	31	MH	70	20	1.00		1.00	36	12564	5747	1.00	36.4	5.5	41.9	N	N	Y	Y	Clay-like	0.595	0.481	0.313	2764	Clay	0.310
114.3	-100.0	29	MH	70	20	1.00		1.00	34	13139	6010	1.00	34.0	5.5	39.5	N	N	Y	Y	Clay-like	0.590	0.477	0.310	2866	Clay	0.307
119.3	-105.0	46	MH	70	20	1.00		1.00	54	13714	6273	1.00	54.0	5.5	59.5	N	N	Y	Y	Clay-like	0.587	0.475	0.309	2977	Clay	0.306
124.3	-110.0	52	MH	70	20	1.00		1.00	61	14289	6536	1.00	61.0	5.5	66.5	N	N	Y	Y	Clay-like	0.586	0.474	0.308	3099	Clay	0.306

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB11
Station:

Resistance Factors:		By Table 9-10 SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 9.0 ft

Maximum Depth of Liquefied Layers: 24.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)								Clay-like Cyclic Resistance and (D/C)							
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)		User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$		Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.2	CL	70	20	11.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	945	10.0	1.11	1.00	1.11	0.47	2.12	No Loss
3.0	11.2	CL	70	20	14.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	1,395	10.0	1.11	1.00	1.11	0.47	2.13	No Loss
5.0	9.2	CL	70	20	18.1	-	-	-	-	-	-	No Liq.		Eq 7-33,34	1,893	10.0	1.11	1.00	1.11	0.47	2.14	No Loss
7.0	7.2	SM	21	0	26.0	1.10	1.00	0.316	0.348	1.42	0.71	Full Liq.		-	-	-	-	-	-	-	-	-
9.0	5.2	SP-SM	9	0	20.0	1.10	1.00	0.206	0.227	2.16	0.46	Full Liq.		-	-	-	-	-	-	-	-	-
14.3	0.0	SP-SM	9	0	32.2	-	-	-	-	-	-	No Liq.		-	-	-	-	-	-	-	-	-
19.3	-5.0	SP-SM	9	0	38.7	-	-	-	-	-	-	No Liq.		-	-	-	-	-	-	-	-	-
24.3	-10.0	SP	3	0	26.1	1.09	1.00	0.320	0.347	1.32	0.75	Full Liq.		-	-	-	-	-	-	-	-	-
29.3	-15.0	SM	30	12	47.0	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,331	10.0	1.11	1.00	1.11	0.42	2.37	No Loss
34.3	-20.0	MH	70	20	28.7	-	-	-	-	-	-	No Liq.		Eq 7-33,34	3,473	10.0	1.11	1.00	1.11	0.41	2.43	No Loss
39.3	-25.0	MH	70	20	40.4	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,240	10.0	1.11	1.00	1.11	0.40	2.50	No Loss
44.3	-30.0	MH	70	20	38.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,906	10.0	1.11	1.00	1.11	0.39	2.58	No Loss
49.3	-35.0	MH	62	30	30.1	-	-	-	-	-	-	No Liq.		Eq 7-33,34	3,687	9.8	1.09	1.00	1.09	0.38	2.61	No Loss
54.3	-40.0	MH	70	20	37.1	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,745	10.0	1.11	1.00	1.11	0.36	2.74	No Loss
59.3	-45.0	MH	70	20	55.9	-	-	-	-	-	-	No Liq.		Eq 7-33,34	7,562	10.0	1.11	1.00	1.11	0.35	2.83	No Loss
64.3	-50.0	MH	70	20	106.4	-	-	-	-	-	-	No Liq.		Eq 7-33,34	15,129	10.0	1.11	1.00	1.11	0.34	2.92	No Loss
69.3	-55.0	MH	75	34	32.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,047	7.2	0.85	1.00	0.85	0.43	2.30	No Loss
74.3	-60.0	MH	70	20	75.9	-	-	-	-	-	-	No Liq.		Eq 7-33,34	10,558	10.0	1.11	1.00	1.11	0.32	3.10	No Loss
79.3	-65.0	MH	70	20	122.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	17,598	10.0	1.11	1.00	1.11	0.31	3.18	No Loss
84.3	-70.0	MH	70	20	122.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.31	3.27	No Loss
89.3	-75.0	MH	70	20	122.8	-	-	-	-	-	-	No Liq.		Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.30	3.35	No Loss
94.3	-80.0	MH	90	42	37.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,752	6.0	0.73	1.00	0.73	0.44	2.26	No Loss
99.3	-85.0	MH	70	20	37.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	4,752	5.6	0.70	1.00	0.70	0.46	2.19	No Loss
104.3	-90.0	MH	70	20	71.2	-	-	-	-	-	-	No Liq.		Eq 7-33,34	9,856	10.0	1.11	1.00	1.11	0.28	3.54	No Loss
109.3	-95.0	MH	70	20	41.9	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,456	5.9	0.73	1.00	0.73	0.43	2.34	No Loss
114.3	-100.0	MH	70	20	39.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	5,104	5.1	0.65	1.00	0.65	0.47	2.11	No Loss
119.3	-105.0	MH	70	20	59.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	8,096	8.6	0.99	1.00	0.99	0.31	3.23	No Loss
124.3	-110.0	MH	70	20	66.5	-	-	-	-	-	-	No Liq.		Eq 7-33,34	9,152	9.6	1.07	1.00	1.07	0.29	3.51	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB11
Station:

Lateral Displacement Index, LDI: 0.76 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 1.77 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.147	1.8	-	-	-	-	0.76
3.0	11.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.147	1.8	-	-	-	-	0.76
5.0	9.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.147	1.8	-	-	-	-	0.76
7.0	7.2	38.1	1.7	23.1	Full Residual	428.2	0.57	0.22	212	81	29.9	12.4	-	0.078	7.0%	0.170	0.016	2.00	0.032	0.147	1.8	71	7.0%	2.00	0.14	0.76
9.0	5.2	37.2	0.9	20.2	Full Residual	383.7	0.47	0.18	220	84	25.0	10.1	-	0.158	15.8%	0.516	0.023	2.00	0.046	0.116	1.4	63	15.8%	2.00	0.32	0.62
14.3	0.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.070	0.8	-	-	-	-	0.31
19.3	-5.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.070	0.8	-	-	-	-	0.31
24.3	-10.0	40.1	0.3	26.4	Full Residual	1307.2	0.77	0.29	979	373	37.5	16.3	-	0.077	6.2%	0.162	0.014	5.00	0.070	0.070	0.8	72	6.2%	5.00	0.31	0.31
29.3	-15.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-20.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-25.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-30.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-35.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-40.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-45.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-50.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-55.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-60.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-65.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-70.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-75.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-80.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-85.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-90.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-95.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-100.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-105.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-110.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

400psf, 10 deg.

1300psf, 16 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB14
Station:
Offset:

Hazard Level	SEE
PGA	0.37
M_W	7.30
Elevation	15.5 ft
Water Depth	0.0 ft
Hammer ER	70.4%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.17	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	N-value Correction							SSL Susceptibility Screening					Cyclic Stress					
								Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	14.5	9	CH	65	50	1.00		0.60	6	115	53	1.00	6.3	5.5	11.8	Y	N	Y	Y	Clay-like	1.004	0.812	0.528	43	Clay	0.524
3.0	12.5	20	CH	64	52	1.00		0.66	15	345	158	1.00	15.5	5.5	21.0	Y	N	Y	Y	Clay-like	0.999	0.808	0.525	128	Clay	0.521
5.0	10.5	21	SM	25	0	1.00		0.72	18	575	263	1.70	30.0	5.1	35.1	N	Y	Y	N	None	0.994	0.804	0.523	211	Clay	0.518
7.0	8.5	17	SM	25	0	1.00		0.77	15	805	368	1.70	26.0	5.1	31.0	N	Y	Y	N	None	0.988	0.799	0.519	294	Clay	0.515
9.0	6.5	21	SM	25	0	1.00		0.81	20	1035	473	1.70	33.8	5.1	38.9	N	Y	Y	N	None	0.982	0.794	0.516	376	Clay	0.512
14.3	1.3	4	SC	27	8	1.00		0.89	4	1639	750	1.68	7.0	5.2	12.2	Y	Y	Y	N	Sand-like	0.963	0.779	0.506	584	Sand	0.480
19.3	-3.7	23	SM	25	0	1.00		0.93	25	2214	1013	1.45	36.4	5.1	41.5	N	Y	Y	N	None	0.944	0.763	0.496	773	Clay	0.492
24.3	-8.7	18	SP-SM	6	0	1.00		0.96	20	2789	1276	1.29	26.1	0.0	26.2	Y	Y	Y	N	Sand-like	0.922	0.746	0.485	952	Sand	0.460
29.3	-13.7	37	SC	22	18	1.00		0.98	42	3364	1539	1.17	49.8	4.8	54.5	N	N	Y	Y	Clay-like	0.899	0.728	0.473	1119	Clay	0.469
34.3	-18.7	34	MH	70	20	1.00		0.99	39	3939	1802	1.00	39.4	5.5	44.9	N	N	Y	Y	Clay-like	0.876	0.708	0.460	1276	Clay	0.456
39.3	-23.7	49	MH	70	20	1.00		0.99	57	4514	2065	1.00	57.1	5.5	62.6	N	N	Y	Y	Clay-like	0.851	0.688	0.447	1421	Clay	0.444
44.3	-28.7	54	MH	70	20	1.00		1.00	63	5089	2328	1.00	63.1	5.5	68.6	N	N	Y	Y	Clay-like	0.826	0.668	0.434	1556	Clay	0.431
49.3	-33.7	28	SC	40	34	1.00		1.00	33	5664	2591	0.90	29.6	5.5	35.1	N	N	Y	Y	Clay-like	0.801	0.648	0.421	1679	Clay	0.418
54.3	-38.7	63	MH	70	20	1.00		1.00	74	6239	2854	1.00	73.8	5.5	79.3	N	N	Y	Y	Clay-like	0.777	0.629	0.409	1793	Clay	0.405
59.3	-43.7	25	MH	70	20	1.00		1.00	29	6814	3117	1.00	29.3	5.5	34.8	N	N	Y	Y	Clay-like	0.753	0.609	0.396	1899	Clay	0.393
64.3	-48.7	100	MH	70	20	1.00		1.00	117	7389	3380	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.730	0.591	0.384	1996	Clay	0.381
69.3	-53.7	29	MH	70	20	1.00		1.00	34	7964	3643	1.00	34.0	5.5	39.5	N	N	Y	Y	Clay-like	0.708	0.573	0.373	2088	Clay	0.369
74.3	-58.7	67	CH	79	27	1.00		1.00	79	8539	3906	1.00	78.6	5.5	84.1	N	N	Y	Y	Clay-like	0.688	0.557	0.362	2174	Clay	0.359
79.3	-63.7	31	MH	70	20	1.00		1.00	36	9114	4169	1.00	36.4	5.5	41.9	N	N	Y	Y	Clay-like	0.669	0.541	0.352	2257	Clay	0.349
84.3	-68.7	39	MH	70	20	1.00		1.00	46	9689	4432	1.00	45.8	5.5	51.3	N	N	Y	Y	Clay-like	0.652	0.527	0.343	2337	Clay	0.340
89.3	-73.7	100	MH	70	20	1.00		1.00	117	10264	4695	1.00	117.3	5.5	122.8	N	N	Y	Y	Clay-like	0.637	0.515	0.335	2417	Clay	0.332
94.3	-78.7	22	MH	68	31	1.00		1.00	26	10839	4958	1.00	25.8	5.5	31.3	N	N	Y	Y	Clay-like	0.623	0.504	0.328	2498	Clay	0.325
99.3	-83.7	30	MH	70	20	1.00		1.00	35	11414	5221	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.611	0.495	0.321	2582	Clay	0.319
104.3	-88.7	48	MH	70	20	1.00		1.00	56	11989	5484	1.00	56.3	5.5	61.8	N	N	Y	Y	Clay-like	0.602	0.487	0.317	2670	Clay	0.314
109.3	-93.7	30	MH	70	20	1.00		1.00	35	12564	5747	1.00	35.2	5.5	40.7	N	N	Y	Y	Clay-like	0.595	0.481	0.313	2764	Clay	0.310
114.3	-98.7	28	MH	70	20	1.00		1.00	33	13139	6010	1.00	32.9	5.5	38.4	N	N	Y	Y	Clay-like	0.590	0.477	0.310	2866	Clay	0.307
119.3	-103.7	48	MH	70	20	1.00		1.00	56	13714	6273	1.00	56.3	5.5	61.8	N	N	Y	Y	Clay-like	0.587	0.475	0.309	2977	Clay	0.306
124.3	-108.7	44	MH	70	20	1.00		1.00	52	14289	6536	1.00	51.6	5.5	57.1	N	N	Y	Y	Clay-like	0.586	0.474	0.308	3099	Clay	0.306

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB14
Station:

Resistance Factors:	By Table 9-10	SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 10.3 ft

Maximum Depth of Liquefied Layers: 24.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
	N					Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f (k=0.23, Su, σ'_{vo})	Eq 13-21 f (OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	14.5	CH	65	50	11.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	945	10.0	1.11	1.00	1.11	0.47	2.12	No Loss
3.0	12.5	CH	64	52	21.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,325	10.0	1.11	1.00	1.11	0.47	2.13	No Loss
5.0	10.5	SM	25	0	35.1	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
7.0	8.5	SM	25	0	31.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
9.0	6.5	SM	25	0	38.9	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	1.3	SC	27	8	12.2	1.09	1.00	0.134	0.145	3.30	0.30	Full Liq.	-	-	-	-	-	-	-	-	-
19.3	-3.7	SM	25	0	41.5	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
24.3	-8.7	SP-SM	6	0	26.2	1.09	1.00	0.320	0.348	1.32	0.76	Full Liq.	-	-	-	-	-	-	-	-	-
29.3	-13.7	SC	22	18	54.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,363	10.0	1.11	1.00	1.11	0.42	2.37	No Loss
34.3	-18.7	MH	70	20	44.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,905	10.0	1.11	1.00	1.11	0.41	2.43	No Loss
39.3	-23.7	MH	70	20	62.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,558	10.0	1.11	1.00	1.11	0.40	2.50	No Loss
44.3	-28.7	MH	70	20	68.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	9,462	10.0	1.11	1.00	1.11	0.39	2.58	No Loss
49.3	-33.7	SC	40	34	35.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,915	10.0	1.11	1.00	1.11	0.38	2.66	No Loss
54.3	-38.7	MH	70	20	79.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	11,072	10.0	1.11	1.00	1.11	0.36	2.74	No Loss
59.3	-43.7	MH	70	20	34.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,396	9.7	1.08	1.00	1.08	0.36	2.75	No Loss
64.3	-48.7	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,591	10.0	1.11	1.00	1.11	0.34	2.92	No Loss
69.3	-53.7	MH	70	20	39.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,103	9.6	1.07	1.00	1.07	0.34	2.90	No Loss
74.3	-58.7	CH	79	27	84.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	11,790	10.0	1.11	1.00	1.11	0.32	3.10	No Loss
79.3	-63.7	MH	70	20	41.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,455	8.8	1.00	1.00	1.00	0.35	2.87	No Loss
84.3	-68.7	MH	70	20	51.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,864	10.0	1.11	1.00	1.11	0.31	3.27	No Loss
89.3	-73.7	MH	70	20	122.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,599	10.0	1.11	1.00	1.11	0.30	3.35	No Loss
94.3	-78.7	MH	68	31	31.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,872	4.6	0.60	1.00	0.60	0.54	1.84	No Loss
99.3	-83.7	MH	70	20	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,280	6.4	0.77	1.00	0.77	0.41	2.43	No Loss
104.3	-88.7	MH	70	20	61.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,448	10.0	1.11	1.00	1.11	0.28	3.54	No Loss
109.3	-93.7	MH	70	20	40.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,280	5.6	0.70	1.00	0.70	0.44	2.27	No Loss
114.3	-98.7	MH	70	20	38.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,928	4.9	0.63	1.00	0.63	0.49	2.04	No Loss
119.3	-103.7	MH	70	20	61.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,448	9.1	1.03	1.00	1.03	0.30	3.37	No Loss
124.3	-108.7	MH	70	20	57.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	7,744	7.8	0.91	1.00	0.91	0.34	2.97	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB14
Station:

Lateral Displacement Index, LDI: 2.26 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 2.91 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	14.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
3.0	12.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
5.0	10.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
7.0	8.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
9.0	6.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
14.3	1.3	30.4	2.2	9.2	Full Residual	124.5	0.09	0.09	68	64	5.2	4.9	-	0.372	37.2%	0.856	0.033	5.25	0.173	0.242	2.9	49	37.2%	5.25	1.95	2.26
19.3	-3.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.069	0.8	-	-	-	-	0.31
24.3	-8.7	40.1	0.6	26.7	Full Residual	1307.2	0.79	0.30	1008	385	38.3	16.8	-	0.077	6.1%	0.160	0.014	5.00	0.069	0.069	0.8	72	6.1%	5.00	0.31	0.31
29.3	-13.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-18.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-23.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-28.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-33.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-38.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-43.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-48.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-53.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-58.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-63.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-68.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-73.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-78.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-83.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-88.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-93.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-98.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-103.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-108.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

125psf, 5 deg.

1300psf, 17 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB15
Station:
Offset:

Hazard Level	SEE
PGA	0.37
M_W	7.30
Elevation	14.9 ft
Water Depth	0.0 ft
Hammer ER	70.4%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.17	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

Note:								N-value Correction								SSL Susceptibility Screening					Cyclic Stress						
						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.9	4	CH	65	50	1.00		0.60	3	115	53	1.00	2.8	5.5	8.3	Y	N	Y	Y	Clay-like	1.004	0.812	0.528	43	Clay	0.524
3.0	11.9	17	CH	65	50	1.00		0.66	13	345	158	1.00	13.2	5.5	18.7	Y	N	Y	Y	Clay-like	0.999	0.808	0.525	128	Clay	0.521
5.0	9.9	21	SC	27	10	1.00		0.72	18	575	263	1.70	30.0	5.2	35.2	N	Y	Y	N	None	0.994	0.804	0.523	211	Clay	0.518
7.0	7.9	18	SM	19	3	1.00		0.77	16	805	368	1.70	27.5	4.3	31.8	N	Y	Y	N	None	0.988	0.799	0.519	294	Sand	0.493
9.0	5.9	16	SC	21	5	1.00		0.81	15	1035	473	1.70	25.8	4.6	30.4	N	Y	Y	N	None	0.982	0.794	0.516	376	Clay	0.512
14.3	0.6	24	SP-SM	12	0	1.00		0.89	25	1639	750	1.68	42.0	2.1	44.0	N	Y	Y	N	None	0.963	0.779	0.506	584	Sand	0.480
19.3	-4.4	29	SP-SM	12	0	1.00		0.93	32	2214	1013	1.45	45.9	2.1	48.0	N	Y	Y	N	None	0.944	0.763	0.496	773	Sand	0.471
24.3	-9.4	26	SP	3	0	1.00		0.96	29	2789	1276	1.29	37.8	0.0	37.8	N	Y	Y	N	None	0.922	0.746	0.485	952	Sand	0.460
29.3	-14.4	36	MH	70	20	1.00		0.98	41	3364	1539	1.00	41.3	5.5	46.8	N	N	Y	Y	Clay-like	0.899	0.728	0.473	1119	Clay	0.469
34.3	-19.4	51	MH	70	20	1.00		0.99	59	3939	1802	1.00	59.0	5.5	64.5	N	N	Y	Y	Clay-like	0.876	0.708	0.460	1276	Clay	0.456
39.3	-24.4	49	MH	70	20	1.00		0.99	57	4514	2065	1.00	57.1	5.5	62.6	N	N	Y	Y	Clay-like	0.851	0.688	0.447	1421	Clay	0.444
44.3	-29.4	39	MH	70	20	1.00		1.00	46	5089	2328	1.00	45.6	5.5	51.1	N	N	Y	Y	Clay-like	0.826	0.668	0.434	1556	Clay	0.431
49.3	-34.4	62	MH	70	20	1.00		1.00	73	5664	2591	1.00	72.6	5.5	78.1	N	N	Y	Y	Clay-like	0.801	0.648	0.421	1679	Clay	0.418
54.3	-39.4	100	MH	70	20	1.00		1.00	117	6239	2854	1.00	117.2	5.5	122.7	N	N	Y	Y	Clay-like	0.777	0.629	0.409	1793	Clay	0.405
59.3	-44.4	47	MH	70	20	1.00		1.00	55	6814	3117	1.00	55.1	5.5	60.6	N	N	Y	Y	Clay-like	0.753	0.609	0.396	1899	Clay	0.393

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB15
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 0.0 ft

Maximum Depth of Liquefied Layers: 0.0 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
	N					Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	$1 / (D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	$1 / (D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = $0.8 \cdot \tau_{peak}$)
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	$CSR^*_{eq} / CRR^*_{eq} = (D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	$CSR^*_{eq} / CRR^*_{eq} = (D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.9	CH	65	50	8.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	420	10.0	1.11	1.00	1.11	0.47	2.12	No Loss
3.0	11.9	CH	65	50	18.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,976	10.0	1.11	1.00	1.11	0.47	2.13	No Loss
5.0	9.9	SC	27	10	35.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
7.0	7.9	SM	19	3	31.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
9.0	5.9	SC	21	5	30.4	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	0.6	SP-SM	12	0	44.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.4	SP-SM	12	0	48.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
24.3	-9.4	SP	3	0	37.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
29.3	-14.4	MH	70	20	46.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,191	10.0	1.11	1.00	1.11	0.42	2.37	No Loss
34.3	-19.4	MH	70	20	64.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,857	10.0	1.11	1.00	1.11	0.41	2.43	No Loss
39.3	-24.4	MH	70	20	62.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,558	10.0	1.11	1.00	1.11	0.40	2.50	No Loss
44.3	-29.4	MH	70	20	51.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,834	10.0	1.11	1.00	1.11	0.39	2.58	No Loss
49.3	-34.4	MH	70	20	78.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	10,884	10.0	1.11	1.00	1.11	0.38	2.66	No Loss
54.3	-39.4	MH	70	20	122.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	17,574	10.0	1.11	1.00	1.11	0.36	2.74	No Loss
59.3	-44.4	MH	70	20	60.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,265	10.0	1.11	1.00	1.11	0.35	2.83	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB15
Station:

Lateral Displacement Index, LDI: 0.00 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 0.00 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
3.0	11.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
5.0	9.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
7.0	7.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
9.0	5.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
14.3	0.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
19.3	-4.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB1
Station:
Offset:

Hazard Level	SEE
PGA	0.37
M_W	7.30
Elevation	27.8 ft
Water Depth	16.3 ft
Hammer ER	77.8%
Borehole Diameter	4.00 in

Unit Weight	115 pcf	
Sample Liners Required	No	
Sample Liners Used	No	
C_B	1.00	Table 7-5
C_E	1.30	Eq 7-2
C_S	1.00	Table 7-4
MSF_{Sand}	1.054	Eq 13-11
MSF_{Clay}	1.009	Eq 13-12

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
2.2	25.6	9	SM	30	5	1.00		0.64	7	253	253	1.70	12.6	5.4	18.0	Y	Y	N	N	None	1.001	0.370	0.241	94	Clay	0.239
4.2	23.6	22	SM	30	5	1.00		0.70	20	483	483	1.70	33.7	5.4	39.1	N	Y	N	N	None	0.996	0.369	0.240	178	Clay	0.238
6.2	21.6	6	SM	30	5	1.00		0.75	6	713	713	1.70	9.9	5.4	15.2	Y	Y	N	N	None	0.990	0.366	0.238	261	Clay	0.236
8.2	19.6	12	SM	30	5	1.00		0.79	12	943	943	1.50	18.4	5.4	23.8	Y	Y	N	N	None	0.984	0.364	0.237	343	Clay	0.235
10.2	17.6	4	ML	60	5	1.00		0.83	4	1173	1173	1.00	4.3	5.5	9.8	Y	Y	N	N	None	0.978	0.362	0.235	424	Clay	0.233
14.3	13.6	15	SM	21	0	1.00		0.89	17	1639	1639	1.14	19.6	4.6	24.2	Y	Y	N	N	None	0.963	0.356	0.232	584	Clay	0.230
19.3	8.6	2	SC	24	9	1.00		0.93	2	2214	2030	1.02	2.5	5.0	7.5	Y	Y	Y	N	Sand-like	0.944	0.381	0.248	773	Sand	0.235
24.3	3.6	5	SP-SM	5	0	1.00		0.96	6	2789	2293	0.96	6.0	0.0	6.0	Y	Y	Y	N	Sand-like	0.922	0.415	0.270	952	Sand	0.256
29.3	-1.5	14	SP-SM	6	0	1.00		0.98	18	3364	2556	0.91	16.1	0.0	16.2	Y	Y	Y	N	Sand-like	0.899	0.438	0.285	1119	Sand	0.270
34.3	-6.5	21	SP-SM	5	0	1.00		0.99	27	3939	2819	0.87	23.3	0.0	23.3	Y	Y	Y	N	Sand-like	0.876	0.453	0.294	1276	Sand	0.279
39.3	-11.5	12	SP	3	0	1.00		0.99	15	4514	3082	0.83	12.8	0.0	12.8	Y	Y	Y	N	Sand-like	0.851	0.461	0.300	1421	Sand	0.284
44.3	-16.5	18	SC	30	25	1.00		1.00	23	5089	3345	0.80	18.5	5.4	23.8	Y	N	Y	Y	Clay-like	0.826	0.465	0.302	1556	Clay	0.300
49.3	-21.5	20	SC	39	28	1.00		1.00	26	5664	3608	0.77	19.8	5.5	25.3	Y	N	Y	Y	Clay-like	0.801	0.466	0.303	1679	Clay	0.300
54.3	-26.5	22	SC	30	25	1.00		1.00	28	6239	3871	0.74	21.1	5.4	26.4	Y	N	Y	Y	Clay-like	0.777	0.463	0.301	1793	Clay	0.299
59.3	-31.5	27	SC	45	33	1.00		1.00	35	6814	4134	0.72	25.0	5.5	30.5	N	N	Y	Y	Clay-like	0.753	0.459	0.299	1899	Clay	0.296
64.3	-36.5	19	CH	60	41	1.00		1.00	25	7389	4397	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.730	0.454	0.295	1996	Clay	0.293
69.3	-41.5	19	CH	60	40	1.00		1.00	25	7964	4660	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.708	0.448	0.291	2088	Clay	0.289
74.3	-46.5	17	CH	60	40	1.00		1.00	22	8539	4923	1.00	22.0	5.5	27.5	Y	N	Y	Y	Clay-like	0.688	0.442	0.287	2174	Clay	0.285
79.3	-51.5	35	SM	39	32	1.00		1.00	45	9114	5186	0.64	29.0	5.5	34.5	N	N	Y	Y	Clay-like	0.669	0.435	0.283	2257	Clay	0.280
84.3	-56.5	17	MH	90	62	1.00		1.00	22	9689	5449	1.00	22.0	5.5	27.5	Y	N	Y	Y	Clay-like	0.652	0.429	0.279	2337	Clay	0.276
89.3	-61.5	46	MH	70	40	1.00		1.00	60	10264	5712	1.00	59.6	5.5	65.1	N	N	Y	Y	Clay-like	0.637	0.423	0.275	2417	Clay	0.273
93.6	-65.8	100	MH	70	40	1.00		1.00	130	10764	5940	1.00	129.7	5.5	135.2	N	N	Y	Y	Clay-like	0.625	0.419	0.272	2488	Clay	0.270
99.3	-71.5	11	MH	70	40	1.00		1.00	14	11414	6238	1.00	14.3	5.5	19.8	Y	N	Y	Y	Clay-like	0.611	0.414	0.269	2582	Clay	0.267

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB1
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 25.0 ft

Maximum Depth of Liquefied Layers: 39.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 5.7 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
2.2	25.6	SM	30	5	18.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
4.2	23.6	SM	30	5	39.1	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
6.2	21.6	SM	30	5	15.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
8.2	19.6	SM	30	5	23.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
10.2	17.6	ML	60	5	9.8	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	13.6	SM	21	0	24.2	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
19.3	8.6	SC	24	9	7.5	1.00	1.00	0.101	0.101	2.32	0.43	Full Liq.	-	-	-	-	-	-	-	-	-
24.3	3.6	SP-SM	5	0	6.0	0.99	1.00	0.092	0.091	2.80	0.36	Full Liq.	-	-	-	-	-	-	-	-	-
29.3	-1.5	SP-SM	6	0	16.2	0.98	1.00	0.166	0.163	1.66	0.60	Full Liq.	-	-	-	-	-	-	-	-	-
34.3	-6.5	SP-SM	5	0	23.3	0.96	1.00	0.254	0.243	1.15	0.87	Full Liq.	-	-	-	-	-	-	-	-	-
39.3	-11.5	SP	3	0	12.8	0.96	1.00	0.138	0.133	2.14	0.47	Full Liq.	-	-	-	-	-	-	-	-	-
44.3	-16.5	SC	30	25	23.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,485	6.6	0.80	1.00	0.80	0.38	2.66	No Loss
49.3	-21.5	SC	39	28	25.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,880	6.9	0.82	1.00	0.82	0.36	2.74	No Loss
54.3	-26.5	SC	30	25	26.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,273	7.1	0.84	1.00	0.84	0.35	2.83	No Loss
59.3	-31.5	SC	45	33	30.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,247	8.5	0.97	1.00	0.97	0.30	3.28	No Loss
64.3	-36.5	CH	60	41	30.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,694	5.0	0.64	1.00	0.64	0.46	2.20	No Loss
69.3	-41.5	CH	60	40	30.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,694	4.7	0.61	1.00	0.61	0.48	2.10	No Loss
74.3	-46.5	CH	60	40	27.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,306	3.8	0.51	1.00	0.51	0.55	1.81	No Loss
79.3	-51.5	SM	39	32	34.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,807	8.8	1.00	1.00	1.00	0.28	3.58	No Loss
84.3	-56.5	MH	90	62	27.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,306	3.4	0.46	1.00	0.46	0.60	1.68	No Loss
89.3	-61.5	MH	70	40	65.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	8,947	10.0	1.11	1.00	1.11	0.25	4.07	No Loss
93.6	-65.8	MH	70	40	135.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	19,450	10.0	1.11	1.00	1.11	0.24	4.11	No Loss
99.3	-71.5	MH	70	40	19.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,139	1.6	0.26	1.00	0.26	1.02	0.98	1712

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB1
Station:

Lateral Displacement Index, LDI: 10.11 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 9.82 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
2.2	25.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
4.2	23.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
6.2	21.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
8.2	19.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
10.2	17.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
14.3	13.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
19.3	8.6	26.2	1.9	4.4	Full Residual	126.4	0.06	0.06	114	113	3.2	3.2	-	0.631	63.1%	0.947	0.044	5.00	0.219	0.818	9.8	38	63.1%	5.00	3.15	10.11
24.3	3.6	29.6	0.5	6.5	Full Residual	197.9	0.07	0.07	160	156	4.0	3.9	-	0.751	75.1%	0.948	0.049	5.00	0.243	0.600	7.2	34	75.1%	5.00	3.76	6.96
29.3	-1.5	35.8	0.6	16.7	Full Residual	635.4	0.35	0.14	890	362	19.2	8.1	-	0.242	24.2%	0.705	0.027	5.00	0.136	0.357	4.3	56	24.2%	5.00	1.21	3.20
34.3	-6.5	38.9	0.5	23.8	Full Residual	1460.5	0.61	0.23	1709	652	31.2	13.0	-	0.109	4.9%	0.335	0.012	5.00	0.062	0.221	2.7	68	4.9%	5.00	0.24	1.99
39.3	-11.5	34.0	0.3	13.1	Full Residual	489.4	0.15	0.11	457	347	8.4	6.4	-	0.349	34.9%	0.837	0.032	5.00	0.160	0.160	1.9	50	34.9%	5.00	1.74	1.74
44.3	-16.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-21.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-26.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-31.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-36.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-41.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-46.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-51.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-56.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-61.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
93.6	-65.8	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-71.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	5.65	-	0.000	0.0	-	-	5.65	-	0.00

150psf, 3 deg.

800psf, 8 deg.

Neglected in the analysis

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	SEE	Unit Weight	115 pcf		
County: JASPER COUNTY	PGA	0.37	Sample Liners Required	No		
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No		
Boring: BS-STB3	Elevation	26.9 ft	C_B	1.00	Table 7-5	
Station:	Water Depth	16.3 ft	C_E	1.30	Eq 7-2	
Offset:	Hammer ER	77.8%	C_S	1.00	Table 7-4	
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11	
			MSF_{Clay}	1.009	Eq 13-12	

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
2.2	24.7	3	SM	30	6	1.00		0.64	2	253	253	1.70	4.2	5.4	9.6	Y	Y	N	N	None	1.001	0.370	0.241	94	Clay	0.239
4.2	22.7	3	SM	30	6	1.00		0.70	3	483	483	1.70	4.6	5.4	10.0	Y	Y	N	N	None	0.996	0.369	0.240	178	Clay	0.238
6.2	20.7	11	SM	30	6	1.00		0.75	11	713	713	1.70	18.1	5.4	23.5	Y	Y	N	N	None	0.990	0.366	0.238	261	Clay	0.236
8.2	18.7	14	SM	30	6	1.00		0.79	14	943	943	1.50	21.5	5.4	26.9	Y	Y	N	N	None	0.984	0.364	0.237	343	Clay	0.235
10.2	16.7	8	SC-SM	30	6	1.00		0.83	9	1173	1173	1.34	11.5	5.4	16.9	Y	Y	N	N	None	0.978	0.362	0.235	424	Clay	0.233
14.3	12.7	3	SC-SM	40	7	1.00		0.89	3	1639	1639	1.14	3.9	5.5	9.4	Y	Y	N	N	None	0.963	0.356	0.232	584	Clay	0.230
19.3	7.7	11	CL	59	21	1.00		0.93	13	2214	2030	1.00	13.3	5.5	18.8	Y	N	Y	Y	Clay-like	0.944	0.381	0.248	773	Clay	0.245
24.3	2.7	15	SM	18	0	1.00		0.96	19	2789	2293	0.96	18.0	4.1	22.0	Y	Y	Y	N	Sand-like	0.922	0.415	0.270	952	Sand	0.256
29.3	-2.4	20	SM	30	5	1.00		0.98	25	3364	2556	0.91	23.1	5.4	28.4	Y	Y	Y	N	Sand-like	0.899	0.438	0.285	1119	Sand	0.270
34.3	-7.4	15	SP	4	0	1.00		0.99	19	3939	2819	0.87	16.6	0.0	16.6	Y	Y	Y	N	Sand-like	0.876	0.453	0.294	1276	Sand	0.279
39.3	-12.4	11	SP	5	0	1.00		0.99	14	4514	3082	0.83	11.7	0.0	11.7	Y	Y	Y	N	Sand-like	0.851	0.461	0.300	1421	Sand	0.284
44.3	-17.4	23	SC	25	15	1.00		1.00	30	5089	3345	0.80	23.6	5.1	28.7	Y	N	Y	Y	Clay-like	0.826	0.465	0.302	1556	Clay	0.300
49.3	-22.4	17	SC	36	23	1.00		1.00	22	5664	3608	0.77	16.8	5.5	22.3	Y	N	Y	Y	Clay-like	0.801	0.466	0.303	1679	Clay	0.300
54.3	-27.4	21	SC	30	20	1.00		1.00	27	6239	3871	0.74	20.1	5.4	25.5	Y	N	Y	Y	Clay-like	0.777	0.463	0.301	1793	Clay	0.299
59.3	-32.4	16	CH	64	51	1.00		1.00	21	6814	4134	1.00	20.7	5.5	26.2	Y	N	Y	Y	Clay-like	0.753	0.459	0.299	1899	Clay	0.296
64.3	-37.4	14	CH	75	20	1.00		1.00	18	7389	4397	1.00	18.1	5.5	23.6	Y	N	Y	Y	Clay-like	0.730	0.454	0.295	1996	Clay	0.293
69.3	-42.4	13	CH	70	44	1.00		1.00	17	7964	4660	1.00	16.9	5.5	22.4	Y	N	Y	Y	Clay-like	0.708	0.448	0.291	2088	Clay	0.289
74.3	-47.4	22	MH	64	46	1.00		1.00	29	8539	4923	1.00	28.5	5.5	34.0	N	N	Y	Y	Clay-like	0.688	0.442	0.287	2174	Clay	0.285
79.3	-52.4	12	MH	70	20	1.00		1.00	16	9114	5186	1.00	15.6	5.5	21.1	Y	N	Y	Y	Clay-like	0.669	0.435	0.283	2257	Clay	0.280
84.3	-57.4	25	MH	70	20	1.00		1.00	32	9689	5449	1.00	32.4	5.5	37.9	N	N	Y	Y	Clay-like	0.652	0.429	0.279	2337	Clay	0.276
89.3	-62.4	28	CH	60	51	1.00		1.00	36	10264	5712	1.00	36.3	5.5	41.8	N	N	Y	Y	Clay-like	0.637	0.423	0.275	2417	Clay	0.273
94.3	-67.4	23	CH	70	40	1.00		1.00	30	10839	5975	1.00	29.8	5.5	35.3	N	N	Y	Y	Clay-like	0.623	0.418	0.272	2498	Clay	0.269
99.3	-72.4	13	CH	70	40	1.00		1.00	17	11414	6238	1.00	16.9	5.5	22.4	Y	N	Y	Y	Clay-like	0.611	0.414	0.269	2582	Clay	0.267
103.7	-76.8	100	CH	70	40	1.00		1.00	130	11926	6472	1.00	129.7	5.5	135.2	N	N	Y	Y	Clay-like	0.603	0.411	0.267	2660	Clay	0.265
109.3	-82.4	15	CH	70	40	1.00		1.00	19	12564	6764	1.00	19.4	5.5	24.9	Y	N	Y	Y	Clay-like	0.595	0.409	0.266	2764	Clay	0.263

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB3
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 15.0 ft

Maximum Depth of Liquefied Layers: 39.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
2.2	24.7	SM	30	6	9.6	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
4.2	22.7	SM	30	6	10.0	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
6.2	20.7	SM	30	6	23.5	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
8.2	18.7	SM	30	6	26.9	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
10.2	16.7	SC-SM	30	6	16.9	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
14.3	12.7	SC-SM	40	7	9.4	-	-	-	-	-	-	No Liq.	-	-	-	-	-	-	-	-	-
19.3	7.7	CL	59	21	18.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,996	6.1	0.75	1.00	0.75	0.33	3.07	No Loss
24.3	2.7	SM	18	0	22.0	0.99	1.00	0.234	0.231	1.11	0.90	Full Liq.	-	-	-	-	-	-	-	-	-
29.3	-2.4	SM	30	5	28.4	0.97	1.00	0.402	0.390	0.69	1.45	No Liq.	-	-	-	-	-	-	-	-	-
34.3	-7.4	SP	4	0	16.6	0.97	1.00	0.170	0.165	1.69	0.59	Full Liq.	-	-	-	-	-	-	-	-	-
39.3	-12.4	SP	5	0	11.7	0.96	1.00	0.130	0.126	2.26	0.44	Full Liq.	-	-	-	-	-	-	-	-	-
44.3	-17.4	SC	25	15	28.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,454	9.0	1.02	1.00	1.02	0.29	3.40	No Loss
49.3	-22.4	SC	36	23	22.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,298	5.6	0.70	1.00	0.70	0.43	2.33	No Loss
54.3	-27.4	SC	30	20	25.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,078	6.7	0.81	1.00	0.81	0.37	2.70	No Loss
59.3	-32.4	CH	64	51	26.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,109	4.4	0.58	1.00	0.58	0.51	1.94	No Loss
64.3	-37.4	CH	75	20	23.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,722	3.4	0.47	1.00	0.47	0.62	1.62	No Loss
69.3	-42.4	CH	70	44	22.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,528	2.9	0.42	1.00	0.42	0.70	1.44	No Loss
74.3	-47.4	MH	64	46	34.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,278	5.3	0.67	1.00	0.67	0.43	2.34	No Loss
79.3	-52.4	MH	70	20	21.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,334	2.3	0.34	1.00	0.34	0.81	1.23	No Loss
84.3	-57.4	MH	70	20	37.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,862	5.4	0.68	1.00	0.68	0.40	2.47	No Loss
89.3	-62.4	CH	60	51	41.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,446	5.9	0.73	1.00	0.73	0.37	2.68	No Loss
94.3	-67.4	CH	70	40	35.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,473	4.4	0.57	1.00	0.57	0.47	2.13	No Loss
99.3	-72.4	CH	70	40	22.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,528	2.0	0.31	1.00	0.31	0.86	1.16	No Loss
103.7	-76.8	CH	70	40	135.2	-	-	-	-	-	-	No Liq.	Eq 7-33,34	19,450	10.0	1.11	1.00	1.11	0.24	4.19	No Loss
109.3	-82.4	CH	70	40	24.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,917	2.2	0.33	1.00	0.33	0.80	1.25	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB3
Station:

Lateral Displacement Index, LDI: 3.34 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 4.35 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

	Sand-like Residual Strength													Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
2.2	24.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
4.2	22.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
6.2	20.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
8.2	18.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
10.2	16.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
14.3	12.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
19.3	7.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
24.3	2.7	36.6	1.5	19.5	Full Residual	729.6	0.44	0.17	1016	388	23.9	9.6	-	0.126	4.6%	0.406	0.012	5.00	0.060	0.362	4.3	66	4.6%	5.00	0.23	3.34
29.3	-2.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.302	3.6	75	#VALUE!	-	-	3.11
34.3	-7.4	36.0	0.4	17.0	Full Residual	707.3	0.38	0.14	1067	407	20.7	8.2	-	0.231	23.1%	0.684	0.027	5.00	0.133	0.302	3.6	57	23.1%	5.00	1.15	3.11
39.3	-12.4	33.4	0.5	12.2	Full Residual	435.7	0.13	0.11	400	328	7.4	6.1	-	0.392	39.2%	0.870	0.034	5.00	0.169	0.169	2.0	48	39.2%	5.00	1.96	1.96
44.3	-17.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-22.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-27.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-32.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-37.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-42.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-47.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-52.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-57.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-62.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-67.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-72.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
103.7	-76.8	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-82.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

700psf, 9 deg.

500psf, 6 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page A: Input Parameters, Susceptibility and Cyclic Stress

SCDOT Project: I-95 BRO BAGSHAW SWAMP	Hazard Level	SEE	Unit Weight	115 pcf		
County: JASPER COUNTY	PGA	0.37	Sample Liners Required	No		
Terracon Number: EN175299	M_W	7.30	Sample Liners Used	No		
Boring: BS-STB13	Elevation	14.4 ft	C_B	1.00	Table 7-5	
Station:	Water Depth	3.4 ft	C_E	1.37	Eq 7-2	
Offset:	Hammer ER	82.1%	C_S	1.00	Table 7-4	
	Borehole Diameter	4.00 in	MSF_{Sand}	1.054	Eq 13-11	
			MSF_{Clay}	1.009	Eq 13-12	

Blue Text — Input Values
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

							N-value Correction								SSL Susceptibility Screening					Cyclic Stress					
Note:						Eq 13-27, 29, Soil Aging Coeff.	CRR override for Clay-like Soil	Eq 7-5, 5 ft 'stick-up'	Eq 7-8	Total Vert. Stress	Eff. Vert. Stress	Eq 7-4	Eq 7-9	Eq 13-15	Eq 13-14	Sand-like			Clay-like	Sections 13.6.1, 13.6.2, 13.6.3	Eq 13-7,8,9	Eq 13-5	Eq 13-4 (65%)	Eq 13-6	Eq 13-11,12	Eq 13-3
Depth (ft)	Elevation (ft)	N_{Meas}	Soil Type (USCS)	Fines content (%)	PI	KDR for sand	Su (psf)	C_R	N^*_{60}	σ_{vc} (psf)	σ_{vc}' (psf)	C_N	$N^*_{1,60}$	$\Delta N^*_{1,60}$	$N^*_{1,60\text{-}cs}$	$N^*_{1,60\text{-}cs} < 30$	PI ≤ 10	Saturated	PI > 10	Potential SSL Susceptibility	Stress Reduct. Coeff. r_d	CSR_{Peak}	CSR_{eq}	Max. EQ-Induced Shear Stress, τ_{max} (psf)	MSF Type	CSR^*_{eq}
1.0	13.4	6	SC	30	15	1.00		0.60	5	116	116	1.70	8.3	5.4	13.7	Y	N	N	Y	Clay-like	1.004	0.372	0.242	43	Clay	0.239
3.0	11.4	6	SC	30	15	1.00		0.66	5	345	345	1.70	9.2	5.4	14.6	Y	N	N	Y	Clay-like	0.999	0.370	0.240	128	Clay	0.238
5.0	9.4	10	CL	60	15	1.00		0.72	10	575	475	1.00	9.8	5.5	15.3	Y	N	Y	Y	Clay-like	0.994	0.445	0.289	211	Clay	0.287
7.0	7.4	11	SM	13	0	1.00		0.77	12	805	580	1.70	19.6	2.5	22.1	Y	Y	Y	N	Sand-like	0.988	0.507	0.330	294	Sand	0.313
9.0	5.4	9	SP-SM	12	0	1.00		0.81	10	1035	686	1.70	16.9	2.1	19.0	Y	Y	Y	N	Sand-like	0.982	0.548	0.356	376	Sand	0.338
14.3	0.2	4	SC	15	15	1.00		0.89	5	1639	962	1.48	7.2	3.3	10.5	Y	Y	Y	N	Sand-like	0.963	0.607	0.395	584	Sand	0.374
19.3	-4.9	9	SP	4	0	1.00		0.93	11	2214	1225	1.31	15.1	0.0	15.1	Y	Y	Y	N	Sand-like	0.944	0.631	0.410	773	Sand	0.389
24.3	-9.9	12	SC	30	10	1.00		0.96	16	2789	1488	1.19	18.8	5.4	24.2	Y	Y	Y	N	Sand-like	0.922	0.640	0.416	952	Sand	0.394
29.3	-14.9	22	SC	31	18	1.00		0.98	29	3364	1751	1.10	32.3	5.4	37.7	N	N	Y	Y	Clay-like	0.899	0.639	0.416	1119	Clay	0.412
34.3	-19.9	18	SC	30	20	1.00		0.99	24	3939	2014	1.03	24.9	5.4	30.3	N	N	Y	Y	Clay-like	0.876	0.634	0.412	1276	Clay	0.408
39.3	-24.9	22	SC	43	21	1.00		0.99	30	4514	2277	0.96	28.8	5.5	34.3	N	N	Y	Y	Clay-like	0.851	0.624	0.406	1421	Clay	0.402
44.3	-29.9	22	CH	60	20	1.00		1.00	30	5089	2540	1.00	30.0	5.5	35.5	N	N	Y	Y	Clay-like	0.826	0.613	0.398	1556	Clay	0.395
49.3	-34.9	30	CH	52	38	1.00		1.00	41	5664	2803	1.00	40.9	5.5	46.4	N	N	Y	Y	Clay-like	0.801	0.599	0.389	1679	Clay	0.386
54.3	-39.9	12	MH	72	14	1.00		1.00	16	6239	3066	1.00	16.4	5.5	21.9	Y	N	Y	Y	Clay-like	0.777	0.585	0.380	1793	Clay	0.377
59.3	-44.9	27	MH	70	12	1.00		1.00	37	6814	3329	1.00	36.9	5.5	42.4	N	N	Y	Y	Clay-like	0.753	0.570	0.371	1899	Clay	0.368
64.3	-49.9	23	MH	62	31	1.00		1.00	31	7389	3592	1.00	31.5	5.5	37.0	N	N	Y	Y	Clay-like	0.730	0.556	0.361	1996	Clay	0.358
69.3	-54.9	28	MH	70	20	1.00		1.00	38	7964	3855	1.00	38.3	5.5	43.8	N	N	Y	Y	Clay-like	0.708	0.542	0.352	2088	Clay	0.349
74.3	-59.9	16	MH	87	34	1.00		1.00	22	8539	4118	1.00	21.9	5.5	27.4	Y	N	Y	Y	Clay-like	0.688	0.528	0.343	2174	Clay	0.340
79.3	-64.9	65	MH	97	41	1.00		1.00	89	9114	4381	1.00	88.9	5.5	94.4	N	N	Y	Y	Clay-like	0.669	0.515	0.335	2257	Clay	0.332
83.6	-69.2	100	MH	70	30	1.00		1.00	137	9614	4610	1.00	136.8	5.5	142.3	N	N	Y	Y	Clay-like	0.654	0.505	0.328	2327	Clay	0.325
89.3	-74.9	69	MH	70	30	1.00		1.00	94	10264	4907	1.00	94.4	5.5	99.9	N	N	Y	Y	Clay-like	0.637	0.493	0.320	2417	Clay	0.317
94.3	-79.9	15	MH	99	43	1.00		1.00	21	10839	5170	1.00	20.5	5.5	26.0	Y	N	Y	Y	Clay-like	0.623	0.483	0.314	2498	Clay	0.311
99.3	-84.9	100	MH	70	30	1.00		1.00	137	11414	5433	1.00	136.8	5.5	142.3	N	N	Y	Y	Clay-like	0.611	0.475	0.309	2582	Clay	0.306
104.3	-89.9	18	MH	70	30	1.00		1.00	25	11989	5696	1.00	24.6	5.5	30.1	N	N	Y	Y	Clay-like	0.602	0.469	0.305	2670	Clay	0.302
108.6	-94.2	100	MH	70	30	1.00		1.00	137	12483	5922	1.00	136.8	5.5	142.3	N	N	Y	Y	Clay-like	0.596	0.465	0.302	2751	Clay	0.299
114.3	-99.9	27	MH	70	30	1.00		1.00	37	13139	6222	1.00	36.9	5.5	42.4	N	N	Y	Y	Clay-like	0.590	0.461	0.299	2866	Clay	0.297
119.3	-104.9	16	MH	70	30	1.00		1.00	22	13714	6485	1.00	21.9	5.5	27.4	Y	N	Y	Y	Clay-like	0.587	0.459	0.298	2977	Clay	0.296
124.3	-109.9	20	MH	70	30	1.00		1.00	27	14289	6748	1.00	27.4	5.5	32.9	N	N	Y	Y	Clay-like	0.586	0.459	0.299	3099	Clay	0.296

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page B: Cyclic Resistance and Triggering Results

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB13
Station:

Resistance Factors:		By Table 9-10
		SEE
$\phi_{SL\text{-}Sand}$	0.90	0.90
$\phi_{SL\text{-}Clay}$	0.90	0.90

Total Thickness of Liquefied Layers: 19.3 ft

Maximum Depth of Liquefied Layers: 24.3 ft

Total Thickness of Limited Liquefaction: 0.0 ft

Total Thickness of Clay-like Strength Loss: 0.0 ft

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

						Sand-like Cyclic Resistance and (D/C)							Clay-like Cyclic Resistance and (D/C)								
Note:						Eq 13-22, 13-24	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-16	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Table 13-6 ($R_u < 0.7$, $0.7 \le R_u \approx 1$)	User defined or N^*_{60} correlated	User defined, or Eq 7-33, 7-34	Eq 7-40 f(k=0.23, Su, σ'_{vo})	Eq 13-21 f(OCR, n=0.8)	Section 13.9.6 (initial τ_s assumed 0)	Eq 13-13	Eq 13-2	1 / $(D/C)_{SL}$	Eq 13-62 80% Static Su (τ_{rs} = 0.8·τ_{peak})
Depth (ft)	Elevation (ft)	Soil Type (USCS)	Fines content (%)	PI	$N^*_{1,60\text{-}cs}$	K_σ for sand	K_α for sand	CRR* or $CRR_{M=7.5,\ 1tsf}$	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	$(D/C)_{SL} \le \phi_{SL}$	Shear Strength Input	Shear Strength, Su (psf)	OCR (min.=1)	CRR* or $CRR_{M=7.5,\ 1tsf}$	K_α for clay	CRR^*_{eq}	CSR^*_{eq} / CRR^*_{eq} = $(D/C)_{SL}$	Factor of Safety	Residual Su (τ_{rs}) (psf)
1.0	13.4	SC	30	15	13.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	735	10.0	1.11	1.00	1.11	0.22	4.64	No Loss
3.0	11.4	SC	30	15	14.6	-	-	-	-	-	-	No Liq.	Eq 7-33,34	813	10.0	1.11	1.00	1.11	0.21	4.66	No Loss
5.0	9.4	CL	60	15	15.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	1,471	10.0	1.11	1.00	1.11	0.26	3.87	No Loss
7.0	7.4	SM	13	0	22.1	1.10	1.00	0.235	0.258	1.21	0.83	Full Liq.	-	-	-	-	-	-	-	-	-
9.0	5.4	SP-SM	12	0	19.0	1.10	1.00	0.194	0.213	1.58	0.63	Full Liq.	-	-	-	-	-	-	-	-	-
14.3	0.2	SC	15	15	10.5	1.07	1.00	0.121	0.129	2.90	0.35	Full Liq.	-	-	-	-	-	-	-	-	-
19.3	-4.9	SP	4	0	15.1	1.06	1.00	0.157	0.167	2.34	0.43	Full Liq.	-	-	-	-	-	-	-	-	-
24.3	-9.9	SC	30	10	24.2	1.04	1.00	0.272	0.284	1.39	0.72	Full Liq.	-	-	-	-	-	-	-	-	-
29.3	-14.9	SC	31	18	37.7	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,412	10.0	1.11	1.00	1.11	0.37	2.69	No Loss
34.3	-19.9	SC	30	20	30.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,646	10.0	1.11	1.00	1.11	0.37	2.72	No Loss
39.3	-24.9	SC	43	21	34.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,481	10.0	1.11	1.00	1.11	0.36	2.76	No Loss
44.3	-29.9	CH	60	20	35.5	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,496	10.0	1.11	1.00	1.11	0.36	2.81	No Loss
49.3	-34.9	CH	52	38	46.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	6,142	10.0	1.11	1.00	1.11	0.35	2.88	No Loss
54.3	-39.9	MH	72	14	21.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	2,459	4.8	0.61	1.00	0.61	0.61	1.63	No Loss
59.3	-44.9	MH	70	12	42.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,537	10.0	1.11	1.00	1.11	0.33	3.02	No Loss
64.3	-49.9	MH	62	31	37.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,718	8.8	1.01	1.00	1.01	0.36	2.81	No Loss
69.3	-54.9	MH	70	20	43.8	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,745	10.0	1.11	1.00	1.11	0.31	3.18	No Loss
74.3	-59.9	MH	87	34	27.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,283	4.7	0.61	1.00	0.61	0.56	1.79	No Loss
79.3	-64.9	MH	97	41	94.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	13,340	10.0	1.11	1.00	1.11	0.30	3.35	No Loss
83.6	-69.2	MH	70	30	142.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	20,524	10.0	1.11	1.00	1.11	0.29	3.41	No Loss
89.3	-74.9	MH	70	30	99.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	14,162	10.0	1.11	1.00	1.11	0.29	3.50	No Loss
94.3	-79.9	MH	99	43	26.0	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,079	3.3	0.46	1.00	0.46	0.68	1.46	No Loss
99.3	-84.9	MH	70	30	142.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	20,525	10.0	1.11	1.00	1.11	0.28	3.63	No Loss
104.3	-89.9	MH	70	30	30.1	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,694	3.7	0.50	1.00	0.50	0.61	1.64	No Loss
108.6	-94.2	MH	70	30	142.3	-	-	-	-	-	-	No Liq.	Eq 7-33,34	20,525	10.0	1.11	1.00	1.11	0.27	3.71	No Loss
114.3	-99.9	MH	70	30	42.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	5,542	5.4	0.68	1.00	0.68	0.44	2.30	No Loss
119.3	-104.9	MH	70	30	27.4	-	-	-	-	-	-	No Liq.	Eq 7-33,34	3,284	2.7	0.39	1.00	0.39	0.76	1.31	No Loss
124.3	-109.9	MH	70	30	32.9	-	-	-	-	-	-	No Liq.	Eq 7-33,34	4,105	3.4	0.47	1.00	0.47	0.64	1.57	No Loss

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB13
Station:

Lateral Displacement Index, LDI: 4.37 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 6.01 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.501	6.0	-	-	-	-	4.37
3.0	11.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.501	6.0	-	-	-	-	4.37
5.0	9.4	-	-	-	No Loss								-	-	-	-	-	-	-	0.501	6.0	-	-	-	-	4.37
7.0	7.4	37.4	1.2	20.8	Full Residual	434.8	0.48	0.18	281	107	25.8	10.5	-	0.125	5.8%	0.403	0.015	2.00	0.031	0.501	6.0	66	5.8%	2.00	0.12	4.37
9.0	5.4	36.1	1.1	18.0	Full Residual	351.0	0.40	0.15	276	105	22.0	8.7	-	0.178	8.0%	0.571	0.024	2.00	0.048	0.470	5.6	61	8.0%	2.00	0.16	4.25
14.3	0.2	30.5	1.3	8.5	Full Residual	143.9	0.09	0.08	82	78	4.9	4.6	-	0.450	45.0%	0.904	0.036	5.25	0.191	0.422	5.1	45	45.0%	5.25	2.36	4.09
19.3	-4.9	35.3	0.4	15.5	Full Residual	384.6	0.25	0.13	300	161	13.8	7.5	-	0.272	27.2%	0.750	0.029	5.00	0.143	0.232	2.8	54	27.2%	5.00	1.36	1.73
24.3	-9.9	37.0	2.4	21.2	Full Residual	637.1	0.50	0.19	742	283	26.5	10.8	-	0.098	7.3%	0.282	0.018	5.00	0.089	0.089	1.1	69	7.3%	5.00	0.37	0.37
29.3	-14.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-49.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-54.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-59.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-64.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
83.6	-69.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-74.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-79.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-84.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-89.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
108.6	-94.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-99.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-104.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-109.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

300psf, 7 deg.

Cone Penetration Sounding (CPT) Liquefaction Screening

CLiq Plots

Terracon Consultants
Geotechnical Engineers
North Charleston, SC

LIQUEFACTION ANALYSIS REPORT

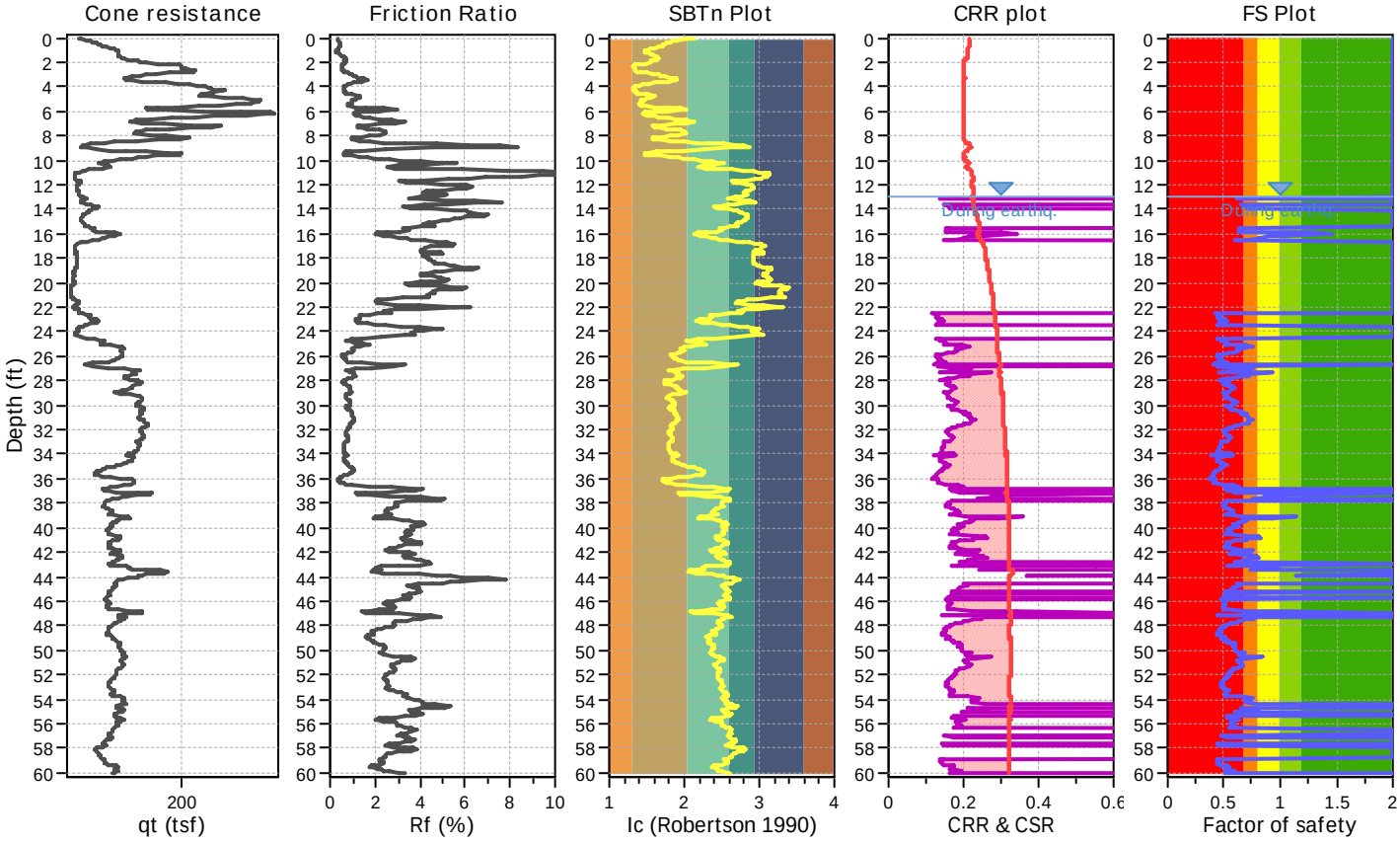
Project title : I-95 Bridge Replacement

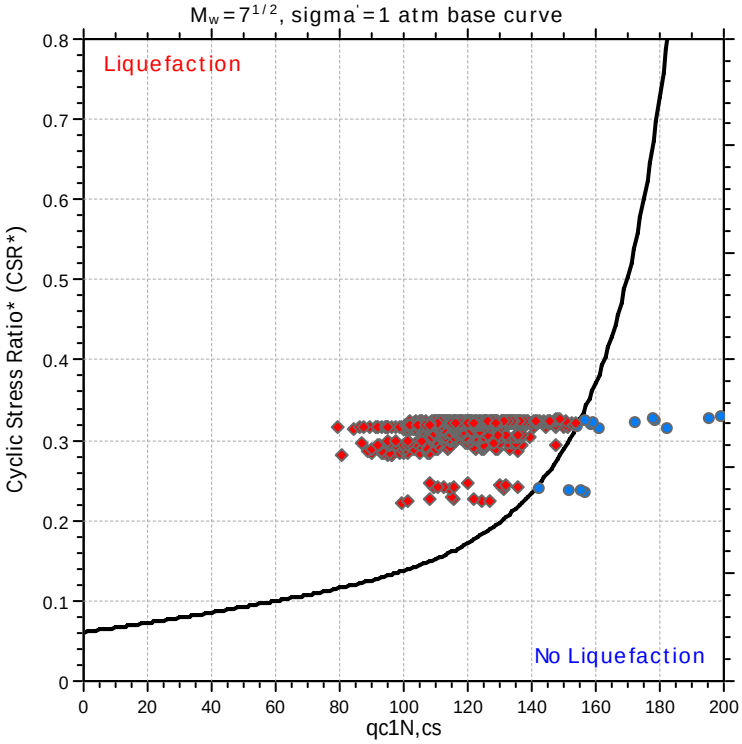
Location : Bagshaw Swamp, Hardeeville

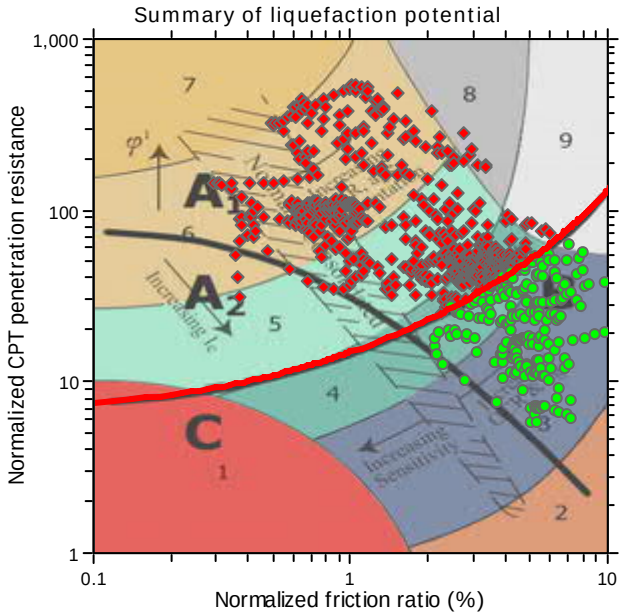
CPT file : BS-CPT4

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.30	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		



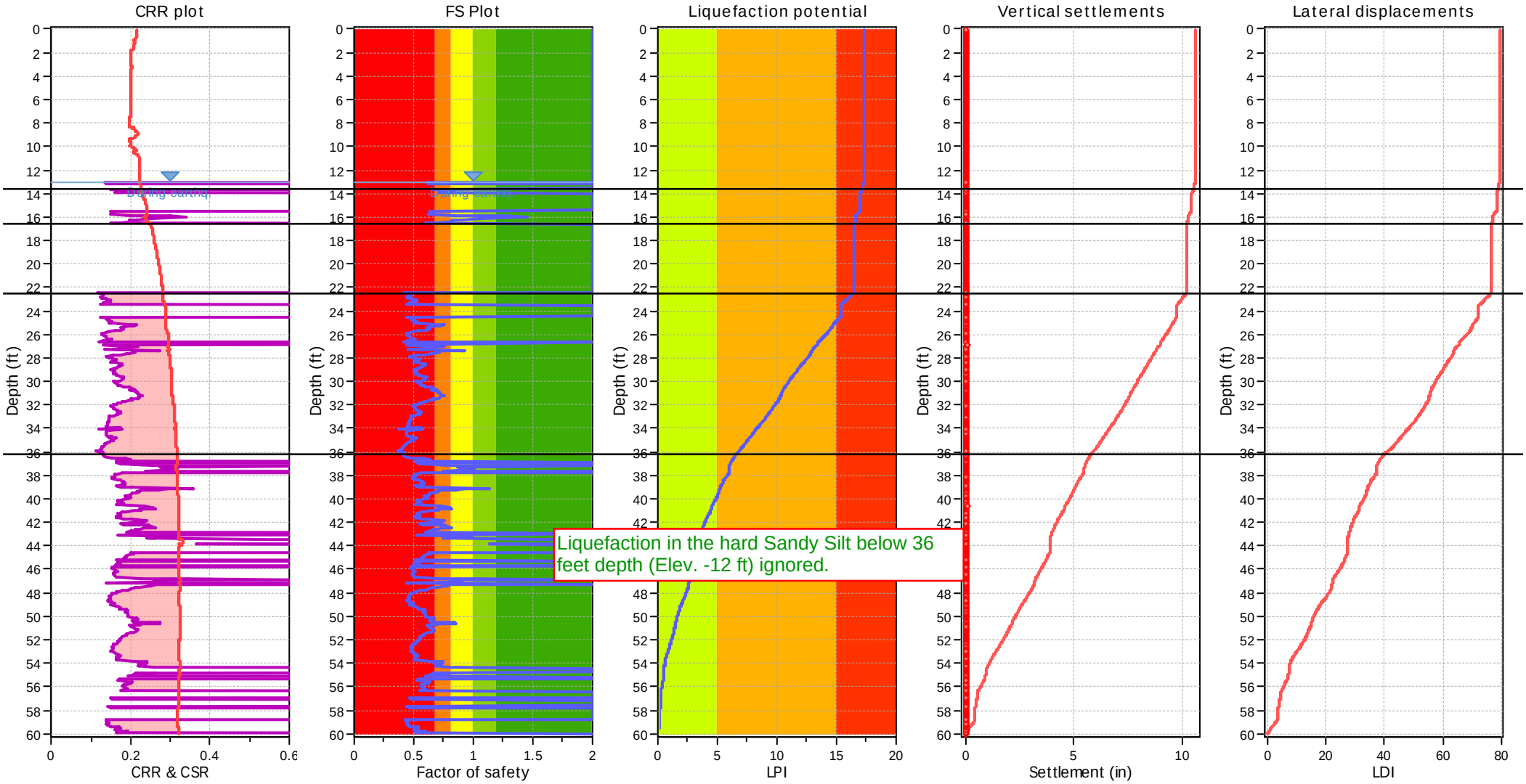




Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Surface Elevation: 24.5 feet NAVD88

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	13.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	13.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme
- Very high risk
- High risk
- Low risk

Terracon Consultants
Geotechnical Engineers
North Charleston, SC

LIQUEFACTION ANALYSIS REPORT

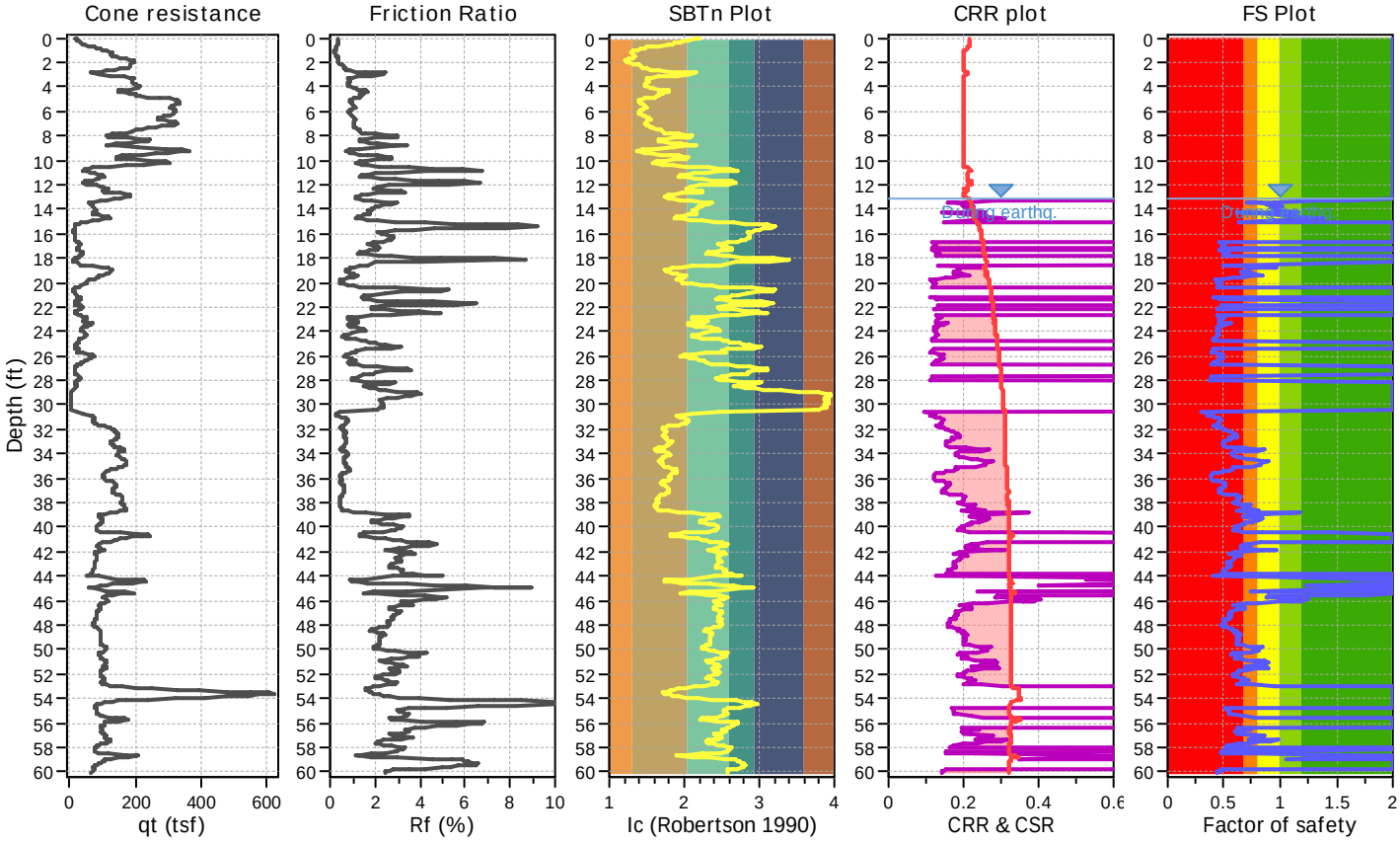
Project title : I-95 Bridge Replacement

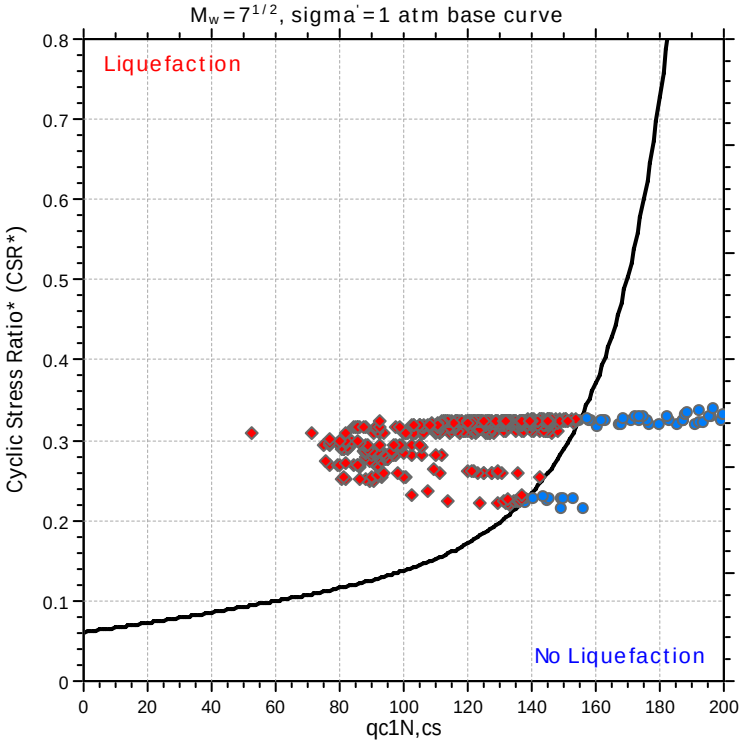
Location : Bagshaw Swamp, Hardeeville

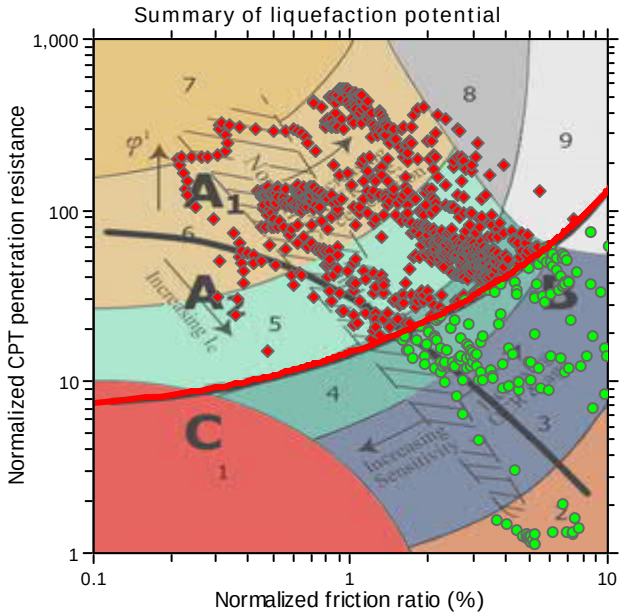
CPT file : BS-CPT5

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.20 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.20 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.30	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

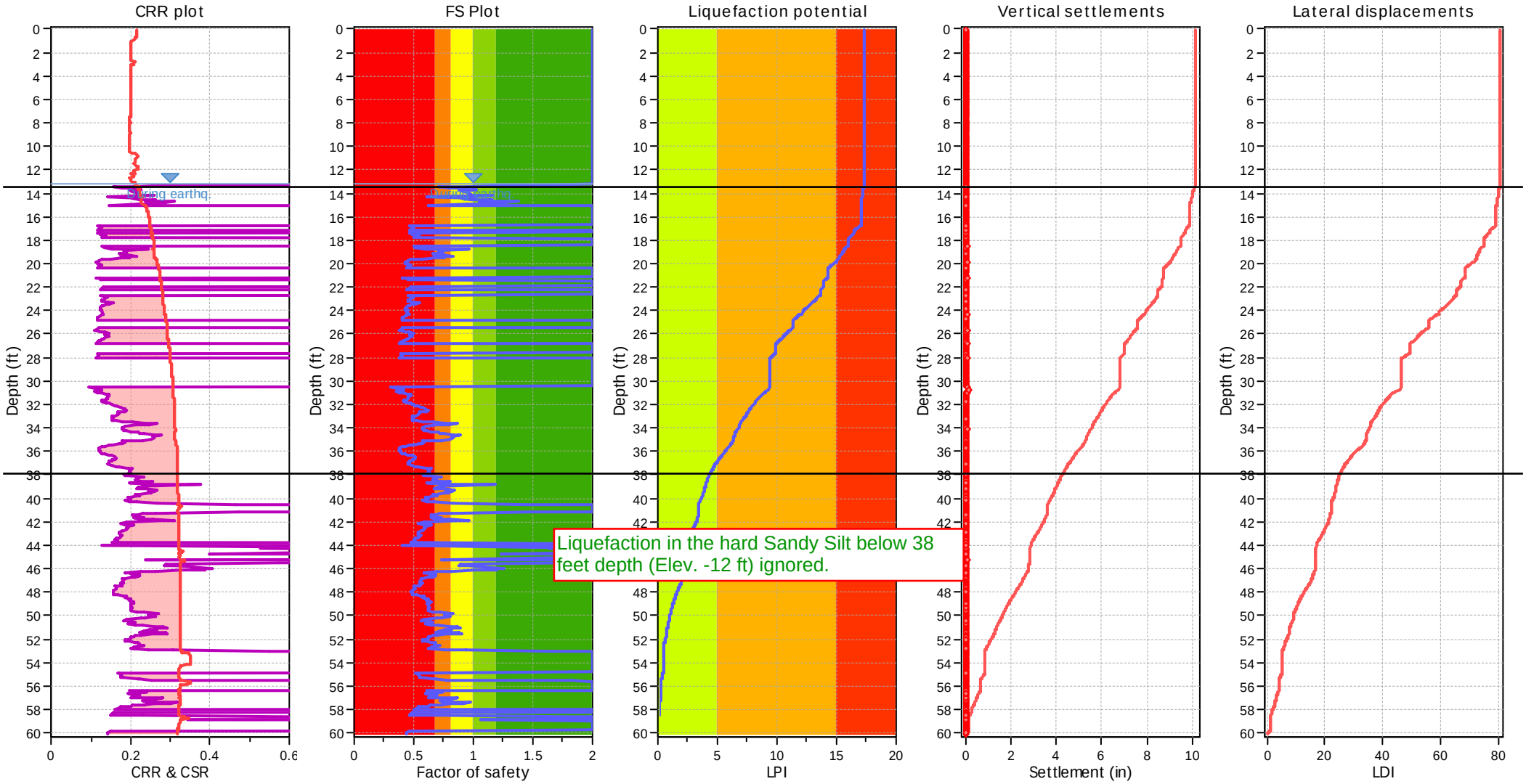






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	13.20 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	13.20 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Terracon Consultants
Geotechnical Engineers
North Charleston, SC

LIQUEFACTION ANALYSIS REPORT

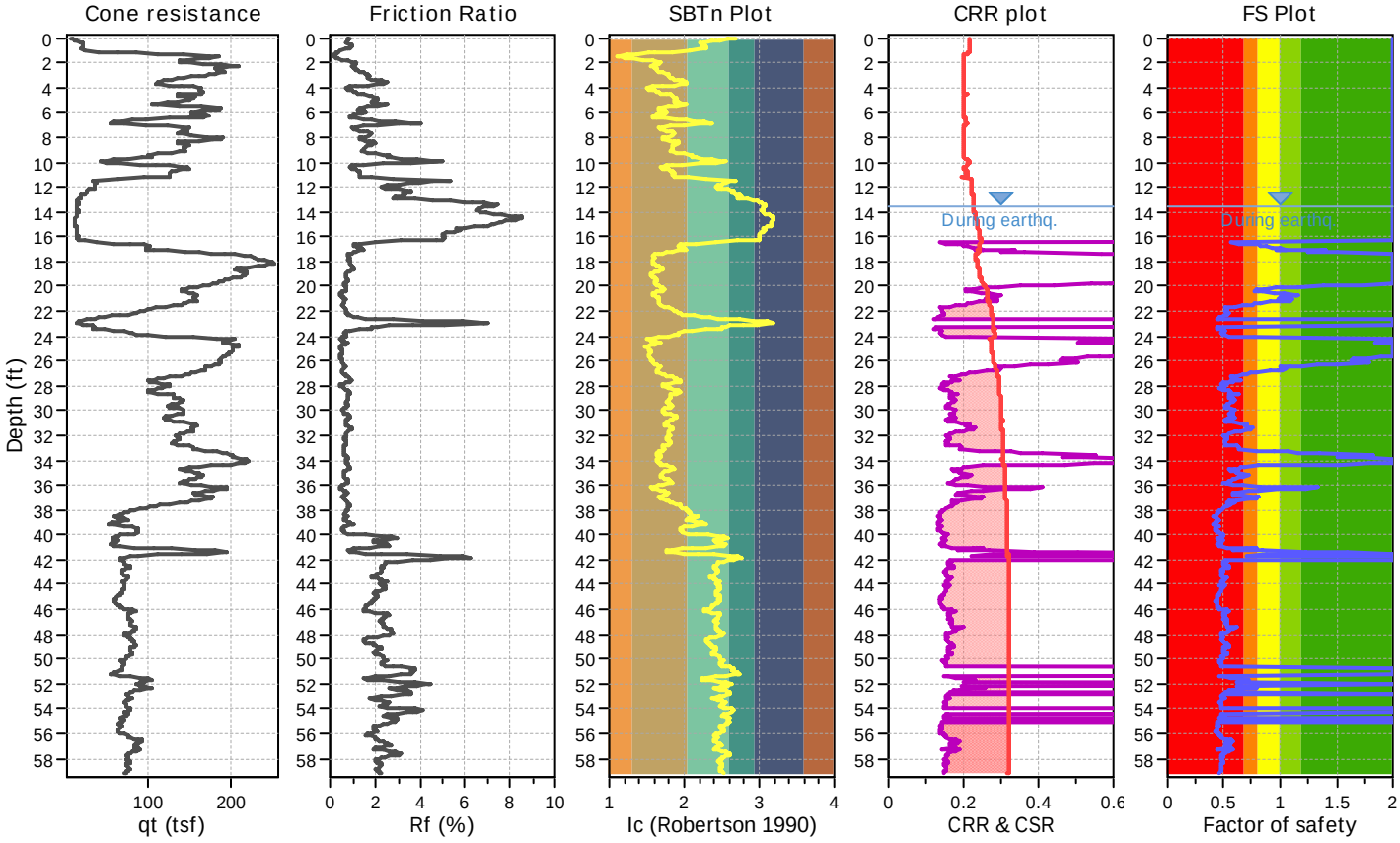
Project title : I-95 Bridge Replacement

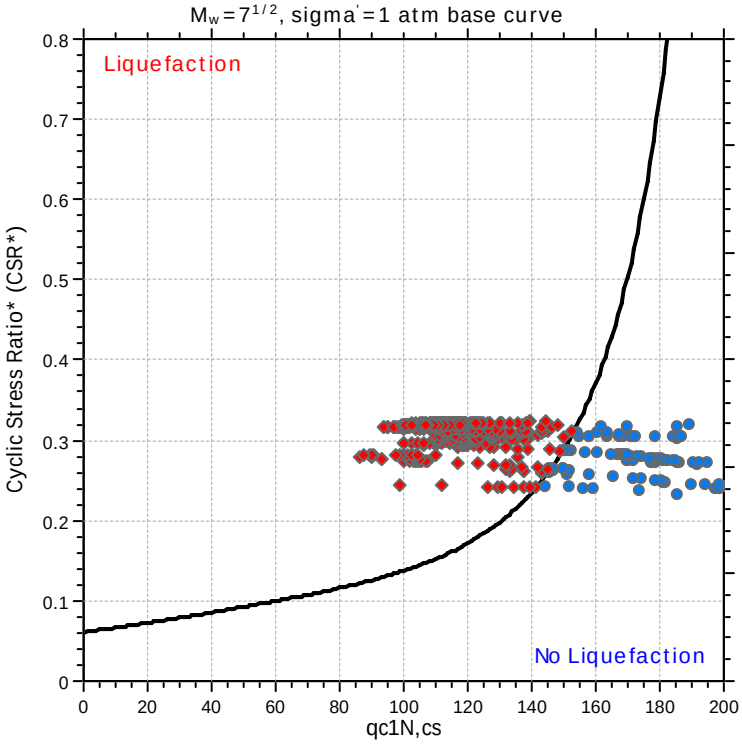
Location : Bagshaw Swamp, Hardeeville

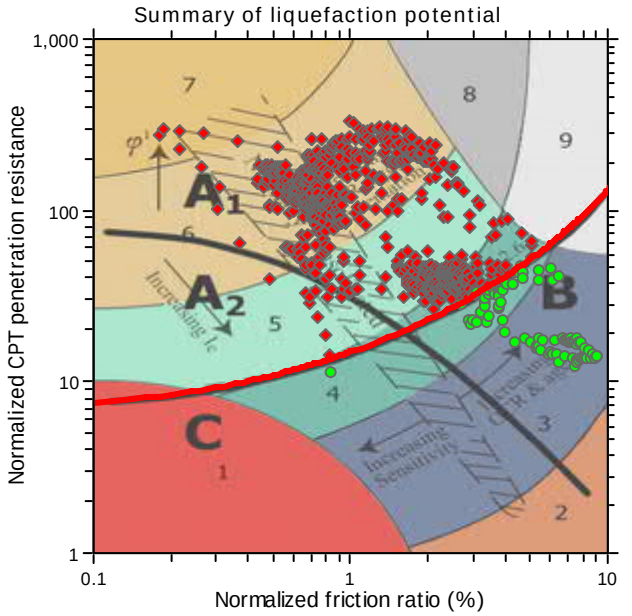
CPT file : BS-CPT6

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.50 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.30	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

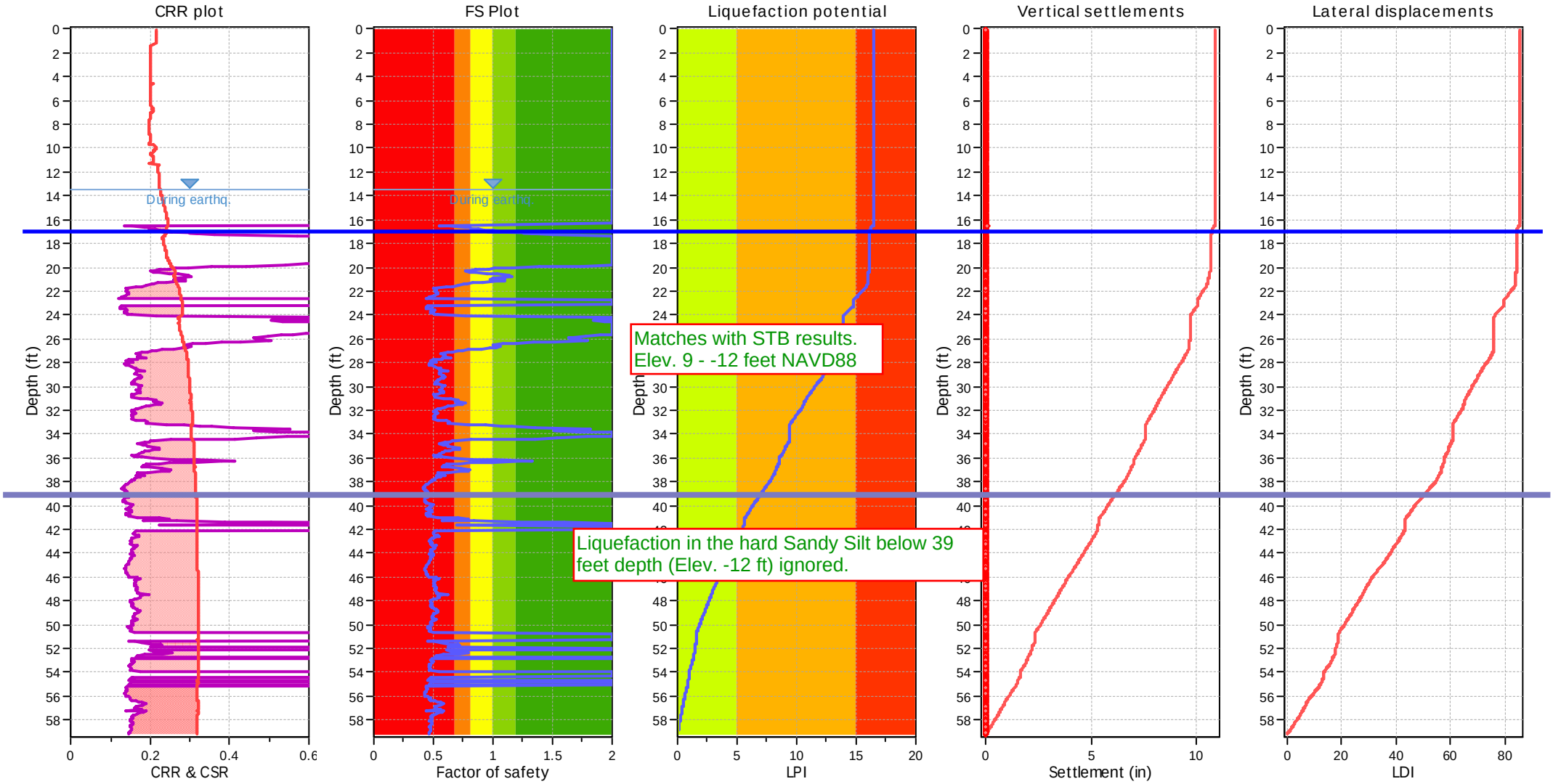






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	13.50 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	13.50 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme
- Very high risk
- High risk
- Low risk

Terracon Consultants
Geotechnical Engineers
North Charleston, SC

LIQUEFACTION ANALYSIS REPORT

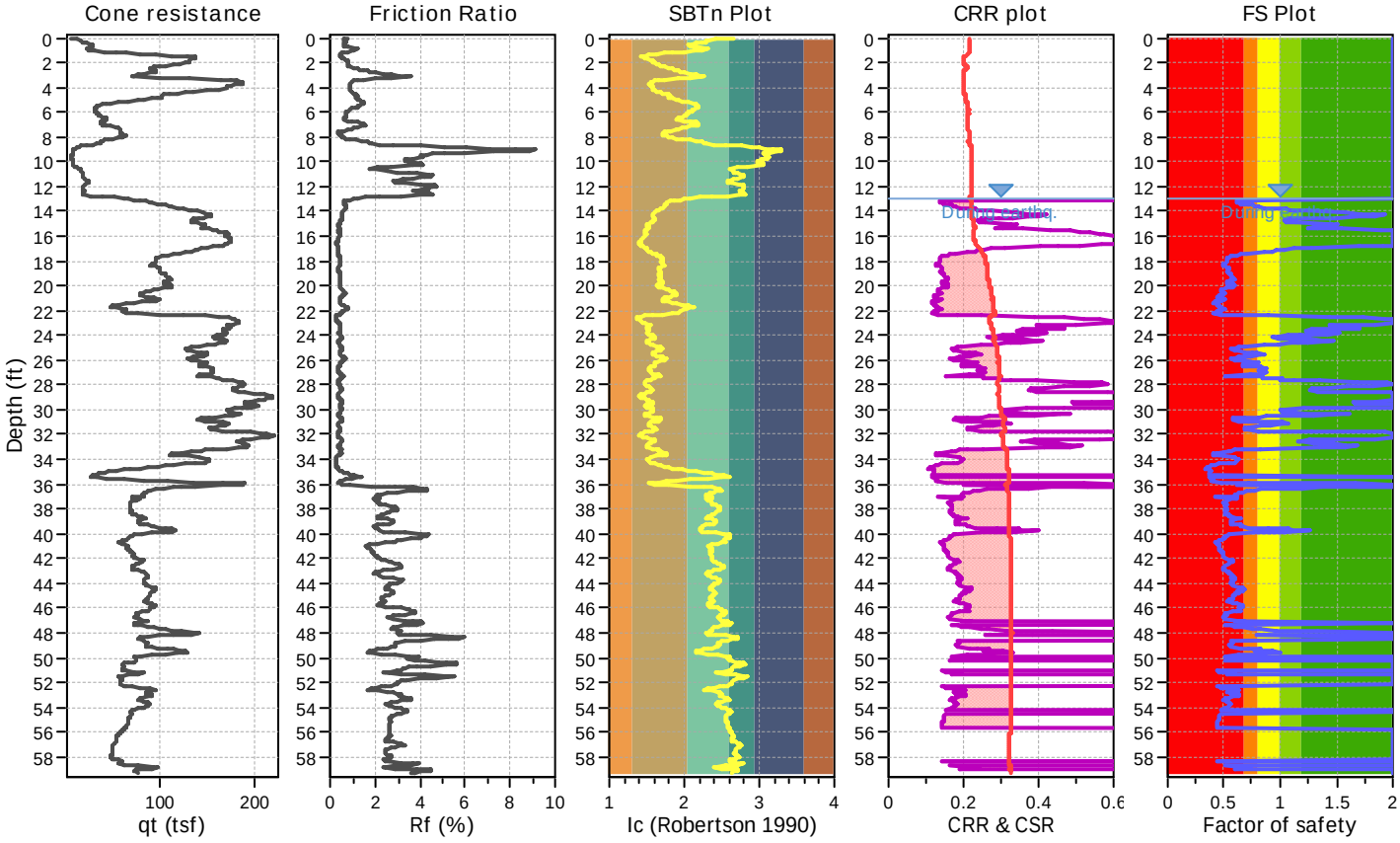
Project title : I-95 Bridge Replacement

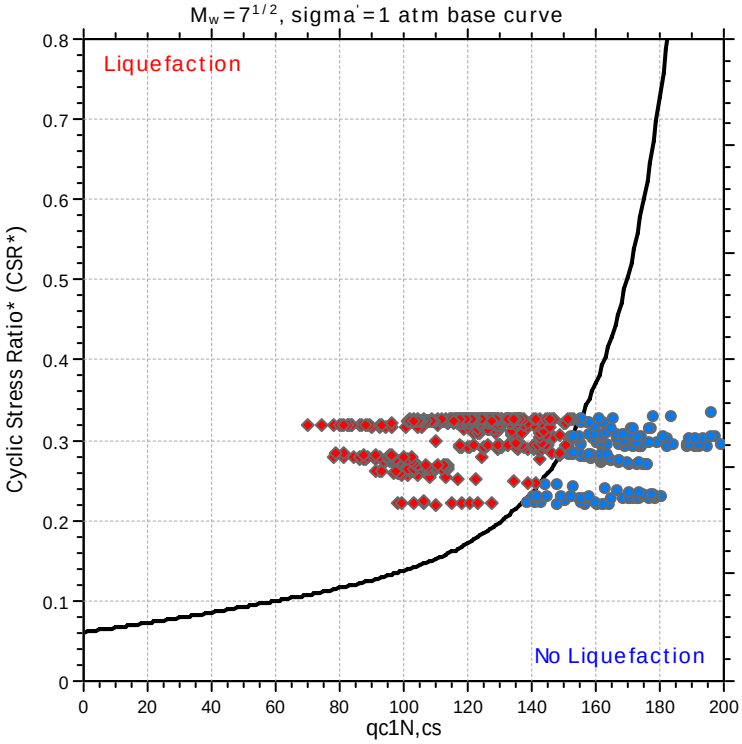
Location : Bagshaw Swamp, Hardeeville

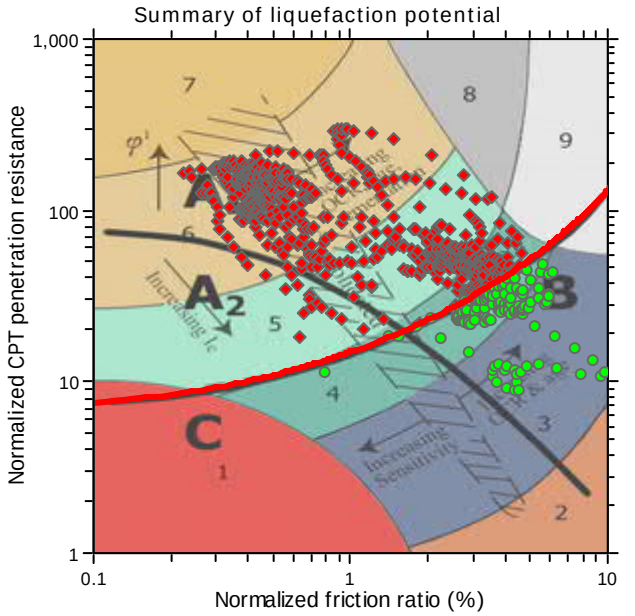
CPT file : BS-CPT7

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	13.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	13.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.30	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		



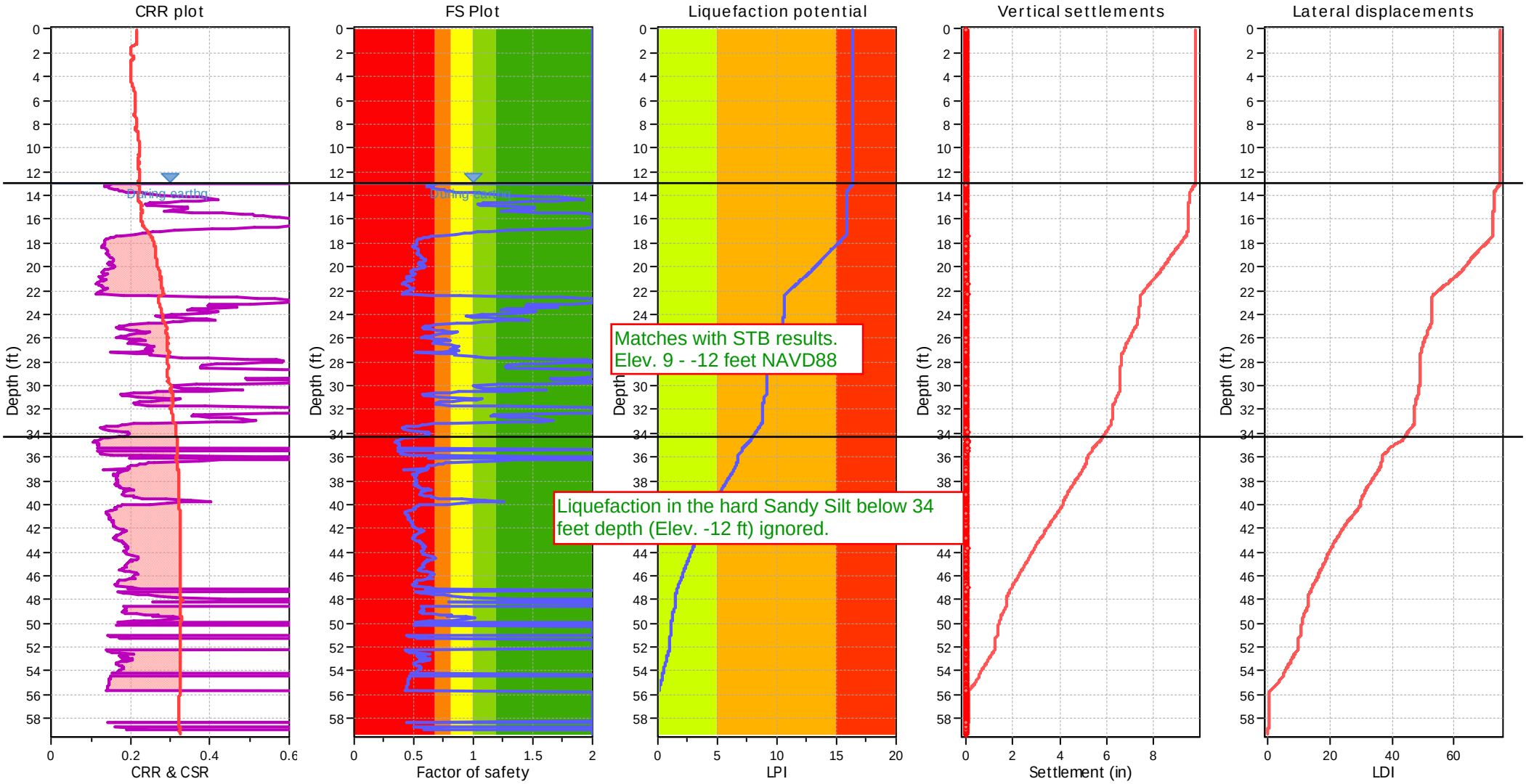




Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots

Surface Elev. 22 feet NAVD88



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	13.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	13.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

EXHIBIT C-3: SOIL PROFILE AND PARAMETERS

SOIL STRATIGRAPHY AND SOIL STRENGTH INFORMATION

The following subsurface profile is based on review of the boring logs, laboratory test results, literature, and engineering judgement. The parameters presented below are site specific.
Ground water elevation is assumed at the existing ground surface or Elev. 15 ft NAVD88.

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1. Existing Fill – End Bents 1 and 5 Embankment Fill

Silty Sand, Silty, clayey Sand with seams of Sandy Silt (treated as Sand-Like)

Unified Soil Classifications: SM, SC-SM
AASHTO Soil Classifications: A-2-4, A-4
Moisture Content: w = NA
Unit Weight: γ = 120 pcf
Average N_{60}: $\bar{N}_{60}$ = 12
Average $(N^*_1)_{60}$: $(\bar{N}^*_1)_{60}$ = 15

Above Elev. 23 ft

Effective Shear Strength: ϕ' = 32°, c' = 29 psf (CU test results for BS-Bulk2)
Total Shear Strengths: ϕ = 29°, c = 58 psf (CU test results for BS-Bulk2)
Modulus of Elasticity: E = 400 ksf (Table 7-19, GDM 2019)
Rankine At-Rest Lateral Earth Pressure Coefficient: k_0 = 0.47

Elev. 23 – 20 ft

Effective Shear Strength: ϕ' = 36°, c' = 0 psf (Eq. 7-47, 7-52, 7-55, 7-60, Section 7.11.1 GDM 2019)
Total Shear Strengths: ϕ = 36°, c = 0 psf (Eq. 7-33, 7-34 GDM 2019)
Modulus of Elasticity: E = 600 ksf (Table 7-19, GDM 2019)
Rankine At-Rest Lateral Earth Pressure Coefficient: k_0 = 0.41

Elev. 20 ft - Existing Grade

Effective Shear Strength: ϕ' = 30°, c' = 0 psf (Eq. 7-47, 7-52, 7-55, 7-60, Section 7.11.1 GDM 2019)
Total Shear Strengths: ϕ = 30°, c = 0 psf (Eq. 7-33, 7-34 GDM 2019)
Modulus of Elasticity: E = 600 ksf (Table 7-19, GDM 2019)
Rankine At-Rest Lateral Earth Pressure Coefficient: k_0 = 0.5

2. Sandy Clay

Exis. Grade – Elev. 9 ft Soft to Very Stiff Sandy fat and lean Clay and Medium Dense Clayey Sand

Unified Soil Classifications: CH, CL, SC
AASHTO Soil Classifications: A-7-5, A-6, A-2-4
Moisture Content: w = 21% to 39%
Liquid Limit, Plasticity Index: LL = 26% to 38% (CH @ 88%), PI = 10% to 21% (CH @ 52%)
% Passing No. 200 Sieve: FC = 27% to 68%
Average N_{60}: $\bar{N}_{60}$ = 16 bpf
Average $(N^*_1)_{60}$: $(\bar{N}^*_1)_{60}$ = 19 bpf
Unit Weight: γ = 125 pcf (Table 8-8, GDM 2019)
Effective Shear Strengths Properties : ϕ' = 25°, c' = 120 psf (Eq 7-47, 7-52, 7-55, 7-60, GDM 2019)
Total Shear Strengths Properties: ϕ = 0°, c = 1,200 psf (Eq. 7-33, 7-34, GDM 2019)
Modulus of Elasticity: E = 450 ksf (Table 7-19, GDM 2019)

Effective Preconsolidation Stress: σ'_p = 6.7 ksf (Eq. 7-93, GDM 2019)
Primary Compression Index: C_c = 0.373 ← 0.014·PI (Eq. 7-89, GDM 2019)
Recompression Index: C_r = 0.056 ← 0.15·C_c (Section 7.13.2.2, GDM 2019)
Coefficient of Consolidation: C_v = 0.358 ft²/day (Figure 7-36, GDM 2019)
Rankine At-Rest Lateral Earth Pressure Coefficient: k_0 = 1

3. Very Loose to Medium Dense Sand

Very Loose to Medium Dense Sand, Sand with Silt, Silty Sand, Silty Clayey Sand, and Clayey Sand
Unified Soil Classifications: SP-SM, SP, SM, SC-SM, SC
AASHTO Soil Classifications: A-2-4, A-3, A-4
Moisture Content: w = 19% to 30%
Liquid Limit, Plasticity Index: LL = 0% to 26%, PI = Non-Plastic to 9%
% Passing No. 200 Sieve: FC = 3% to 27% (BS-STB10 @13.5' FC = 40%)
Average N_{60}: $\bar{N}_{60}$ = 18 bpf
Average $(N^*_1)_{60}$: $(\bar{N}^*_1)_{60}$ = 21 bpf

Elev. 9 – 0 ft

Total Unit Weight: γ = 100 pcf (Table 8-8, GDM 2019)
Effective Shear Strength Properties: ϕ' = 28°, c' = 0 psf (Eq 7-47, 7-52, 7-55, 7-60, GDM 2019)
Total Shear Strength Properties: ϕ = 28°, c = 0 psf (Section 7.10.1, GDM 2019)
Modulus of Elasticity: E = 400 ksf (Table 7-19, GDM 2019)
Rankine At-Rest Lateral Earth Pressure Coefficient: k_0 = 0.53

Elev. 0 – -12 ft

Total Unit Weight: γ = 120 pcf (Table 8-8, GDM 2019)
Effective Shear Strength Properties: ϕ' = 36°, c' = 0 psf (Eq 7-47, 7-52, 7-55, 7-60, GDM 2019)
Total Shear Strength Properties: ϕ = 36°, c = 0 psf (Section 7.10.1, GDM 2019)
Modulus of Elasticity: E = 800 ksf (Table 7-19, GDM 2019)
Rankine At-Rest Lateral Earth Pressure Coefficient: k_0 = 0.41

4. Hard Sandy Silt

Elev. -12 – -109 ft Very Stiff and Hard Dark Greenish Gray Elastic Silt, Elastic Silt with Sand, Sandy Elastic Silt, Sandy Fat Clay, Dense and Very Dense Clayey Sand and Silty Sand

Unified Soil Classifications: MH, SM, SC, CH
AASHTO Soil Classifications: A-2-6, A-2-7, A-7-5, A-7-6
Moisture Content: @SM, SC, CH w = 38% to 56% , @MH w = 60% to 123%
Liquid Limit, Plasticity Index: LL = 37% to 110% (generally increases with depth), PI = 12 to 62%
% Passing No. 200 Sieve: FC = 25% to 99% (generally increases with depth)
Average N_{60}: $\bar{N}_{60}$ = 48 bpf
Average $(N^*_1)_{60}$: $(\bar{N}^*_1)_{60}$ = 35 bpf
Unit Weight: γ = 115 pcf (Table 8-8, GDM 2019)
Total Shear Strength Properties: ϕ = 0°, c = 3,500 psf (Eq. 7-33, 7-34, GDM 2019)
Effective Shear Strengths Properties : ϕ' = 22°, c' = 400 psf (Eq 7-47, 7-52, 7-55, 7-60, GDM 2019)
Rankine At-Rest Lateral Earth Pressure Coefficient: k_0 = 1

Compressibility of this layer has been neglected in the settlement analyses due to its depth and age as well as it being overconsolidated.

The following stratigraphy was adopted for both the northbound and southbound embankments.

Stratum	Top Elev. (ft)	Bot. Elev. (ft)
Existing Embankment	28*	23
	23	20
	20	15
Sandy Clay	15	9
Very Loose to Medium Dense Sand	9	0
	0	-12
Hard Sandy Silt	-12	PMDE**

*No change in grade for proposed bridge
**PMDE = Present to Maximum Depth Explored

Full liquefied thickness of Sand-Like materials is approximately 21 ft (Elev. 9 to -12 feet). The SSL screening results are shown in the table below.

Stratum	Top Elev. (ft)	Bot. Elev. (ft)
Liquefied Sand Layer 1	9	6
Liquefied Sand Layer 2	6	2
Liquefied Sand Layer 3	2	-2
Liquefied Sand Layer 4	-2	-10
Liquefied Sand Layer 5	-10	-12

SPT Corrections and Strength Estimate
(Final Borings)

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Project: I-95 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB1
Station:

Input Parameters

Boring Elevation, ft	27.8	Clay-like assumed OC
Water Table Depth, ft	16.8	assumed based on BS-STB13
Average ɣ above water table (kcf) =	0.115	assumed
Average ɣ below water table (kcf) =	0.115	assumed
Borehole Diameter (in)	4	
Correction for Liners Required (Y/N)	N	

																				DESIGN INPUT PARAMETERS					
																		Effective Stress	Total Stress		Effective Stress		Total Stress			
Depth (ft)	Elevation (ft)	Measured N	Soil Type[0] 1=Sand-Like, 2=Clay-Like	Fines Content (%)[1]	Plasticity Index	L=Low Plasticity, H=Med-High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N'_{60}	$N'_{1,60}$	$N'_{1,60,CS}$	Estimated ϕ'[2]	Estimated c' (ksf)[7]	Estimated Su (ksf)[3]	Design ϕ'	c' (ksf)	Design Su (ksf)[4]	Total Unit Weight[5] (pcf)	Es[6] (ksf)	NOTES
1.2	26.6	9	1	30	5	L	SM	77.8	0.1	0.1	1.3	1.7	0.8	1.0	1.0	1.2	11.7	19.8	8.8	14.9	18.2	35.1	0.0	n.a.						
3.2	24.6	22	1	30	5	L	SM	77.8	0.4	0.4	1.3	1.7	0.8	1.0	1.0	1.2	28.5	48.5	21.4	36.4	42.2	43.7	0.0	n.a.						
5.2	22.6	6	1	30	5	L	SM	77.8	0.6	0.6	1.3	1.7	0.8	1.0	1.0	1.3	7.8	13.2	5.8	9.9	12.6	32.4	0.0	n.a.	36	0.0	n.a.	115	600	
7.2	20.6	12	1	30	5	L	SM	77.8	0.8	0.8	1.3	1.6	0.9	1.0	1.0	1.2	15.6	24.2	13.2	20.6	24.5	37.8	0.0	n.a.						
9.2	18.6	4	1	60	5	L	ML	77.8	1.1	1.1	1.3	1.4	0.9	1.0	1.0	1.7	5.2	7.1	4.4	6.1	10.5	29.7	0.0	n.a.	30	0.0	n.a.	110	400	
13.5	14.3	15	1	21	0	L	SM	77.8	1.6	1.6	1.3	1.1	1.0	1.0	1.0	1.1	19.5	22.1	18.5	21.0	23.8	38.0	0.0	n.a.	36	0.0	n.a.	125	800	
18.5	9.3	2	1	24	9	L	SC	77.8	2.1	2.0	1.3	1.0	1.0	1.0	1.0	1.6	2.6	2.6	2.5	2.5	3.9	26.1	0.0	n.a.						
23.5	4.3	5	1	5	0	L	SP-SM	77.8	2.7	2.3	1.3	0.9	1.0	1.0	1.0	1.1	6.5	6.1	6.2	5.8	6.1	29.4	0.0	n.a.	28	0.0	n.a.	100	400	
28.5	-0.7	14	1	6	0	L	SP-SM	77.8	3.3	2.5	1.3	0.9	1.0	1.0	1.0	1.0	18.2	16.1	18.2	16.1	16.8	35.7	0.0	n.a.						
33.5	-5.7	21	1	5	0	L	SP-SM	77.8	3.9	2.8	1.3	0.8	1.0	1.0	1.0	1.0	27.2	23.0	27.2	23.0	23.7	38.8	0.0	n.a.	36	0.0	n.a.	125	800	
38.5	-10.7	12	1	3	0	L	SP	77.8	4.4	3.1	1.3	0.8	1.0	1.0	1.0	1.0	15.6	12.6	15.6	12.6	12.9	33.9	0.0	n.a.						
43.5	-15.7	18	2	30	25	H	SC	77.8	5.0	3.3	1.3	0.8	1.0	1.0	1.0	1.2	23.3	18.1	23.3	18.1	21.7	24.4	0.4	3.5						
48.5	-20.7	20	2	39	28	H	SC	77.8	5.6	3.6	1.3	0.7	1.0	1.0	1.0	1.3	25.9	19.3	25.9	19.3	24.3	23.7	0.4	3.9						
53.5	-25.7	22	2	30	25	H	SC	77.8	6.2	3.9	1.3	0.7	1.0	1.0	1.0	1.2	28.5	20.5	28.5	20.5	24.5	24.4	0.4	4.3						
58.5	-30.7	27	2	45	33	H	SC	77.8	6.7	4.1	1.3	0.7	1.0	1.0	1.0	1.3	35.0	24.4	35.0	24.4	31.0	22.7	0.5	5.3						
63.5	-35.7	19	2	60	41	H	CH	77.8	7.3	4.4	1.3	0.7	1.0	1.0	1.0	1.4	24.6	16.6	24.6	16.6	23.6	21.4	0.4	3.7						
68.5	-40.7	19	2	60	40	H	CH	77.8	7.9	4.7	1.3	0.7	1.0	1.0	1.0	1.4	24.6	16.2	24.6	16.2	23.0	21.6	0.4	3.7						
73.5	-45.7	17	2	60	40	H	CH	77.8	8.5	4.9	1.3	0.6	1.0	1.0	1.0	1.5	22.0	14.1	22.0	14.1	20.4	21.6	0.3	3.3	22	0.4	5.7	115		
78.5	-50.7	35	2	39	32	H	SM	77.8	9.0	5.2	1.3	0.6	1.0	1.0	1.0	1.2	45.4	28.2	45.4	28.2	34.6	22.9	0.6	6.8						
83.5	-55.7	17	2	90	62	H	MH	77.8	9.6	5.4	1.3	0.6	1.0	1.0	1.0	1.7	22.0	13.4	22.0	13.4	22.7	19.3	0.3	3.3						
88.5	-60.7	46	2	70	40	H	MH	77.8	10.2	5.7	1.3	0.6	1.0	1.0	1.0	1.4	59.6	35.3	59.6	35.3	48.7	21.6	0.6	8.9						
93.5	-65.7	100	2	70	40	H	MH	77.8	10.8	6.0	1.3	0.6	1.0	1.0	1.0	1.3	129.7	75.1	129.7	75.1	99.6	21.6	0.6	19.5						
98.5	-70.7	11	2	70	40	H	MH	77.8	11.3	6.2	1.3	0.6	1.0	1.0	1.0	1.7	14.3	8.1	14.3	8.1	13.8	21.6	0.2	2.1						

Notes:
0 - From SCDOT GDM 2019 Table 7-6
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equations 7-47, 7-52, 7-55
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed
5 - From SCDOT GDM 2019 Table 8-8
6 - From SCDOT GDM 2019 Table 7-19
7 - Equation 7-60 and Section 7.11.1 GDM 2019

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Project: I-95 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB3
Station:

Input Parameters

Boring Elevation, ft	26.9		Clay-like assumed	OC
Water Table Depth, ft	15.9	assumed based on BS-STB13		
Average ɣ above water table (kcf) =	0.115	assumed		
Average ɣ below water table (kcf) =	0.115	assumed		
Borehole Diameter (in)	4			
Correction for Liners Required (Y/N)	N			

																				DESIGN INPUT PARAMETERS					
																		Effective Stress	Total Stress		Effective Stress		Total Stress			
Depth (ft)	Elevation (ft)	Measured N	Soil Type[0] 1=Sand-Like, 2=Clay-Like	Fines Content (%)[1]	Plasticity Index	L=Low Plasticity, H=Med-High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N'_{60}	$N'_{1,60}$	$N'_{1,60,CS}$	Estimated ϕ'[2]	Estimated c' (ksf)[7]	Estimated Su (ksf)[3]	Design ϕ'	c' (ksf)	Design Su (ksf)[4]	Total Unit Weight[5] (pcf)	Es[6] (ksf)	NOTES
1.2	25.7	3	1	30	6	L	SM	77.8	0.1	0.1	1.3	1.7	0.8	1.0	1.0	1.4	3.9	6.6	2.9	5.0	7.1	28.7	0.0	n.a.	29	0.0	n.a.	100	400	
3.2	23.7	3	1	30	6	L	SM	77.8	0.4	0.4	1.3	1.7	0.8	1.0	1.0	1.4	3.9	6.6	2.9	5.0	7.1	28.7	0.0	n.a.						
5.2	21.7	11	1	30	6	L	SM	77.8	0.6	0.6	1.3	1.7	0.8	1.0	1.0	1.2	14.3	24.2	10.7	18.2	21.9	36.7	0.0	n.a.	36	0.0	n.a.	125	800	
7.2	19.7	14	1	30	6	L	SM	77.8	0.8	0.8	1.3	1.6	0.9	1.0	1.0	1.2	18.2	28.2	15.4	24.0	28.4	39.2	0.0	n.a.						
9.2	17.7	8	1	30	6	L	SC-SM	77.8	1.1	1.1	1.3	1.4	0.9	1.0	1.0	1.2	10.4	14.3	8.8	12.1	15.1	33.7	0.0	n.a.	34	0.0	n.a.	100	400	
13.5	13.4	3	1	40	7	L	SC-SM	77.8	1.6	1.6	1.3	1.1	1.0	1.0	1.0	1.6	3.9	4.4	3.7	4.2	6.9	28.0	0.0	n.a.	28	0.0	n.a.	100	400	
18.5	8.4	11	2	59	21	H	CL	77.8	2.1	2.0	1.3	1.0	1.0	1.0	1.0	1.5	14.3	14.4	13.6	13.7	19.8	25.5	0.2	2.1	25	0.2	2.1	125	600	
23.5	3.4	15	1	18	0	L	SM	77.8	2.7	2.2	1.3	0.9	1.0	1.0	1.0	1.1	19.5	18.4	18.5	17.5	19.7	36.4	0.0	n.a.						
28.5	-1.6	20	1	30	5	L	SM	77.8	3.3	2.5	1.3	0.9	1.0	1.0	1.0	1.2	25.9	23.2	25.9	23.2	27.5	38.9	0.0	n.a.	36	0.0	n.a.	125	800	
33.5	-6.6	15	1	4	0	L	SP	77.8	3.9	2.8	1.3	0.9	1.0	1.0	1.0	1.0	19.5	16.6	19.5	16.6	17.0	36.0	0.0	n.a.						
38.5	-11.6	11	1	5	0	L	SP	77.8	4.4	3.0	1.3	0.8	1.0	1.0	1.0	1.0	14.3	11.6	14.3	11.6	12.1	33.4	0.0	n.a.						
43.5	-16.6	23	2	25	15	H	SC	77.8	5.0	3.3	1.3	0.8	1.0	1.0	1.0	1.2	29.8	23.3	29.8	23.3	26.9	27.5	0.4	4.5						
48.5	-21.6	17	2	36	23	H	SC	77.8	5.6	3.5	1.3	0.8	1.0	1.0	1.0	1.3	22.0	16.6	22.0	16.6	20.7	24.9	0.3	3.3						
53.5	-26.6	21	2	30	20	H	SC	77.8	6.2	3.8	1.3	0.7	1.0	1.0	1.0	1.2	27.2	19.7	27.2	19.7	23.6	25.8	0.4	4.1						
58.5	-31.6	16	2	64	51	H	CH	77.8	6.7	4.1	1.3	0.7	1.0	1.0	1.0	1.5	20.7	14.5	20.7	14.5	21.5	20.2	0.3	3.1						
63.5	-36.6	14	2	75	20	H	CH	77.8	7.3	4.3	1.3	0.7	1.0	1.0	1.0	1.6	18.2	12.3	18.2	12.3	19.8	25.8	0.3	2.7						
68.5	-41.6	13	2	70	44	H	CH	77.8	7.9	4.6	1.3	0.7	1.0	1.0	1.0	1.6	16.9	11.1	16.9	11.1	17.7	21.0	0.3	2.5						
73.5	-46.6	22	2	64	46	H	MH	77.8	8.5	4.9	1.3	0.6	1.0	1.0	1.0	1.4	28.5	18.3	28.5	18.3	26.2	20.7	0.4	4.3						
78.5	-51.6	12	2	70	20	H	MH	77.8	9.0	5.1	1.3	0.6	1.0	1.0	1.0	1.6	15.6	9.7	15.6	9.7	15.9	25.8	0.2	2.3	23	0.4	4.8	115		
83.5	-56.6	25	2	70	20	H	MH	77.8	9.6	5.4	1.3	0.6	1.0	1.0	1.0	1.5	32.4	19.8	32.4	19.8	28.8	25.8	0.5	4.9						
88.5	-61.6	28	2	60	51	H	CH	77.8	10.2	5.6	1.3	0.6	1.0	1.0	1.0	1.4	36.3	21.6	36.3	21.6	29.8	20.2	0.5	5.4						
93.5	-66.6	23	2	70	40	H	CH	77.8	10.8	5.9	1.3	0.6	1.0	1.0	1.0	1.5	29.8	17.3	29.8	17.3	25.7	21.6	0.4	4.5						
98.5	-71.6	13	2	70	40	H	CH	77.8	11.3	6.2	1.3	0.6	1.0	1.0	1.0	1.6	16.9	9.6	16.9	9.6	15.8	21.6	0.3	2.5						
103.5	-76.6	100	2	70	40	H	CH	77.8	11.9	6.4	1.3	0.6	1.0	1.0	1.0	1.3	129.7	72.3	129.7	72.3	96.0	21.6	0.6	19.5						
108.5	-81.6	15	2	70	40	H	CH	77.8	12.5	6.7	1.3	0.5	1.0	1.0	1.0	1.6	19.5	10.6	19.5	10.6	17.1	21.6	0.3	2.9						

Notes:
0 - From SCDOT GDM 2019 Table 7-6
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equations 7-47, 7-52, 7-55
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed
5 - From SCDOT GDM 2019 Table 8-8
6 - From SCDOT GDM 2019 Table 7-19
7 - Equation 7-60 and Section 7.11.1 GDM 2019

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Project: I-95 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB13
Station:

Input Parameters

Boring Elevation, ft	14.4		Clay-like assumed	OC
Water Table Depth, ft	3.4	measured		
Average ɣ above water table (kcf) =	0.115	assumed		
Average ɣ below water table (kcf) =	0.115	assumed		
Borehole Diameter (in)	4			
Correction for Liners Required (Y/N)	N			

																				DESIGN INPUT PARAMETERS					
																		Effective Stress		Total Stress	Effective Stress		Total Stress			
Depth (ft)	Elevation (ft)	Measured N	Soil Type[0] 1=Sand-Like, 2=Clay-Like	Fines Content (%)[1]	Plasticity Index	L=Low Plasticity, H=Med-High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N'_{60}	$N'_{1,60}$	$N'_{1,60,CS}$	Estimated ϕ'[2]	Estimated c' (ksf)[7]	Estimated Su (ksf)[3]	Design ϕ'	c' (ksf)	Design Su (ksf)[4]	Total Unit Weight[5] (pcf)	Es[6] (ksf)	NOTES
0.0	14.4	6	2	30	15	H	SC	82.1	0.0	0.0	1.4	1.7	0.8	1.0	1.0	1.3	8.2	14.0	6.2	10.5	13.2	27.5	0.1	1.2						
2	12.4	6	2	30	15	H	SC	82.1	0.2	0.2	1.4	1.7	0.8	1.0	1.0	1.3	8.2	14.0	6.2	10.5	13.2	27.5	0.1	1.2						
4	10.4	10	2	60	15	H	CL	82.1	0.5	0.4	1.4	1.7	0.8	1.0	1.0	1.4	13.7	23.3	10.3	17.4	24.6	27.5	0.2	2.1						
6	8.4	11	1	13	0	L	SM	82.1	0.7	0.5	1.4	1.7	0.9	1.0	1.0	1.1	15.1	25.6	12.8	21.7	23.5	38.3	0.0	n.a.						
8	6.4	9	1	12	0	L	SP-SM	82.1	0.9	0.6	1.4	1.7	0.9	1.0	1.0	1.1	12.3	20.9	10.5	17.8	19.2	36.6	0.0	n.a.	36	0.0	n.a.	115	400	
13.5	0.9	4	1	15	15	H	SC	82.1	1.6	0.9	1.4	1.5	1.0	1.0	1.0	1.2	5.5	8.1	5.2	7.7	8.9	30.9	0.0	n.a.	31	0.0	n.a.	100	400	
18.5	-4.1	9	1	4	0	L	SP	82.1	2.1	1.2	1.4	1.3	1.0	1.0	1.0	1.0	12.3	16.0	11.7	15.2	15.6	35.3	0.0	n.a.						
23.5	-9.1	12	1	30	10	L	SC	82.1	2.7	1.4	1.4	1.2	1.0	1.0	1.0	1.2	16.4	19.3	15.6	18.3	22.0	36.8	0.0	n.a.	36	0.0	n.a.	115	600	
28.5	-14.1	22	2	31	18	H	SC	82.1	3.3	1.7	1.4	1.1	1.0	1.0	1.0	1.2	30.1	32.5	30.1	32.5	38.1	26.4	0.5	4.5						
33.5	-19.1	18	2	30	20	H	SC	82.1	3.9	2.0	1.4	1.0	1.0	1.0	1.0	1.2	24.6	24.8	24.6	24.8	29.3	25.8	0.4	3.7						
38.5	-24.1	22	2	43	21	H	SC	82.1	4.4	2.2	1.4	0.9	1.0	1.0	1.0	1.2	30.1	28.5	30.1	28.5	35.5	25.5	0.5	4.5						
43.5	-29.1	22	2	60	20	H	CH	82.1	5.0	2.5	1.4	0.9	1.0	1.0	1.0	1.4	30.1	26.9	30.1	26.9	36.4	25.8	0.5	4.5						
48.5	-34.1	30	2	52	38	H	CH	82.1	5.6	2.8	1.4	0.9	1.0	1.0	1.0	1.3	41.1	34.9	41.1	34.9	44.8	21.9	0.6	6.2						
53.5	-39.1	12	2	72	14	H	MH	82.1	6.2	3.0	1.4	0.8	1.0	1.0	1.0	1.6	16.4	13.3	16.4	13.3	20.8	28.0	0.2	2.5						
58.5	-44.1	27	2	70	12	H	MH	82.1	6.7	3.3	1.4	0.8	1.0	1.0	1.0	1.4	36.9	28.8	36.9	28.8	40.4	28.9	0.6	5.5						
63.5	-49.1	23	2	62	31	H	MH	82.1	7.3	3.6	1.4	0.8	1.0	1.0	1.0	1.4	31.5	23.6	31.5	23.6	32.6	23.1	0.5	4.7						
68.5	-54.1	28	2	70	20	H	MH	82.1	7.9	3.8	1.4	0.7	1.0	1.0	1.0	1.4	38.3	27.7	38.3	27.7	39.0	25.8	0.6	5.7						
73.5	-59.1	16	2	87	34	H	MH	82.1	8.5	4.1	1.4	0.7	1.0	1.0	1.0	1.6	21.9	15.3	21.9	15.3	25.0	22.6	0.3	3.3						
78.5	-64.1	65	2	97	41	H	MH	82.1	9.0	4.3	1.4	0.7	1.0	1.0	1.0	1.5	88.9	60.4	88.9	60.4	88.6	21.4	0.6	13.3	24	0.5	7.7	115		
83.5	-69.1	100	2	70	30	H	MH	82.1	9.6	4.6	1.4	0.7	1.0	1.0	1.0	1.3	136.8	90.2	136.8	90.2	118.9	23.3	0.6	20.5						
88.5	-74.1	69	2	70	30	H	MH	82.1	10.2	4.9	1.4	0.6	1.0	1.0	1.0	1.3	94.4	60.5	94.4	60.5	81.0	23.3	0.6	14.2						
93.5	-79.1	15	2	99	43	H	MH	82.1	10.8	5.1	1.4	0.6	1.0	1.0	1.0	1.8	20.5	12.8	20.5	12.8	22.8	21.1	0.3	3.1						
98.5	-84.1	100	2	70	30	H	MH	82.1	11.3	5.4	1.4	0.6	1.0	1.0	1.0	1.3	136.8	83.3	136.8	83.3	110.2	23.3	0.6	20.5						
103.5	-89.1	18	2	70	30	H	MH	82.1	11.9	5.7	1.4	0.6	1.0	1.0	1.0	1.5	24.6	14.6	24.6	14.6	22.2	23.3	0.4	3.7						
108.5	-94.1	100	2	70	30	H	MH	82.1	12.5	5.9	1.4	0.6	1.0	1.0	1.0	1.3	136.8	79.5	136.8	79.5	105.3	23.3	0.6	20.5						
113.5	-99.1	27	2	70	30	H	MH	82.1	13.1	6.2	1.4	0.6	1.0	1.0	1.0	1.4	36.9	21.0	36.9	21.0	30.4	23.3	0.6	5.5						
118.5	-104.1	16	2	70	30	H	MH	82.1	13.6	6.4	1.4	0.6	1.0	1.0	1.0	1.6	21.9	12.2	21.9	12.2	19.1	23.3	0.3	3.3						
123.5	-109.1	20	2	70	30	H	MH	82.1	14.2	6.7	1.4	0.5	1.0	1.0	1.0	1.5	27.4	14.9	27.4	14.9	22.6	23.3	0.4	4.1						

Notes:
0 - From SCDOT GDM 2019 Table 7-6
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equations 7-47, 7-52, 7-55
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed
5 - From SCDOT GDM 2019 Table 8-8
6 - From SCDOT GDM 2019 Table 7-19
7 - Equation 7-60 and Section 7.11.1 GDM 2019

SPT Corrections and Strength Estimate
(Preliminary Borings, Copied Here for Completeness)

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Project: US-1 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB02
Station:

Input Parameters

Boring Elevation, ft	14.7	
Water Table Depth, ft	2.9	
Average γ above water table (kcf) =	0.115	assumed
Average γ below water table (kcf) =	0.115	assumed
Borehole Diameter (in)	4	
Correction for Liners Required (Y/N)	N	

Depth (ft)	Elevation (ft)	Measured N	Soil Type 1=Granular, 2=Cohesive	Fines Content (%)[1]	For Cohesive, L=Low Plasticity, H=High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Est. ϕ'[2]	Est. Su[3] (ksf)	DESIGN INPUT PARAMETERS: Design ϕ'	Design Su (ksf)	Total Unit Weight (psf)	
1	13.7	17	2	44	L	SC	70.4	0.1	0.1	1.2	1.6	0.8	1.0	1.0	1.3	19.9	31.9	15.0	23.9	30.3		1.5				
3	11.7	13	2	44	L	SC	70.4	0.3	0.3	1.2	1.6	0.8	1.0	1.0	1.3	15.3	24.4	11.4	18.3	23.7		1.1				
5	9.7	21	2	44	L	SC	70.4	0.6	0.4	1.2	1.6	0.8	1.0	1.0	1.3	24.6	39.4	18.5	29.6	37.0		1.8		1.5	115	
7	7.7	14	1	30		SM	70.4	0.8	0.5	1.2	1.6	0.9	1.0	1.0	1.2	16.4	26.3	14.0	22.3	26.5	38.5					
9	5.7	17	1	8		SP-SM	70.4	1.0	0.7	1.2	1.6	0.9	1.0	1.0	1.0	19.9	31.9	17.0	27.1	28.4	40.4					
13.5	1.2	11	1	8		SP-SM	70.4	1.6	0.9	1.2	1.5	1.0	1.0	1.0	1.1	12.9	19.3	12.3	18.4	19.4	36.8					
18.5	-3.8	22	1	8		SP-SM	70.4	2.1	1.2	1.2	1.3	1.0	1.0	1.0	1.0	25.8	34.0	24.5	32.3	33.7	42.3		38		120	
23.5	-8.8	28	1	8		SP-SM	70.4	2.7	1.4	1.2	1.2	1.0	1.0	1.0	1.0	32.9	39.0	31.2	37.1	38.7	43.9					
28.5	-13.8	34	2	30	L	SM	70.4	3.3	1.7	1.2	1.1	1.0	1.0	1.0	1.2	39.9	43.5	39.9	43.5	50.2		3.0				
33.5	-18.8	31	2	35	L	SM	70.4	3.9	1.9	1.2	1.0	1.0	1.0	1.0	1.2	36.4	36.9	36.4	36.9	43.8		2.7				
38.5	-23.8	69	2	36	L	SM	70.4	4.4	2.2	1.2	1.0	1.0	1.0	1.0	1.2	81.0	77.1	81.0	77.1	90.0		6.1				
43.5	-28.8	48	2	70	L	MH	70.4	5.0	2.5	1.2	0.9	1.0	1.0	1.0	1.3	56.3	50.7	56.3	50.7	68.4		4.2		3.7	115	
48.5	-33.8	32	2	65	L	MH	70.4	5.6	2.7	1.2	0.9	1.0	1.0	1.0	1.4	37.5	32.1	37.5	32.1	43.7		2.8				
53.5	-38.8	42	2	70	L	MH	70.4	6.2	3.0	1.2	0.8	1.0	1.0	1.0	1.4	49.3	40.3	49.3	40.3	55.0		3.7				
58.5	-43.8	36	2	55	L	MH	70.4	6.7	3.3	1.2	0.8	1.0	1.0	1.0	1.3	42.2	33.1	42.2	33.1	43.1		3.2				
63.5	-48.8	71	2	70	L	MH	70.4	7.3	3.5	1.2	0.8	1.0	1.0	1.0	1.3	83.3	62.8	83.3	62.8	83.9		6.2				
68.5	-53.8	30	2	85	L	MH	70.4	7.9	3.8	1.2	0.7	1.0	1.0	1.0	1.5	35.2	25.6	35.2	25.6	38.5		2.6				
73.5	-58.8	54	2	70	L	MH	70.4	8.5	4.0	1.2	0.7	1.0	1.0	1.0	1.4	63.4	44.5	63.4	44.5	60.5		4.8				
78.5	-63.8	100	2	70	L	MH	70.4	9.0	4.3	1.2	0.7	1.0	1.0	1.0	1.3	117.3	79.9	117.3	79.9	105.8		8.8				
83.5	-68.8	28	2	70	L	MH	70.4	9.6	4.6	1.2	0.7	1.0	1.0	1.0	1.4	32.9	21.7	32.9	21.7	31.3		2.5				
88.5	-73.8	100	2	70	L	MH	70.4	10.2	4.8	1.2	0.6	1.0	1.0	1.0	1.3	117.3	75.5	117.3	75.5	100.1		8.8				
93.5	-78.8	25	2	75	L	MH	70.4	10.8	5.1	1.2	0.6	1.0	1.0	1.0	1.5	29.3	18.4	29.3	18.4	27.6		2.2				
98.5	-83.8	27	2	70	L	MH	70.4	11.3	5.4	1.2	0.6	1.0	1.0	1.0	1.5	31.7	19.3	31.7	19.3	28.3		2.4				
103.5	-88.8	62	2	70	L	MH	70.4	11.9	5.6	1.2	0.6	1.0	1.0	1.0	1.4	72.7	43.4	72.7	43.4	59.0		5.5				
108.5	-93.8	30	2	70	L	MH	70.4	12.5	5.9	1.2	0.6	1.0	1.0	1.0	1.5	35.2	20.5	35.2	20.5	29.8		2.6				
113.5	-98.8	42	2	70	L	MH	70.4	13.1	6.2	1.2	0.6	1.0	1.0	1.0	1.4	49.3	28.1	49.3	28.1	39.5		3.7				
118.5	-103.8	40	2	70	L	MH	70.4	13.6	6.4	1.2	0.6	1.0	1.0	1.0	1.4	46.9	26.2	46.9	26.2	37.0		3.5				
123.5	-108.8	57	2	70	L	MH	70.4	14.2	6.7	1.2	0.5	1.0	1.0	1.0	1.4	66.9	36.6	66.9	36.6	50.4		5.0				

Notes:
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equation 7-47
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Project: US-1 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB10
Station:

Input Parameters

Boring Elevation, ft	14.6	
Water Table Depth, ft	2.4	
Average ɣ above water table (kcf) =	0.115	assumed
Average ɣ below water table (kcf) =	0.115	assumed
Borehole Diameter (in)	4	
Correction for Liners Required (Y/N)	N	

Depth (ft)	Elevation (ft)	Measured N	Soil Type 1=Granular, 2=Cohesive	Fines Content (%)[1]	For Cohesive, L=Low Plasticity, H=High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Est. ϕ'[2]	Es. Su[3] (ksf)	DESIGN INPUT PARAMETERS: Design ϕ'	Design Su (ksf)	Total Unit Weight (psf)	
1	13.6	6	2	70	L	CL	70.4	0.1	0.1	1.2	1.6	0.8	1.0	1.0	1.7	7.0	11.3	5.3	8.4	14.3		0.5				
3	11.6	11	2	70	L	CL	70.4	0.3	0.3	1.2	1.6	0.8	1.0	1.0	1.5	12.9	20.7	9.7	15.5	23.3		1.0				
5	9.6	10	2	68	L	CL	70.4	0.6	0.4	1.2	1.6	0.8	1.0	1.0	1.5	11.7	18.8	8.8	14.1	21.3		0.9		0.8	115	
7	7.6	17	1	3		SP	70.4	0.8	0.5	1.2	1.6	0.9	1.0	1.0	1.0	19.9	31.9	17.0	27.1	27.6	40.4					
9	5.6	6	1	40		SC-SM	70.4	1.0	0.6	1.2	1.6	0.9	1.0	1.0	1.4	7.0	11.3	6.0	9.6	13.1	32.1					
13.5	1.1	4	1	40		SC-SM	70.4	1.6	0.9	1.2	1.5	1.0	1.0	1.0	1.5	4.7	7.2	4.5	6.8	9.9	30.2					
18.5	-3.9	22	1	30		SM	70.4	2.1	1.1	1.2	1.3	1.0	1.0	1.0	1.2	25.8	34.5	24.5	32.7	38.2	42.5		35		120	
23.5	-8.9	18	1	30		SM	70.4	2.7	1.4	1.2	1.2	1.0	1.0	1.0	1.2	21.1	25.4	20.1	24.1	28.5	39.3					
28.5	-13.9	29	2	33	L	SM	70.4	3.3	1.6	1.2	1.1	1.0	1.0	1.0	1.2	34.0	37.5	34.0	37.5	44.1		2.6				
33.5	-18.9	44	2	70	L	MH	70.4	3.9	1.9	1.2	1.0	1.0	1.0	1.0	1.3	51.6	52.8	51.6	52.8	71.1		3.9				
38.5	-23.9	36	2	70	L	MH	70.4	4.4	2.2	1.2	1.0	1.0	1.0	1.0	1.4	42.2	40.5	42.2	40.5	55.3		3.2				
43.5	-28.9	29	2	70	L	MH	70.4	5.0	2.4	1.2	0.9	1.0	1.0	1.0	1.4	34.0	30.8	34.0	30.8	42.9		2.6		3.3	115	
48.5	-33.9	30	2	70	L	MH	70.4	5.6	2.7	1.2	0.9	1.0	1.0	1.0	1.4	35.2	30.3	35.2	30.3	42.3		2.6				
53.5	-38.9	47	2	70	L	MH	70.4	6.2	3.0	1.2	0.8	1.0	1.0	1.0	1.4	55.1	45.3	55.1	45.3	61.5		4.1				
58.5	-43.9	50	2	70	L	MH	70.4	6.7	3.2	1.2	0.8	1.0	1.0	1.0	1.4	58.7	46.2	58.7	46.2	62.6		4.4				

Notes:
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equation 7-47
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Terracon

Project: US-1 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB11
Station:

Input Parameters

Boring Elevation, ft	14.2	
Water Table Depth, ft	2.1	
Average γ above water table (kcf) =	0.115	assumed
Average γ below water table (kcf) =	0.115	assumed
Borehole Diameter (in)	4	
Correction for Liners Required (Y/N)	N	

Depth (ft)	Elevation (ft)	Measured N	Soil Type 1=Granular, 2=Cohesive	Fines Content (%)[1]	For Cohesive, L=Low Plasticity, H=High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Est. ϕ'[2]	Est. Su[3] (ksf)	DESIGN INPUT PARAMETERS: Design ϕ'	Design Su (ksf)	Total Unit Weight (psf)	
1	13.2	9	2	70	L	CL	70.4	0.1	0.1	1.2	1.6	0.8	1.0	1.0	1.6	10.6	16.9	7.9	12.7	19.7		0.8				
3	11.2	12	2	70	L	CL	70.4	0.3	0.3	1.2	1.6	0.8	1.0	1.0	1.5	14.1	22.5	10.6	16.9	25.1		1.1				
5	9.2	15	2	70	L	CL	70.4	0.6	0.4	1.2	1.6	0.8	1.0	1.0	1.4	17.6	28.2	13.2	21.1	30.5		1.3		1.1	115	
7	7.2	14	1	21		SM	70.4	0.8	0.5	1.2	1.6	0.9	1.0	1.0	1.1	16.4	26.3	14.0	22.3	25.3	38.5					
9	5.2	12	1	9		SP-SM	70.4	1.0	0.6	1.2	1.6	0.9	1.0	1.0	1.1	14.1	22.5	12.0	19.1	20.3	37.2					
13.5	0.7	18	1	9		SP-SM	70.4	1.6	0.8	1.2	1.5	1.0	1.0	1.0	1.1	21.1	32.6	20.1	30.9	32.5	41.8					
18.5	-4.3	24	1	9		SP-SM	70.4	2.1	1.1	1.2	1.3	1.0	1.0	1.0	1.0	28.2	37.9	26.8	36.0	37.8	43.5		38		120	
23.5	-9.3	18	1	3		SP	70.4	2.7	1.4	1.2	1.2	1.0	1.0	1.0	1.0	21.1	25.5	20.1	24.3	24.7	39.3					
28.5	-14.3	31	2	30	L	SM	70.4	3.3	1.6	1.2	1.1	1.0	1.0	1.0	1.2	36.4	40.3	36.4	40.3	46.6		2.7				
33.5	-19.3	20	2	70	L	MH	70.4	3.9	1.9	1.2	1.0	1.0	1.0	1.0	1.4	23.5	24.1	23.5	24.1	34.4		1.8				
38.5	-24.3	30	2	70	L	MH	70.4	4.4	2.2	1.2	1.0	1.0	1.0	1.0	1.4	35.2	33.9	35.2	33.9	46.9		2.6				
43.5	-29.3	28	2	70	L	MH	70.4	5.0	2.4	1.2	0.9	1.0	1.0	1.0	1.4	32.9	29.9	32.9	29.9	41.7		2.5		3.0	115	
48.5	-34.3	21	2	62	L	MH	70.4	5.6	2.7	1.2	0.9	1.0	1.0	1.0	1.4	24.6	21.3	24.6	21.3	29.7		1.8				
53.5	-39.3	27	2	70	L	MH	70.4	6.2	2.9	1.2	0.8	1.0	1.0	1.0	1.4	31.7	26.1	31.7	26.1	36.9		2.4				
58.5	-44.3	43	2	70	L	MH	70.4	6.7	3.2	1.2	0.8	1.0	1.0	1.0	1.4	50.5	39.8	50.5	39.8	54.5		3.8				
63.5	-49.3	86	2	70	L	MH	70.4	7.3	3.5	1.2	0.8	1.0	1.0	1.0	1.3	100.9	76.6	100.9	76.6	101.5		7.6				
68.5	-54.3	23	2	75	L	MH	70.4	7.9	3.7	1.2	0.7	1.0	1.0	1.0	1.5	27.0	19.8	27.0	19.8	29.4		2.0				
73.5	-59.3	60	2	70	L	MH	70.4	8.5	4.0	1.2	0.7	1.0	1.0	1.0	1.4	70.4	49.8	70.4	49.8	67.2		5.3				
78.5	-64.3	100	2	70	L	MH	70.4	9.0	4.3	1.2	0.7	1.0	1.0	1.0	1.3	117.3	80.4	117.3	80.4	106.4		8.8				
83.5	-69.3	100	2	70	L	MH	70.4	9.6	4.5	1.2	0.7	1.0	1.0	1.0	1.3	117.3	78.0	117.3	78.0	103.4		8.8				
88.5	-74.3	100	2	70	L	MH	70.4	10.2	4.8	1.2	0.6	1.0	1.0	1.0	1.3	117.3	75.8	117.3	75.8	100.6		8.8				
93.5	-79.3	27	2	90	L	MH	70.4	10.8	5.0	1.2	0.6	1.0	1.0	1.0	1.6	31.7	19.9	31.7	19.9	31.6		2.4				
98.5	-84.3	27	2	70	L	MH	70.4	11.3	5.3	1.2	0.6	1.0	1.0	1.0	1.5	31.7	19.4	31.7	19.4	28.4		2.4				
103.5	-89.3	56	2	70	L	MH	70.4	11.9	5.6	1.2	0.6	1.0	1.0	1.0	1.4	65.7	39.4	65.7	39.4	53.9		4.9				
108.5	-94.3	31	2	70	L	MH	70.4	12.5	5.8	1.2	0.6	1.0	1.0	1.0	1.4	36.4	21.3	36.4	21.3	30.8		2.7				
113.5	-99.3	29	2	70	L	MH	70.4	13.1	6.1	1.2	0.6	1.0	1.0	1.0	1.5	34.0	19.5	34.0	19.5	28.4		2.6				
118.5	-104.3	46	2	70	L	MH	70.4	13.6	6.4	1.2	0.6	1.0	1.0	1.0	1.4	54.0	30.3	54.0	30.3	42.2		4.0				
123.5	-109.3	52	2	70	L	MH	70.4	14.2	6.6	1.2	0.5	1.0	1.0	1.0	1.4	61.0	33.5	61.0	33.5	46.4		4.6				

Notes:
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equation 7-47
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Terracon

Project: US-1 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB14
Station:

Input Parameters

Boring Elevation, ft	15.5	
Water Table Depth, ft	0.0	
Average γ above water table (kcf) =	0.115	assumed
Average γ below water table (kcf) =	0.115	assumed
Borehole Diameter (in)	4	
Correction for Liners Required (Y/N)	N	

Depth (ft)	Elevation (ft)	Measured N	Soil Type 1=Granular, 2=Cohesive	Fines Content (%)[1]	For Cohesive, L=Low Plasticity, H=High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Est. ϕ'[2]	Est. Su[3] (ksf)	DESIGN INPUT PARAMETERS: Design ϕ'	Design Su (ksf)	Total Unit Weight (psf)	
1	14.5	9	2	65	L	CH	70.4	0.1	0.1	1.2	1.6	0.8	1.0	1.0	1.5	10.6	16.9	7.9	12.7	19.2		0.8				
3	12.5	20	2	64	L	CH	70.4	0.3	0.2	1.2	1.6	0.8	1.0	1.0	1.4	23.5	37.5	17.6	28.2	38.6		1.8		1.3	115	
5	10.5	21	1	25		SM	70.4	0.6	0.3	1.2	1.6	0.8	1.0	1.0	1.1	24.6	39.4	18.5	29.6	33.8	41.3					
7	8.5	17	1	25		SM	70.4	0.8	0.4	1.2	1.6	0.9	1.0	1.0	1.1	19.9	31.9	17.0	27.1	31.1	40.4					
9	6.5	21	1	25		SM	70.4	1.0	0.5	1.2	1.6	0.9	1.0	1.0	1.1	24.6	39.4	20.9	33.5	38.1	42.7					
13.5	2.0	4	1	27		SC	70.4	1.6	0.7	1.2	1.6	1.0	1.0	1.0	1.3	4.7	7.5	4.5	7.1	9.3	30.5					
18.5	-3.0	23	1	25		SM	70.4	2.1	1.0	1.2	1.4	1.0	1.0	1.0	1.1	27.0	38.7	25.6	36.8	41.7	43.8		38		120	
23.5	-8.0	18	1	6		SP-SM	70.4	2.7	1.2	1.2	1.3	1.0	1.0	1.0	1.0	21.1	26.9	20.1	25.5	26.4	39.8					
28.5	-13.0	37	2	22	L	SC	70.4	3.3	1.5	1.2	1.2	1.0	1.0	1.0	1.1	43.4	50.1	43.4	50.1	55.7		3.3				
33.5	-18.0	34	2	70	L	MH	70.4	3.9	1.8	1.2	1.1	1.0	1.0	1.0	1.4	39.9	42.5	39.9	42.5	57.9		3.0				
38.5	-23.0	49	2	70	L	MH	70.4	4.4	2.0	1.2	1.0	1.0	1.0	1.0	1.3	57.5	57.1	57.5	57.1	76.6		4.3				
43.5	-28.0	54	2	70	L	MH	70.4	5.0	2.3	1.2	0.9	1.0	1.0	1.0	1.3	63.4	59.2	63.4	59.2	79.3		4.8		3.5	115	
48.5	-33.0	28	2	40	L	SC	70.4	5.6	2.6	1.2	0.9	1.0	1.0	1.0	1.2	32.9	29.1	32.9	29.1	35.7		2.5				
53.5	-38.0	63	2	70	L	MH	70.4	6.2	2.8	1.2	0.8	1.0	1.0	1.0	1.3	73.9	62.3	73.9	62.3	83.3		5.5				
58.5	-43.0	25	2	70	L	MH	70.4	6.7	3.1	1.2	0.8	1.0	1.0	1.0	1.4	29.3	23.6	29.3	23.6	33.8		2.2				
63.5	-48.0	100	2	70	L	MH	70.4	7.3	3.3	1.2	0.8	1.0	1.0	1.0	1.3	117.3	90.8	117.3	90.8	119.7		8.8				
68.5	-53.0	29	2	70	L	MH	70.4	7.9	3.6	1.2	0.7	1.0	1.0	1.0	1.4	34.0	25.4	34.0	25.4	35.9		2.6				
73.5	-58.0	67	2	79	L	CH	70.4	8.5	3.9	1.2	0.7	1.0	1.0	1.0	1.4	78.6	56.5	78.6	56.5	78.4		5.9				
78.5	-63.0	31	2	70	L	MH	70.4	9.0	4.1	1.2	0.7	1.0	1.0	1.0	1.4	36.4	25.3	36.4	25.3	35.9		2.7				
83.5	-68.0	39	2	70	L	MH	70.4	9.6	4.4	1.2	0.7	1.0	1.0	1.0	1.4	45.8	30.9	45.8	30.9	43.0		3.4				
88.5	-73.0	100	2	70	L	MH	70.4	10.2	4.7	1.2	0.7	1.0	1.0	1.0	1.3	117.3	76.9	117.3	76.9	101.9		8.8				
93.5	-78.0	22	2	68	L	MH	70.4	10.8	4.9	1.2	0.6	1.0	1.0	1.0	1.5	25.8	16.5	25.8	16.5	24.3		1.9				
98.5	-83.0	30	2	70	L	MH	70.4	11.3	5.2	1.2	0.6	1.0	1.0	1.0	1.4	35.2	21.9	35.2	21.9	31.5		2.6				
103.5	-88.0	48	2	70	L	MH	70.4	11.9	5.4	1.2	0.6	1.0	1.0	1.0	1.4	56.3	34.1	56.3	34.1	47.2		4.2				
108.5	-93.0	30	2	70	L	MH	70.4	12.5	5.7	1.2	0.6	1.0	1.0	1.0	1.4	35.2	20.8	35.2	20.8	30.2		2.6				
113.5	-98.0	28	2	70	L	MH	70.4	13.1	6.0	1.2	0.6	1.0	1.0	1.0	1.5	32.9	19.0	32.9	19.0	27.8		2.5				
118.5	-103.0	48	2	70	L	MH	70.4	13.6	6.2	1.2	0.6	1.0	1.0	1.0	1.4	56.3	31.9	56.3	31.9	44.3		4.2				
123.5	-108.0	44	2	70	L	MH	70.4	14.2	6.5	1.2	0.6	1.0	1.0	1.0	1.4	51.6	28.6	51.6	28.6	40.2		3.9				

Notes:
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equation 7-47
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed

Determination of SPT Corrections and Strength Estimate (per SCDOT GDM 2019)

Project: US-1 BRO Bagshaw Swamp
Proj. No. EN175299
Boring #: BS-STB15
Station:

Input Parameters

Boring Elevation, ft	14.9	
Water Table Depth, ft	0.0	
Average γ above water table (kcf) =	0.115	assumed
Average γ below water table (kcf) =	0.115	assumed
Borehole Diameter (in)	4	
Correction for Liners Required (Y/N)	N	

Depth (ft)	Elevation (ft)	Measured N	Soil Type 1=Granular, 2=Cohesive	Fines Content (%)[1]	For Cohesive, L=Low Plasticity, H=High Plasticity	USCS Soil Type	Energy ratio, ER	s_{vc} (ksf)	s_{vc}' (ksf)	C_E	C_N	C_R	C_S	C_B	C_F	N_{60}	$N_{1,60}$	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Est. ϕ'[2]	Est. Su[3] (ksf)	DESIGN INPUT PARAMETERS: Design ϕ'	Design Su (ksf)	Total Unit Weight (psf)	
1	13.9	4	2	65	L	CH	70.4	0.1	0.1	1.2	1.6	0.8	1.0	1.0	1.8	4.7	7.5	3.5	5.6	10.3		0.4				
3	11.9	17	2	65	L	CH	70.4	0.3	0.2	1.2	1.6	0.8	1.0	1.0	1.4	19.9	31.9	15.0	23.9	33.4		1.5				
5	9.9	20	2	27	L	SC	70.4	0.6	0.3	1.2	1.6	0.8	1.0	1.0	1.2	23.5	37.5	17.6	28.2	32.6		1.8		1.2	115	
7	7.9	18	1	19		SM	70.4	0.8	0.4	1.2	1.6	0.9	1.0	1.0	1.1	21.1	33.8	18.0	28.7	31.9	41.0					
9	5.9	16	1	21		SC	70.4	1.0	0.5	1.2	1.6	0.9	1.0	1.0	1.1	18.8	30.0	16.0	25.5	28.7	39.8					
13.5	1.4	24	1	12		SP-SM	70.4	1.6	0.7	1.2	1.6	1.0	1.0	1.0	1.1	28.2	45.1	26.8	42.8	45.5	45.7					
18.5	-3.6	29	1	12		SP-SM	70.4	2.1	1.0	1.2	1.4	1.0	1.0	1.0	1.1	34.0	48.8	32.3	46.3	49.2	46.7		38		120	
23.5	-8.6	26	1	3		SP	70.4	2.7	1.2	1.2	1.3	1.0	1.0	1.0	1.0	30.5	38.8	29.0	36.9	37.5	43.8					
28.5	-13.6	36	2	70	L	MH	70.4	3.3	1.5	1.2	1.2	1.0	1.0	1.0	1.4	42.2	48.8	42.2	48.8	66.0		3.2				
33.5	-18.6	51	2	70	L	MH	70.4	3.9	1.8	1.2	1.1	1.0	1.0	1.0	1.3	59.8	63.8	59.8	63.8	85.1		4.5				
38.5	-23.6	49	2	70	L	MH	70.4	4.4	2.0	1.2	1.0	1.0	1.0	1.0	1.3	57.5	57.1	57.5	57.1	76.6		4.3				
43.5	-28.6	39	2	70	L	MH	70.4	5.0	2.3	1.2	0.9	1.0	1.0	1.0	1.4	45.8	42.8	45.8	42.8	58.3		3.4		4.2	115	
48.5	-33.6	62	2	70	L	MH	70.4	5.6	2.6	1.2	0.9	1.0	1.0	1.0	1.3	72.7	64.4	72.7	64.4	85.9		5.5				
53.5	-38.6	100	2	70	L	MH	70.4	6.2	2.8	1.2	0.8	1.0	1.0	1.0	1.3	117.3	98.9	117.3	98.9	130.1		8.8				
58.5	-43.6	47	2	70	L	MH	70.4	6.7	3.1	1.2	0.8	1.0	1.0	1.0	1.4	55.1	44.5	55.1	44.5	60.4		4.1				

Notes:
1 - If fines content <5% is assumed, use 0
2 - SCDOT GDM 2019 Equation 7-47
3 - SCDOT GDM 2019 Equations 7-33 and 7-34
4 - Red values are assumed

Estimation of Consolidation Parameters

Project	I-95 Bridge Replacement over SC 46 and Bagshaw Swamp
Project Number	EN175299
SCDOT Project Number	P030260
Location	Jasper County
Location of Analysis	I-95 Bridge over Bagshaw Swamp

Estimation of Consolidation Parameters

Boring	BS-STB10	BS-STB11	BS-STB2	BS-STB14	BS-STB15	BS-STB3	Average (15 - 9)	Notes
Surface elevation (ft)	14.6	14.2	14.7	15.5	14.9	26.9	--	See Boring logs
Layer Elevation (ft)	14.6,8.6	14.2,10.2	14.7,8.7	15.5,10.5	14.9,10.9	9.9,5.9	--	See Boring logs
Layer avg elevation (ft)	11.6	12.2	11.7	13	12.9	7.9	--	
Groundwater elev (ft)	12.2	12.1	11.8	15.5	14.9	11.6	--	Design groundwater elevation
Ave Liquid Limit	29	30	30	88	60	38	--	See Boring logs
Ave Moisture Content, WC (%)	29	30	20	26	30	29	--	See Boring logs
Su (psf)	800	1100	1500	1300	1200	2100	--	See SPT Corrections and Strength Estimate
PI	15	15	17	52	40	21	--	See Boring logs
Cc (Eqn 7-89)	0.210	0.210	0.238	0.728	0.560	0.294	0.373	Equation 7-89 GDM 2019
e0	0.533	0.533	0.557	0.983	0.837	0.606	0.675	Adopted from GDM 2010, Equation 7-48
Cr (15% of Cc)	0.032	0.032	0.036	0.109	0.084	0.044	0.056	
Ca	0.005	0.006	0.004	0.005	0.006	0.005	0.005	Figure 7-35 GDM 2019
Ca/Cc	0.026	0.027	0.016	0.007	0.010	0.018	0.017	
Cv (ft2/day)	0.60	0.57	0.57	0.03	0.08	0.30	0.358	Figure 7-36 GDM 2019
Cv (ft2/yr)	219	208	208	11	31	108	131	
Cvr (ft2/day)	2.00	2.00	2.00	0.07	0.34	2.00	1.40	Figure 7-36 GDM 2019
Cvr (ft2/yr)	730	730	730	26	126	730	512	
sigma'p (psf)	4834	6647	8676	4299	4651	11188	6716	Equation 7-93 GDM 2019
sigma'vo (psf)	308	236	339	132	105	1954	512	
OCR =	15.7	28.1	25.6	32.7	44.2	5.7	25.3	Equation 7-30 GDM 2019

Red values are assumed.

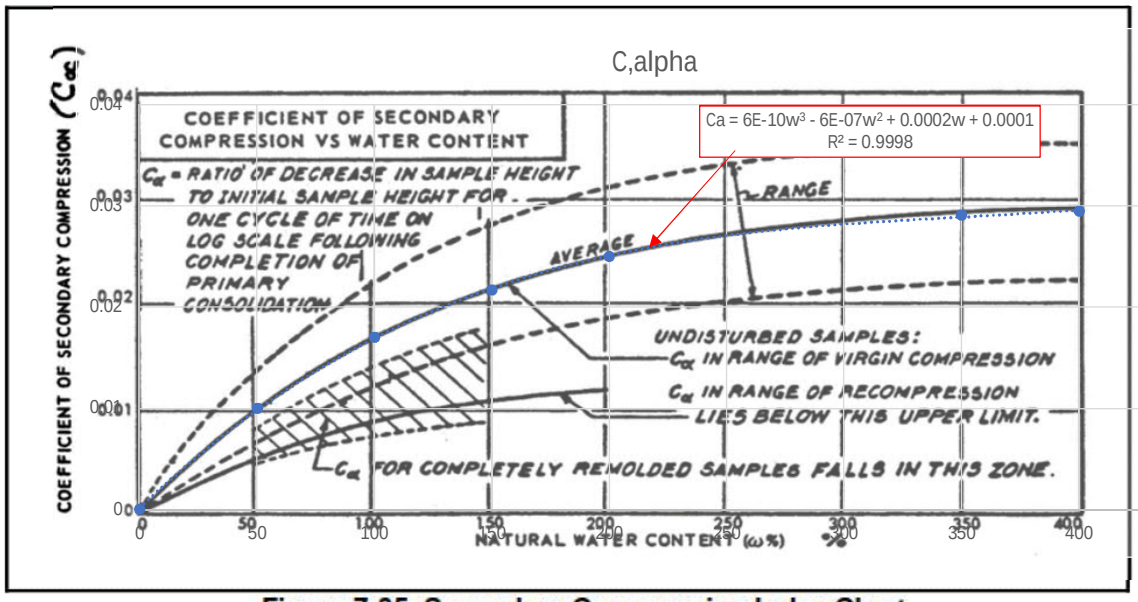


Figure 7-35, Secondary Compression Index Chart (NAVFAC DM-7.1 (1982))

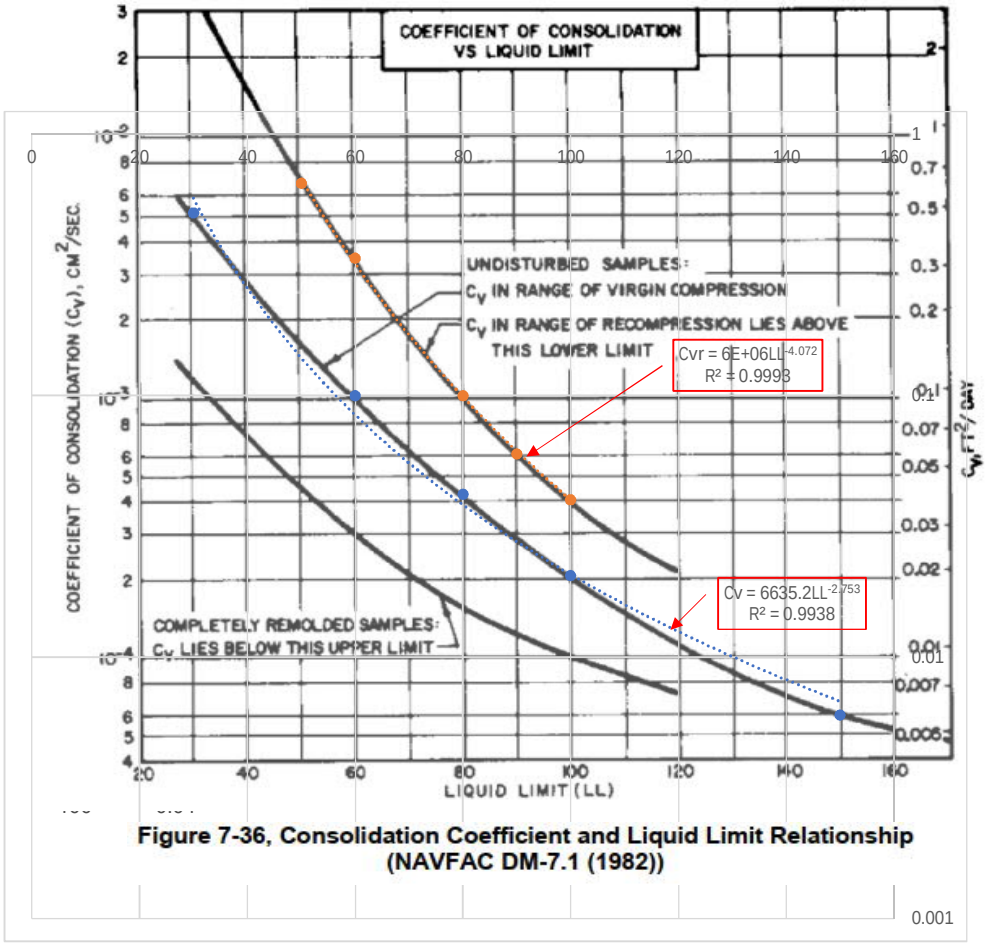


Figure 7-36, Consolidation Coefficient and Liquid Limit Relationship (NAVFAC DM-7.1 (1982))

Summary of SSL Screening

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299

Hazard Level:	FEE	SEE
PGA 0.370	0.14	0.37
M_w 7.30	7.3	7.3

Boring	Station	Offset	Location / Roadway Classification	Lateral Displacement Index (ft)	Total Thickness of Limited Liquefaction (ft)	Total Thickness of Clay-like Strength Loss (ft)	Total Thickness of Full Liquefaction (ft)	Max. Depth of Liquefaction (ft)	Liquefaction Settlement (in)	Longitudinal Differential Settlement	Longitudinal Differential Settlement PL	Comment
BS-STB02			400psf, 10 deg.	1.0	0.0	0.0	7.3	6.3 - -1	14.3	1.7	500psf, 10 deg.	
BS-STB10				2.6	0.0	0.0	9.3	8.3 -6 6 - -1	14.3	3.1	700psf, 16 deg.	
BS-STB11			1300psf, 16 deg.	0.8	0.0	0.0	9.0	24.3	1.8	-	125psf, 6 deg.	
BS-STB14				2.3	0.0	0.0	10.3	3 - -2 5 - -10.3	24.3	2.9	-	125psf, 5 deg.
BS-STB15				0.0	0.0	0.0	0.0	0.0	0.0	-	1300psf, 17 deg.	
BS-STB1			700psf, 9 deg.	10.1	0.0	5.7	25.0	9 - 0 0 - -12	39.3	9.8	-	150psf, 3 deg.
BS-STB3			500psf, 6 deg.	3.3	0.0	0.0	15.0	39.3	4.3	-	800psf, 8 deg.	
BS-STB13				4.4	0.0	0.0	19.3	9 - -10	24.3	6.0	-	
											-	
											-	
											-	
											-	
											-	
											-	

300psf, 7 deg.

SSL Summary:

Elev.	Residual tau,rl	Residual phi',rl
9 - 6	125psf	3 deg.
6 - 2	125psf	6 deg.
2 - -2	125psf	5 deg.
-5 - -10	300psf	7 deg.
-10 - -12	800psf	8 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

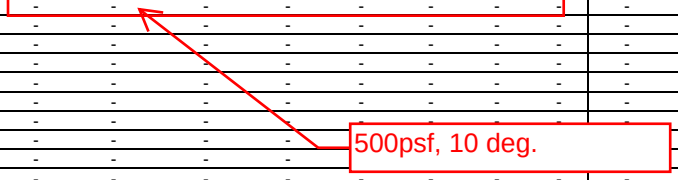
SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB02
Station:

Lateral Displacement Index, LDI: 0.97 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 1.72 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
3.0	11.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
5.0	9.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
7.0	7.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.144	1.7	-	-	-	-	0.97
9.0	5.7	40.5	0.8	28.2	Full Residual	922.6	0.85	0.35	405	166	40.5	19.3	-	0.063	4.9%	0.060	0.011	2.00	0.021	0.144	1.7	74	4.9%	2.00	0.10	0.97
14.3	0.4	37.2	0.8	20.0	Full Residual	472.5	0.46	0.18	344	131	24.7	9.9	-	0.166	16.6%	0.539	0.023	5.25	0.123	0.123	1.5	62	16.6%	5.25	0.87	0.87
19.3	-4.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-49.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-54.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-59.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-64.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-69.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-74.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-79.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-84.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-89.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-94.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-99.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-104.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-109.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00



STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB10
Station:

Lateral Displacement Index, LDI: 2.58 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 3.12 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

	Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.260	3.1	-	-	-	-	2.58
3.0	11.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.260	3.1	-	-	-	-	2.58
5.0	9.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.260	3.1	-	-	-	-	2.58
7.0	7.6	40.0	0.3	26.3	Full Residual	705.6	0.75	0.29	278	106	37.0	16.1	-	0.079	7.1%	0.173	0.016	2.00	0.032	0.260	3.1	71	7.1%	2.00	0.14	2.58
9.0	5.6	32.2	3.2	12.9	Full Residual	133.9	0.14	0.11	68	52	8.1	6.3	-	0.270	27.0%	0.748	0.028	2.00	0.057	0.227	2.7	55	27.0%	2.00	0.54	2.43
14.3	0.3	30.4	3.2	10.2	Full Residual	124.5	0.10	0.09	76	69	5.8	5.3	-	0.361	36.1%	0.847	0.032	5.25	0.170	0.170	2.0	49	36.1%	5.25	1.89	1.89
19.3	-4.7	-	-	-	No Loss									-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
24.3	-9.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
29.3	-14.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

700psf, 16 deg.

125psf, 6 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB11
Station:

Lateral Displacement Index, LDI: 0.76 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 1.77 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.147	1.8	-	-	-	-	0.76
3.0	11.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.147	1.8	-	-	-	-	0.76
5.0	9.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.147	1.8	-	-	-	-	0.76
7.0	7.2	38.1	1.7	23.1	Full Residual	428.2	0.57	0.22	212	81	29.9	12.4	-	0.078	7.0%	0.170	0.016	2.00	0.032	0.147	1.8	71	7.0%	2.00	0.14	0.76
9.0	5.2	37.2	0.9	20.2	Full Residual	383.7	0.47	0.18	220	84	25.0	10.1	-	0.158	15.8%	0.516	0.023	2.00	0.046	0.116	1.4	63	15.8%	2.00	0.32	0.62
14.3	0.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.070	0.8	-	-	-	-	0.31
19.3	-5.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.070	0.8	-	-	-	-	0.31
24.3	-10.0	40.1	0.3	26.4	Full Residual	1307.2	0.77	0.29	979	373	37.5	16.3	-	0.077	6.2%	0.162	0.014	5.00	0.070	0.070	0.8	72	6.2%	5.00	0.31	0.31
29.3	-15.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-20.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-25.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-30.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-35.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-40.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-45.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-50.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-55.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-60.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-65.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-70.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-75.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-80.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-85.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-90.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-95.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-100.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-105.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-110.0	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

400psf, 10 deg.

1300psf, 16 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB14
Station:

Lateral Displacement Index, LDI: 2.26 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 2.91 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	14.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
3.0	12.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
5.0	10.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
7.0	8.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
9.0	6.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.242	2.9	-	-	-	-	2.26
14.3	1.3	30.4	2.2	9.2	Full Residual	124.5	0.09	0.09	68	64	5.2	4.9	-	0.372	37.2%	0.856	0.033	5.25	0.173	0.242	2.9	49	37.2%	5.25	1.95	2.26
19.3	-3.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.069	0.8	-	-	-	-	0.31
24.3	-8.7	40.1	0.6	26.7	Full Residual	1307.2	0.79	0.30	1008	385	38.3	16.8	-	0.077	6.1%	0.160	0.014	5.00	0.069	0.069	0.8	72	6.1%	5.00	0.31	0.31
29.3	-13.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-18.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-23.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-28.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-33.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-38.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-43.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-48.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-53.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-58.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-63.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-68.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-73.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-78.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-83.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-88.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-93.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-98.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-103.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-108.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

125psf, 5 deg.

1300psf, 17 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB1
Station:

Lateral Displacement Index, LDI: 10.11 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 9.82 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
2.2	25.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
4.2	23.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
6.2	21.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
8.2	19.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
10.2	17.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
14.3	13.6	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.818	9.8	-	-	-	-	10.11
19.3	8.6	26.2	1.9	4.4	Full Residual	126.4	0.06	0.06	114	113	3.2	3.2	-	0.631	63.1%	0.947	0.044	5.00	0.219	0.818	9.8	38	63.1%	5.00	3.15	10.11
24.3	3.6	29.6	0.5	6.5	Full Residual	197.9	0.07	0.07	160	156	4.0	3.9	-	0.751	75.1%	0.948	0.049	5.00	0.243	0.600	7.2	34	75.1%	5.00	3.76	6.96
29.3	-1.5	35.8	0.6	16.7	Full Residual	635.4	0.35	0.14	890	362	19.2	8.1	-	0.242	24.2%	0.705	0.027	5.00	0.136	0.357	4.3	56	24.2%	5.00	1.21	3.20
34.3	-6.5	38.9	0.5	23.8	Full Residual	1460.5	0.61	0.23	1709	652	31.2	13.0	-	0.109	4.9%	0.335	0.012	5.00	0.062	0.221	2.7	68	4.9%	5.00	0.24	1.99
39.3	-11.5	34.0	0.3	13.1	Full Residual	489.4	0.15	0.11	457	347	8.4	6.4	-	0.349	34.9%	0.837	0.032	5.00	0.160	0.160	1.9	50	34.9%	5.00	1.74	1.74
44.3	-16.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-21.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-26.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-31.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-36.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-41.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-46.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-51.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-56.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-61.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
93.6	-65.8	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-71.5	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	5.65	-	0.000	0.0	-	-	5.65	-	0.00

150psf, 3 deg.

800psf, 8 deg.

Neglected in the analysis

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB3
Station:

Lateral Displacement Index, LDI: 3.34 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 4.35 in

Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

	Sand-like Residual Strength													Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
2.2	24.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
4.2	22.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
6.2	20.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
8.2	18.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
10.2	16.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
14.3	12.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
19.3	7.7	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.362	4.3	-	-	-	-	3.34
24.3	2.7	36.6	1.5	19.5	Full Residual	729.6	0.44	0.17	1016	388	23.9	9.6	-	0.126	4.6%	0.406	0.012	5.00	0.060	0.362	4.3	66	4.6%	5.00	0.23	3.34
29.3	-2.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	0.302	3.6	75	#VALUE!	-	-	3.11
34.3	-7.4	36.0	0.4	17.0	Full Residual	707.3	0.38	0.14	1067	407	20.7	8.2	-	0.231	23.1%	0.684	0.027	5.00	0.133	0.302	3.6	57	23.1%	5.00	1.15	3.11
39.3	-12.4	33.4	0.5	12.2	Full Residual	435.7	0.13	0.11	400	328	7.4	6.1	-	0.392	39.2%	0.870	0.034	5.00	0.169	0.169	2.0	48	39.2%	5.00	1.96	1.96
44.3	-17.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-22.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-27.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-32.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-37.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-42.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-47.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-52.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
84.3	-57.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-62.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-67.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-72.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
103.7	-76.8	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
109.3	-82.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

700psf, 9 deg.

500psf, 6 deg.

STB Liquefaction Triggering, Lateral Spread, Vertical Settlement Summary

Page C: Residual Strength, Settlement, LDI

SCDOT Project: I-95 BRO BAGSHAW SWAMP
County: JASPER COUNTY
Terracon Number: EN175299
Boring: BS-STB13
Station:

Lateral Displacement Index, LDI: 4.37 ft

Post-Liquefaction Reconsol. Settlement, $S_{v\text{-}1D}$: 6.01 in

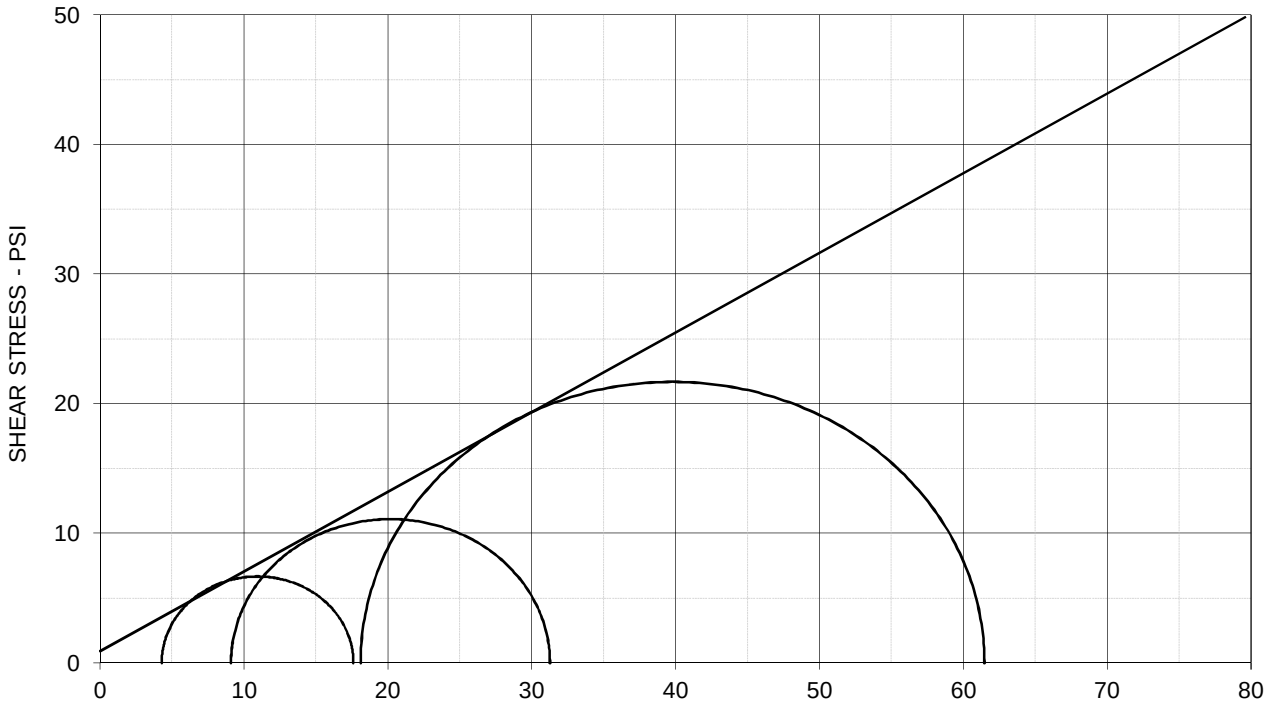
Clay-like Soil Strength Loss
Limited Liquefaction
Full Liquefaction

		Sand-like Residual Strength												Vertical Settlement								Lateral Displacement Index				
Note:		Eq 7-47	Table 13-7 (Seed, 1987)	Eq 13-50		K&W15 Eq 13-60,61	Eq 13-51	Eq 13-52			Eq 13-48	Eq 13-48	~~Eq 13-73~~	Eq 13-81	Eq 13-74,75,76, 77,78,81	Eq 13-79	Eq 13-72	Each layer h	I&B08 Eq 98	I&B08 Eq 98		Zhang et al. 2004, $D_r = 14 \cdot \sqrt{(N^*_{1,60,cs})}$	Eq 13-74,75,76, 77,78,81	Each layer h	Eq 13-98, Zhang et al. 2004	Eq 13-98, Zhang et al. 2004
Depth (ft)	Elevation (ft)	Peak static ϕ' (deg)	$\Delta N_{1,60\text{-}rl}$	$N^*_{1,60\text{-}cs}$	Strength Loss Desc.	Liq. Res. Su, τ_{rl} (psf)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (No Void Redist.)	Residual Shear Strength Ratio, τ_{rl}/σ'_{vo} (Void Redist.)	τ_{rl} (No Void Redist.) (psf)	τ_{rl} (Void Redist.) (psf)	ϕ'_{rl} (No Void Redist) (deg)	ϕ'_{rl} (Void Redist) (deg)	ϕ'_{peak} ~~$\phi'_{rl\text{-}lim}$~~ (deg)	Limiting shear strain, γ_{lim}	Max. Shear Strain, γ_{max} (%)	Fα	Vertical Reconsol. Strain, ε_v (%)	Layer Δh_i (ft)	$\Delta S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (ft)	$\Sigma S_{v\text{-}1D}$ (in)	Relative density, Dr (%)	Max. Shear Strain, γ_{max} (%)	Layer Δh_i (ft)	ΔLDI_i (ft)	ΣLDI (ft)
1.0	13.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.501	6.0	-	-	-	-	4.37
3.0	11.4	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.501	6.0	-	-	-	-	4.37
5.0	9.4	-	-	-	No Loss								-	-	-	-	-	-	-	0.501	6.0	-	-	-	-	4.37
7.0	7.4	37.4	1.2	20.8	Full Residual	434.8	0.48	0.18	281	107	25.8	10.5	-	0.125	5.8%	0.403	0.015	2.00	0.031	0.501	6.0	66	5.8%	2.00	0.12	4.37
9.0	5.4	36.1	1.1	18.0	Full Residual	351.0	0.40	0.15	276	105	22.0	8.7	-	0.178	8.0%	0.571	0.024	2.00	0.048	0.470	5.6	61	8.0%	2.00	0.16	4.25
14.3	0.2	30.5	1.3	8.5	Full Residual	143.9	0.09	0.08	82	78	4.9	4.6	-	0.450	45.0%	0.904	0.036	5.25	0.191	0.422	5.1	45	45.0%	5.25	2.36	4.09
19.3	-4.9	35.3	0.4	15.5	Full Residual	384.6	0.25	0.13	300	161	13.8	7.5	-	0.272	27.2%	0.750	0.029	5.00	0.143	0.232	2.8	54	27.2%	5.00	1.36	1.73
24.3	-9.9	37.0	2.4	21.2	Full Residual	637.1	0.50	0.19	742	283	26.5	10.8	-	0.098	7.3%	0.282	0.018	5.00	0.089	0.089	1.1	69	7.3%	5.00	0.37	0.37
29.3	-14.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
34.3	-19.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
39.3	-24.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
44.3	-29.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
49.3	-34.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
54.3	-39.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
59.3	-44.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
64.3	-49.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
69.3	-54.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
74.3	-59.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
79.3	-64.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
83.6	-69.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
89.3	-74.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
94.3	-79.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
99.3	-84.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
104.3	-89.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
108.6	-94.2	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
114.3	-99.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
119.3	-104.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00
124.3	-109.9	-	-	-	No Loss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.0	-	-	-	-	0.00

300psf, 7 deg.

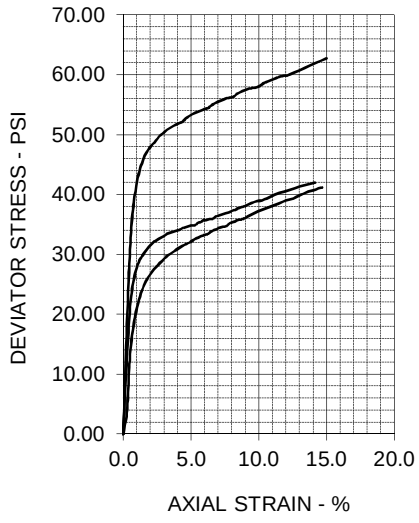
Triaxial CU Test Results

TRIAXIAL SHEAR TEST REPORT



shear strength = 0.9*144 + 2*115*tan(31.6) = 271 psf

EFFECTIVE STRESS PARAMETERS	f ' = 31.6 deg	c' = 0.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.3	10.3	10.3	
Dry Density - pcf	115.7	115.7	115.7	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	16.2	15.4	14.2	
Dry Density - pcf	115.7	115.9	116.0	
Calculated Diameter (in.)	2.82	2.81	2.82	
Height - inches	6.04	6.04	6.07	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	13.33	22.17	43.36	
Total Pore Pressure - psi	50.7	50.9	51.9	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.5	0.6	1.1	
S_1' Failure - psi	17.61	31.27	61.47	
S_3' Failure - psi	4.28	9.10	18.11	

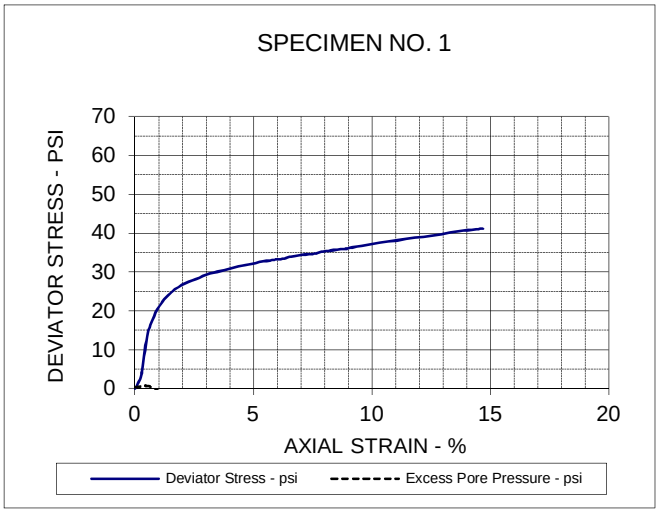
TEST DESCRIPTION

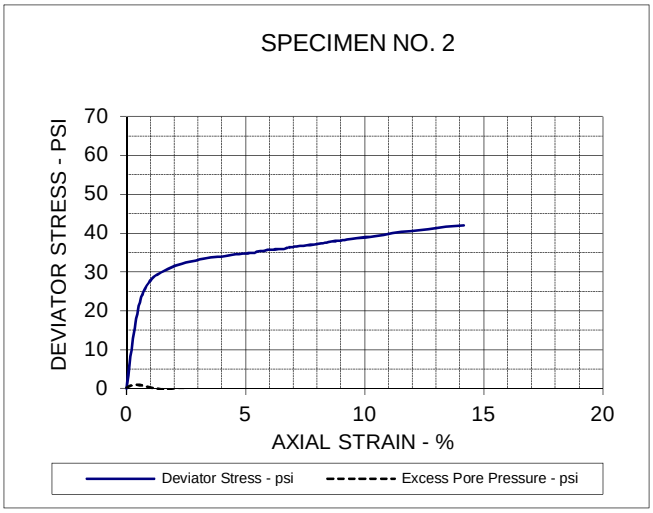
TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk1, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 20.7
REMARKS: Specimens remolded to 95% at opt.

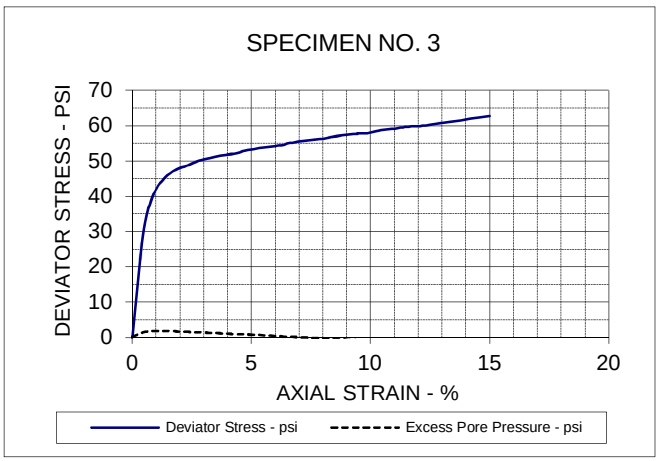
PROJECT INFORMATION

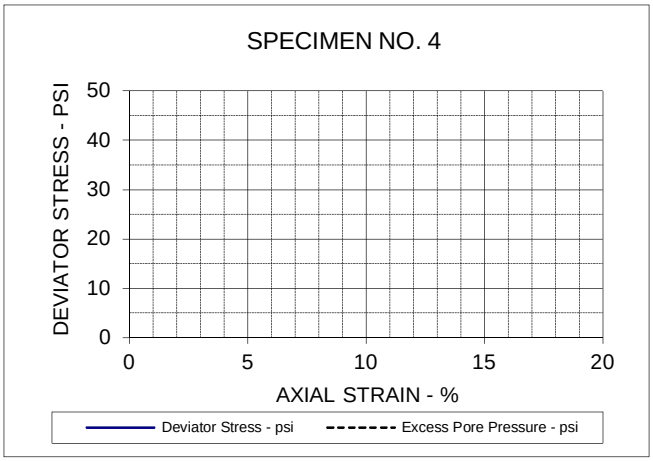
PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

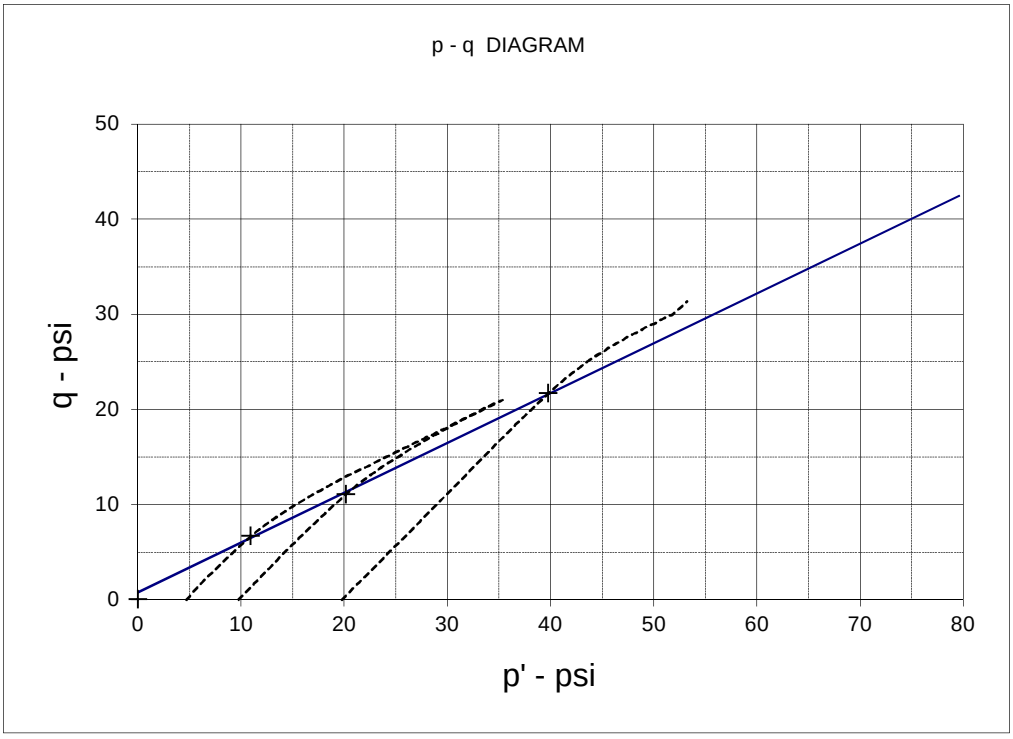
TERRACON











EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	a (deg) = 27.6	a (psi) = 0.8
PROJECT: I-95 Bridge Replacements- Jasper County		TYPE OF TEST & NO: CU with Pore Pressure	
PROJECT NO: EN175299		**TERRACON**	
DESCRIPTION: Silty Sand			

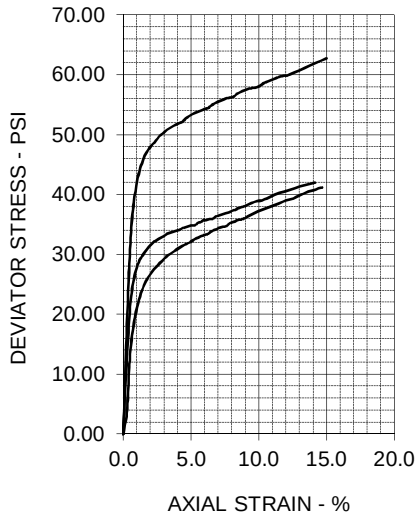
TRIAXIAL SHEAR TEST REPORT

Terracon



shear strength = 0.8*144 + 2*115*tan(30) = 248 psf

TOTAL STRESS PARAMETERS	f = 30.2 deg	c = 0.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.3	10.3	10.3	
Dry Density - pcf	115.7	115.7	115.7	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	16.2	15.4	14.2	
Dry Density - pcf	115.7	115.9	116.0	
Calculated Diameter (in.)	2.82	2.81	2.82	
Height - inches	6.04	6.04	6.07	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	13.33	22.17	43.36	
Total Pore Pressure - psi	50.7	50.9	51.9	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.5	0.6	1.1	
S_1 Failure - psi	18.33	32.17	63.36	
S_3 Failure - psi	5.00	10.00	20.00	

TEST DESCRIPTION

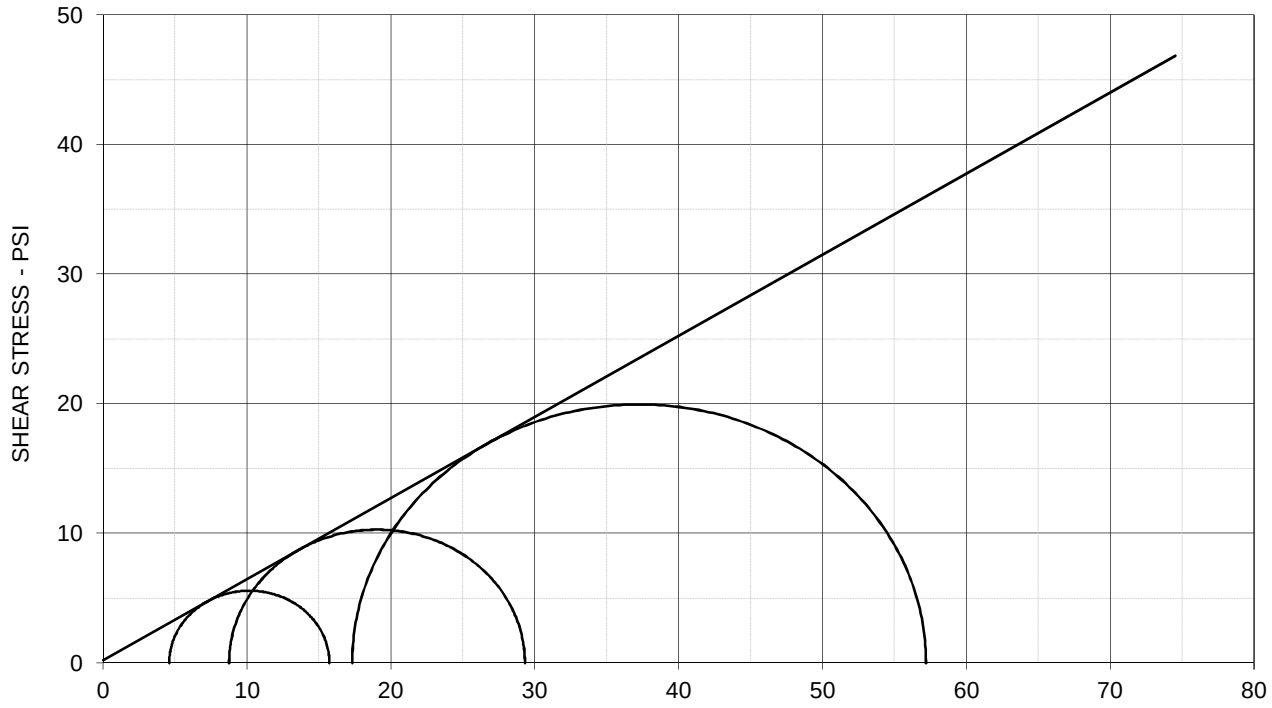
TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk1, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 20.7
REMARKS: Specimens remolded to 95% at opt.

PROJECT INFORMATION

PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

TERRACON

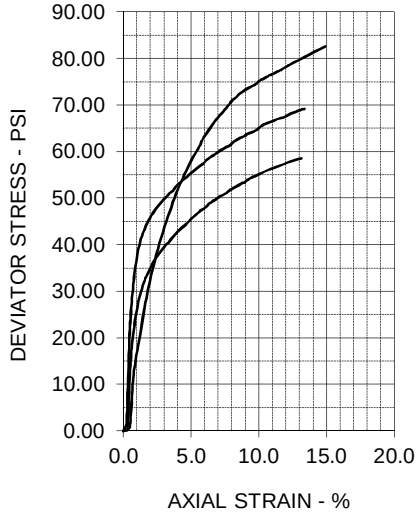
TRIAXIAL SHEAR TEST REPORT



These values were selected for effective stress

shear strength = 0.2*144 + 2*115*tan(32) = 172.5 psf

EFFECTIVE STRESS PARAMETERS	f ' = 32.0 deg	c' = 0.2 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.5	10.5	10.5	
Dry Density - pcf	117.4	117.4	117.4	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	13.2	12.3	12.8	
Dry Density - pcf	117.4	117.5	117.9	
Calculated Diameter (in.)	2.80	2.81	2.81	
Height - inches	6.01	6.03	6.03	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	11.13	20.56	39.88	
Total Pore Pressure - psi	50.4	51.2	52.7	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.7	0.7	1.2	
S_1' Failure - psi	15.73	29.32	57.20	
S_3' Failure - psi	4.60	8.76	17.32	

TEST DESCRIPTION

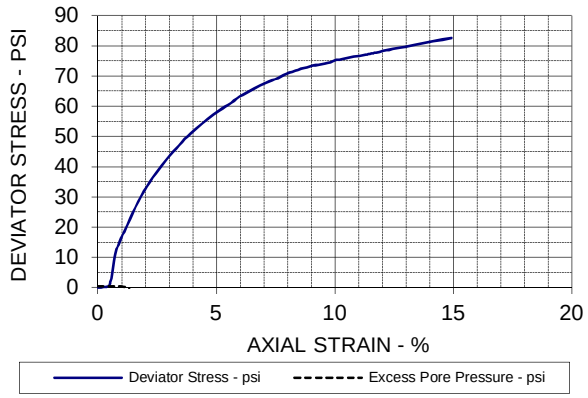
TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk2, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 16.4
REMARKS: Specimens remolded to 95% at opt.

PROJECT INFORMATION

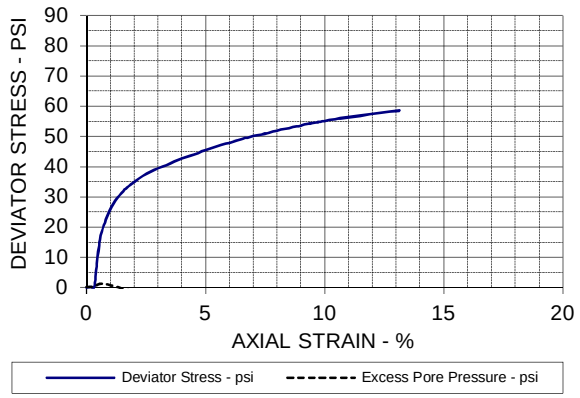
PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

TERRACON

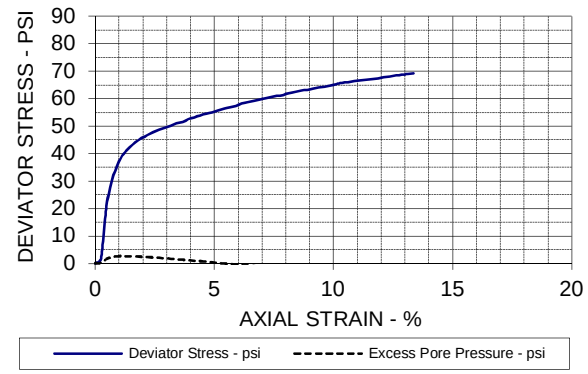
SPECIMEN NO. 1



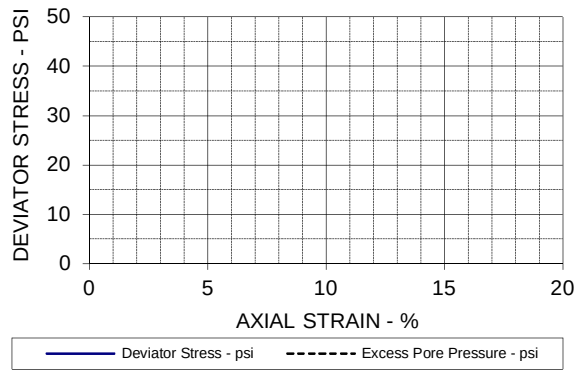
SPECIMEN NO. 2



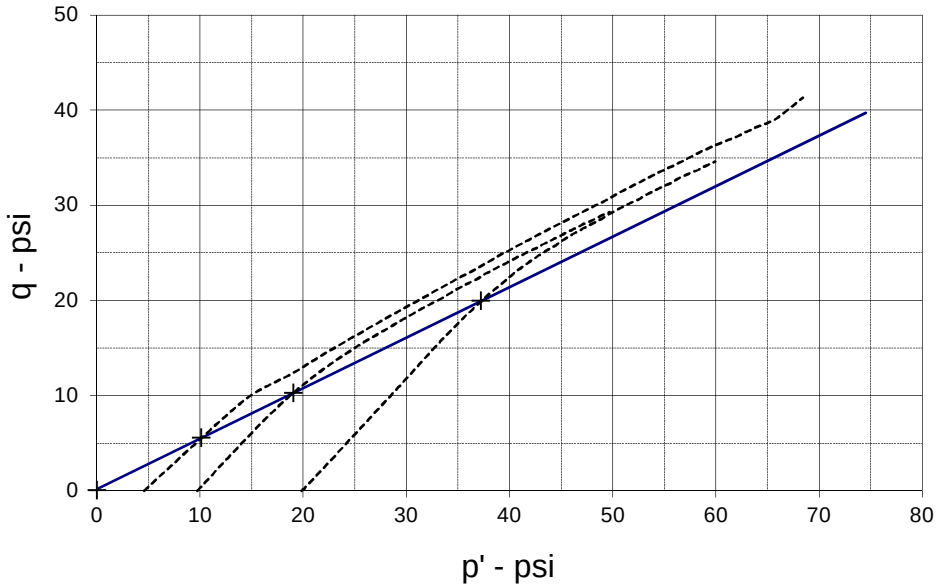
SPECIMEN NO. 3



SPECIMEN NO. 4

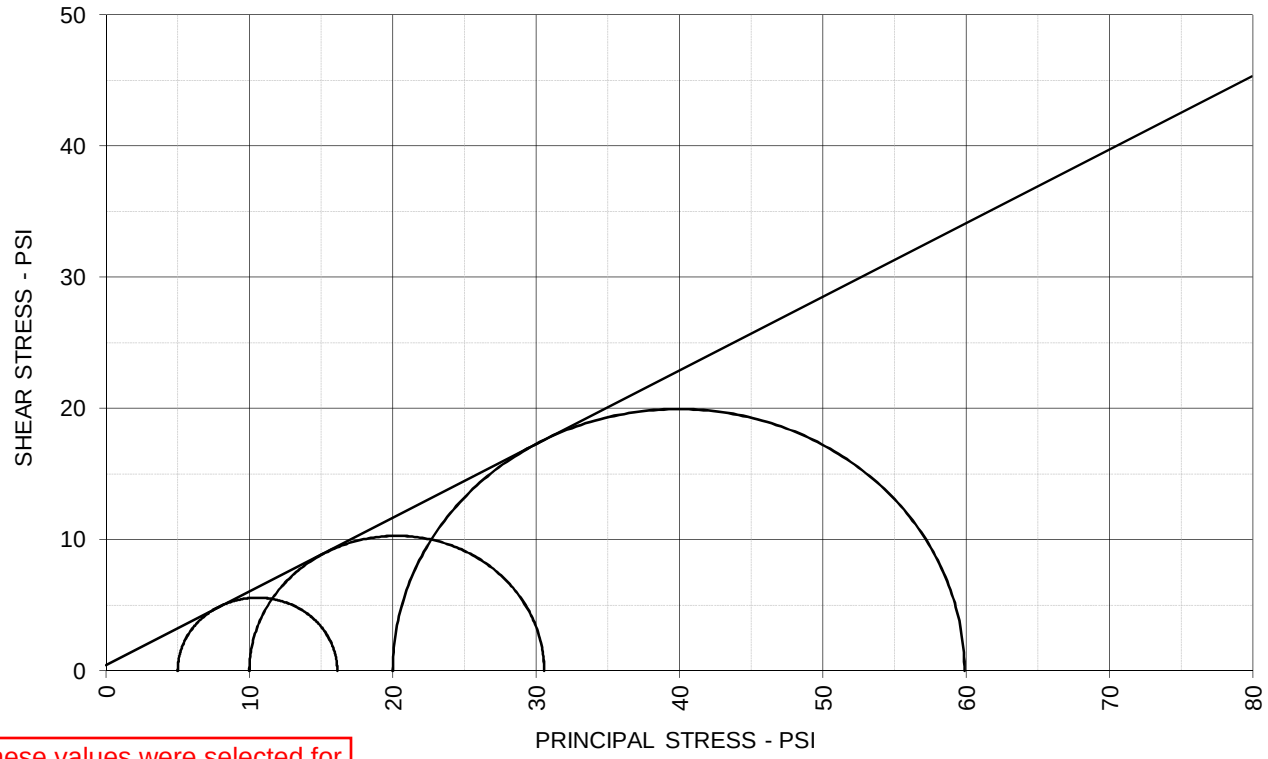


p - q DIAGRAM



EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	a (deg) = 27.9	a (psi) = 0.2
PROJECT: I-95 Bridge Replacements- Jasper County		TYPE OF TEST & NO: CU with Pore Pressure	
PROJECT NO: EN175299		**TERRACON**	
DESCRIPTION: Silty Sand			

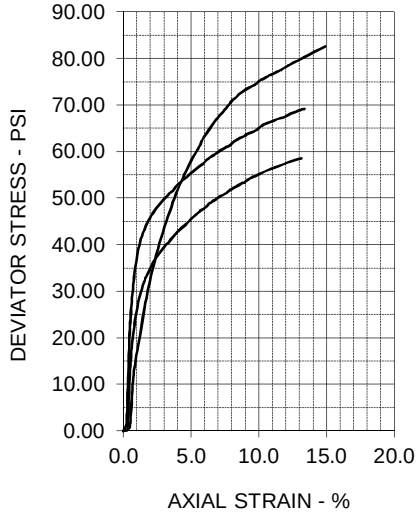
TRIAXIAL SHEAR TEST REPORT



These values were selected for total stress

shear strength = 0.4*144 + 2*115*tan(29) = 185 psf

TOTAL STRESS PARAMETERS	f = 29.3 deg	c = 0.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.5	10.5	10.5	
Dry Density - pcf	117.4	117.4	117.4	
Diameter - inches	2.80	2.80	2.80	
Height - inches	6.00	6.00	6.00	
AT TEST				
Final Moisture - %	13.2	12.3	12.8	
Dry Density - pcf	117.4	117.5	117.9	
Calculated Diameter (in.)	2.80	2.81	2.81	
Height - inches	6.01	6.03	6.03	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	11.13	20.56	39.88	
Total Pore Pressure - psi	50.4	51.2	52.7	
Strain Rate - inches/min.	0.00100	0.00100	0.00100	
Failure Strain - %	0.7	0.7	1.2	
S_1 Failure - psi	16.13	30.56	59.88	
S_3 Failure - psi	5.00	10.00	20.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Remolded
DESCRIPTION: Silty Sand
SAMPLE LOCATION: BS-Bulk2, 0.0-4.0 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NV PL: NP PI: NP Percent -200: 16.4
REMARKS: Specimens remolded to 95% at opt.

PROJECT INFORMATION

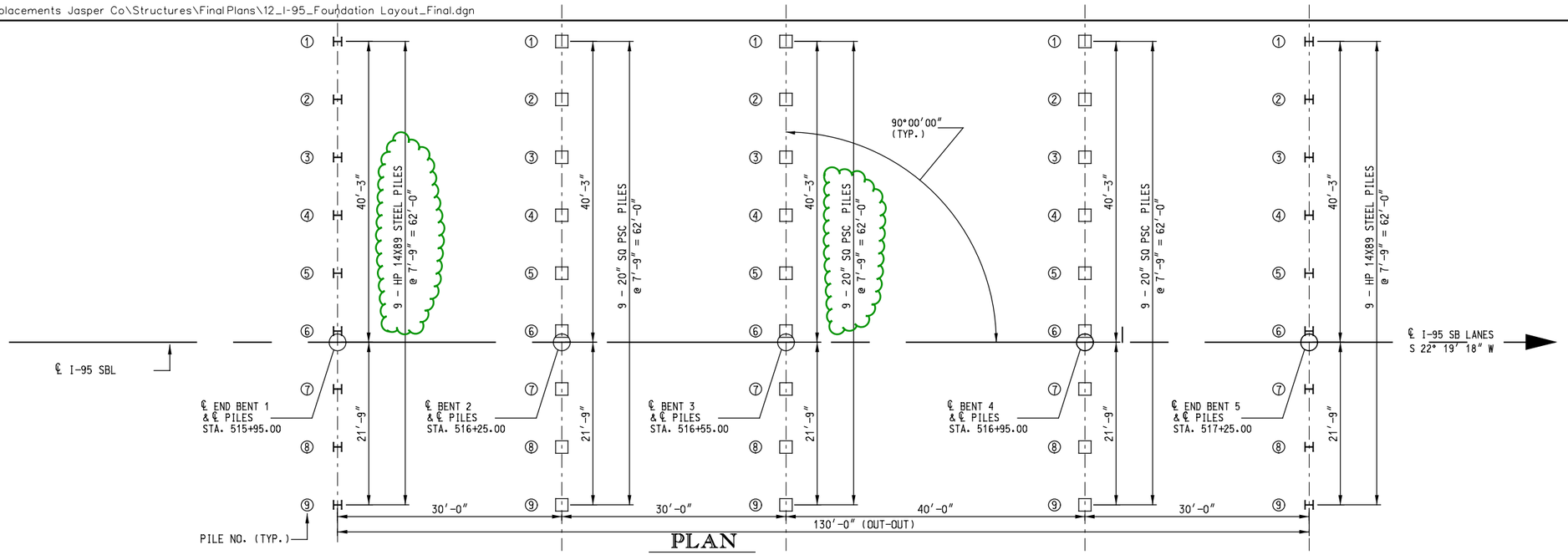
PROJECT: I-95 Bridge Replacements- Jasper County
LOCATION: Columbia, SC
PROJECT NO: EN175299
CLIENT: Infrastructure Consulting & Engineering, PLLC
DATE: 7/21/21

TERRACON

EXHIBIT C-4: BRIDGE LOADS

R:\Projects\18-42 I-95 Bridge Replacements Jasper Co\Structures\Final Plans\12_I-95_Foundation Layout_Final.dgn

BRIDGE PLANS ID	SHEET NO.
P030260-B01	11



PLAN

FOUNDATION NOTES

PILE RESISTANCE TABLE		
BENT I.D.	E.B.1	E.B.4
PILE SECTION	20 Inch Prestressed Concrete	20 Inch Prestressed Concrete
CONTROLLING LIMT STATE	Strength	Strength
FACTORED DESIGN LOAD (KIPS)	208	208
GEOTECHNICAL RESISTANCE FACTOR	0.65	0.65
NOMINAL RESISTANCE (KIPS)	320	320
SETTLEMENT INDUCED UNFACTORED DOWNDRAG (KIPS)	0	0
SETTLEMENT INDUCED FACTORED DOWNDRAG (KIPS)	0	0
LIQUEFACTION INDUCED DOWNDRAG (KIPS)	0	0
REQUIRED DRIVING RESISTANCE (KIPS)	320	320
MINIMUM PILE TIP ELEVATION (FEET MSL)	52	52
ESTIMATED PILE TIP ELEVATION (FEET MSL)	51	51

Method of controlling installation of piles and verifying their resistance: Resistance and stresses will be verified by Pile Driving Analyzer (PDA) and CAPWAP analysis of index pile(s) during driving. A Pile Installation Chart developed from the analysis will be used to verify the resistance of production piles.

The required minimum tip elevation to achieve critical penetration for the 20 inch prestressed concrete piles at End Bent 1 and 4 is 52 feet MSL.

Perform Pile Driving Analyzer (PDA) testing on the first production pile driven at the End Bent 1 or 4. If a CAPWAP analysis determines that resistance has not been achieved, restrike 1 of the production piles. Perform the restrike on the production pile exhibiting the least blows per foot. On initial drive, piles shall be stopped at the highest allowable finished grade on the plans to accommodate a restrike while remaining within an allowable plan finished grade elevation.

An additional 3 feet, minimum, of 20 inch prestressed concrete pile should be included in order to accommodate the initial PDA testing for the first pile driven at End Bent 1 or 4.

Each pile is to be installed in one continuous operation. Include details of any anticipated temporary driving discontinuances including anticipated time intervals in the Pile Installation Plan.

Reference the Standard Specifications for Highway Construction for Driven Pile Foundations, Section 711. Notes included in these plans are in addition to the requirements of the Standard Specifications.

The following estimated parameters were used for performing a drivability analysis for End Bent 1 & End Bent 4:

DRIVABILITY ANALYIS		
BENT I.D.	E.B.1	E.B.4
Skin Quake (QS)	0.10 in	0.10 in
Toe Quake (QT)	0.17 in	0.17 in
Skin Damping (SD)	0.05 s/ft	0.05 s/ft
Toe Damping (TD)	0.15 s/ft	0.15 s/ft
% Skin Friction	40%	40%
Distribution Shape Number	0	0
Pile Installation Chart	Proportional	Proportional
Pile Penetration	95%	95%
Hammer Energy Range	45-80 kip-ft	45-80 kip-ft

Note: GRLWEAP 2010-7 WAS USED TO PERFORM THE WAVE EQUATION ANALYSIS.

A pile hammer having the rated energy as indicated above is considered suitable for driven pile installation. However, final hammer approval is based on a wave equation analysis that accurately reflects the Contractor's proposed driving system.

PILE RESISTANCE TABLE		
BENT I.D.	I.B.2	I.B.3
PILE SECTION	20 Inch Prestressed Concrete with HP10x57 pile point	20 Inch Prestressed Concrete with HP10x57 pile point
	Strength	Strength
FACTORED DESIGN LOAD (KIPS)	223	223
GEOTECHNICAL RESISTANCE FACTOR	0.65	0.65
NOMINAL RESISTANCE (KIPS)	343	343
ESTIMATED SCOUR RESISTANCE (KIPS)	175	175
LIQUEFACTION INDUCED DOWNDRAG (KIPS)	0	0
REQUIRED DRIVING RESISTANCE (KIPS)	517	517
CONCRETE MINIMUM PILE TIP ELEVATION (FEET MSL)	51	51
ESTIMATED PILE TIP ELEVATION CONCRETE (FEET MSL)	51	51
ESTIMATED PILE TIP ELEVATION STEEL (FEET MSL)	41	41

Method of controlling installation of piles and verifying their resistance: Resistance and stresses will be verified by Pile Driving Analyzer (PDA) and CAPWAP analysis of index pile(s) during driving. A Pile Installation Chart developed from the analysis will be used to verify the resistance of production piles.

Perform Pile Driving Analyzer (PDA) testing on the first production pile driven at the Interior Bent 2 or 3. If a CAPWAP analysis determines that resistance has not been achieved, restrike 1 of the production piles. Perform the restrike on the production pile exhibiting the least blows per foot. On initial drive, piles shall be stopped at the highest allowable finished grade on the plans to accommodate a restrike while remaining within an allowable plan finished grade elevation.

An additional 3 feet, minimum, of 20 inch prestressed concrete pile should be included in order to accommodate the initial PDA testing for the first pile driven at Interior Bent 2 or 3.

The following estimated parameters were used for performing a drivability analysis for Interior Bent 2 & 3:

DRIVABILITY ANALYIS		
BENT I.D.	I.B.2	I.B.3
Skin Quake (QS)	0.10 in	0.10 in
Toe Quake (QT)	0.10 in	0.10 in
Skin Damping (SD)	0.05 s/ft	0.05 s/ft
Toe Damping (TD)	0.15 s/ft	0.15 s/ft
% Skin Friction	45%	45%
Distribution Shape Number	0	0
Pile Installation Chart	Proportional	Proportional
Toe No. 2 Quake (QT)	0.17 in	0.17 in
Toe No. 2 Damping (TD)	0.15 s/ft	0.15 s/ft
End Bearing Fraction (Toe No. 2	75%	75%
Pile Penetration	70%	70%
Hammer Energy Range	75-175 kip-ft	75-175 kip-ft

Note: GRLWEAP 2010-7 WAS USED TO PERFORM THE WAVE EQUATION ANALYSIS.

The required minimum tip elevation (to achieve critical penetration) for the 20-inch pre-stressed concrete piles is 51 feet MSL and a minimum tip elevation of the steel pile points of 41 feet MSL. Fabricate and deliver piles to the job site with either a 2.5-foot length of HP10x57 pile point or the full length of HP10x57 pile point extending from the tip of the prestressed concrete pile.

If required minimum tip elevation cannot be achieved by driving alone, predrill pile locations at Bent 2 and 3 to an elevation no lower than 41 feet with equipment that will result in a maximum predrilling diameter of 12". For predrilling for piles, see section 711.4.5.2 of the standard specifications.

A pile hammer having the rated energy as indicated above is considered suitable for driven pile installation. However, final hammer acceptance is based on a wave equation analysis that accurately reflects the Contractor's proposed driving system.

The Contractor may elect to drive a portion of the HP10x57 steel piling extension prior to attaching the remaining prestressed portion. If the Contractor elects to attach the additional extension to the piling prior to picking up the pile, it is expressly understood that the Department is not responsible for any piles damaged during pick-up. Damaged piles are to be replaced at the Contractor's expense.

Reinforced pile tips are required to penetrate partially weathered rock for the HP10x57 steel pile. Install the reinforced pile tips in accordance with the manufacturer's installation recommendations.

PROGRESS DRAWINGS
NOT FOR CONSTRUCTION

TRACKING NO.

DOCUMENT REVIEW

RESPONSIBILTY	NAME	DATE
ORIGINATOR		
CHECKED		
REVISED		
VERIFIED		

	BY	CHK.	DATE
REV.			
REV.			
REV.			
REVIEWED	JPF		12-20
QUAN.			
DR.			
DES.			

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

FOUNDATION LAYOUT

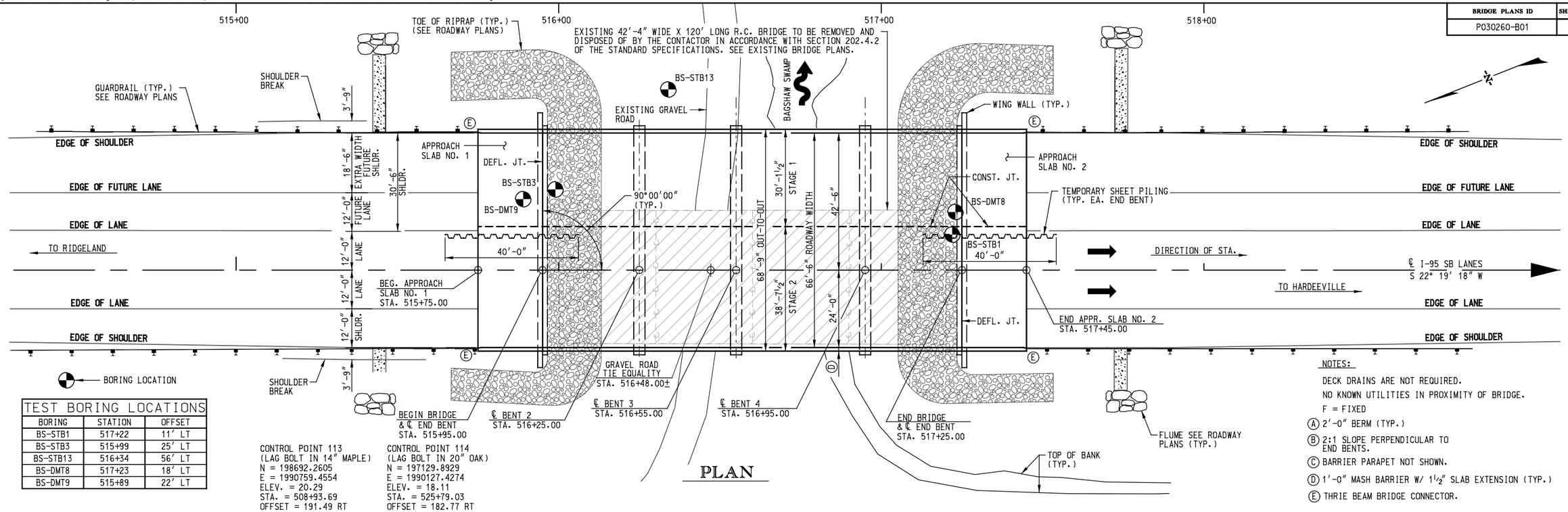
REPLACE I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP

COUNTY	ROUTE
JASPER	I-95 SB

7/8/2021 6:07:07 PM 6:07:07 PM
User: paul.holshouser

R:\Projects\18-42 I-95 Bridge Replacements Jasper Co\Structures\Final Plans\09_I-95_PLAN AND PROFILE.dgn

BRIDGE PLANS ID	SHEET NO.
P030260-B01	9



TEST BORING LOCATIONS		
BORING	STATION	OFFSET
BS-STB1	517+22	11′ LT
BS-STB3	515+99	25′ LT
BS-STB13	516+34	56′ LT
BS-DMT8	517+23	18′ LT
BS-DMT9	515+89	22′ LT

CONTROL POINT 113
(LAG BOLT IN 14″ MAPLE)
N = 198692.2605
E = 1990759.4554
ELEV. = 20.29
STA. = 508+93.69
OFFSET = 191.49 RT

CONTROL POINT 114
(LAG BOLT IN 20″ OAK)
N = 197129.8929
E = 1990127.4274
ELEV. = 18.11
STA. = 525+79.03
OFFSET = 182.77 RT

NOTES:

DECK DRAINS ARE NOT REQUIRED.

NO KNOWN UTILITIES IN PROXIMITY OF BRIDGE.

F = FIXED

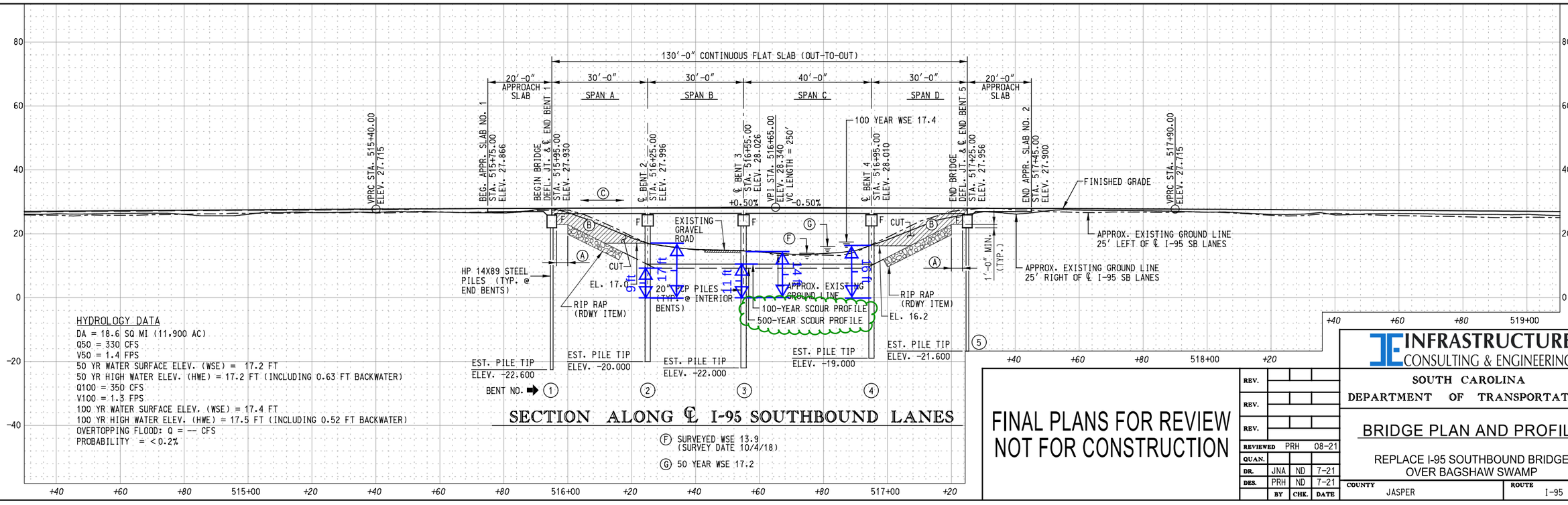
Ⓐ 2′-0″ BERM (TYP.)

Ⓑ 2:1 SLOPE PERPENDICULAR TO END BENTS.

Ⓒ BARRIER PARAPET NOT SHOWN.

Ⓓ 1′-0″ MASH BARRIER W/ 1½″ SLAB EXTENSION (TYP.)

Ⓔ THRIE BEAM BRIDGE CONNECTOR.



HYDROLOGY DATA

DA = 18.6 SQ MI (11,900 AC)
Q50 = 330 CFS
V50 = 1.4 FPS
50 YR WATER SURFACE ELEV. (WSE) = 17.2 FT
50 YR HIGH WATER ELEV. (HWE) = 17.2 FT (INCLUDING 0.63 FT BACKWATER)
Q100 = 350 CFS
V100 = 1.3 FPS
100 YR WATER SURFACE ELEV. (WSE) = 17.4 FT
100 YR HIGH WATER ELEV. (HWE) = 17.5 FT (INCLUDING 0.52 FT BACKWATER)
OVERTOPPING FLOOD: Q = -- CFS
PROBABILITY = < 0.2%

SECTION ALONG ℄ I-95 SOUTHBOUND LANES

Ⓕ SURVEYED WSE 13.9 (SURVEY DATE 10/4/18)

Ⓖ 50 YEAR WSE 17.2

FINAL PLANS FOR REVIEW NOT FOR CONSTRUCTION

INFRASTRUCTURE CONSULTING & ENGINEERING

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

BRIDGE PLAN AND PROFILE

REPLACE I-95 SOUTHBOUND BRIDGE OVER BAGSHAW SWAMP

	BY	CHK.	DATE
REV.			
REV.			
REV.			
REVIEWED	PRH		08-21
QUAN.			
DR.	JNA	ND	7-21
DES.	PRH	ND	7-21

COUNTY: JASPER

ROUTE: I-95 SB

9:31:02 AM
10/1/2021
User: jim.austin

ICE
4505 Falls of Neuse Road
Raleigh, NC 27603
PH: (984)-255-0410

JOB: I-95 Bridge over Bagshaw Swamp- Final

SHEET NO. 1 OF 1
CALCULATED BY: NR DATE: 6/23/2021
CHECKED BY: PRH DATE: 6/29/2021

Top of Pile / Bottom of Cap Loads (Impact NOT Included)

FINAL CONDITION 9 Piles at 7.75 ft cc on 68.75' long cap

*9 HP 14x89 Piles

Top of Pile	El.	21.41	Top Pile-Top Pile Bent [FT]=	0.00
Bottom of Cap	El.	21.41	Top Pile-Fixity [FT]=	-8.59
Fixity	El.	30.00	Top Pile-Fixity [FT]=	-8.59

STRENGTH REACTIONS END BENT

Max Axial (global Fy)

Column Number	Fx K	**Fy K**	Fz K	Mx K-FT	Mz K-FT
1	0.0	**-143.0**	-2.0	-20.0	1.0

Max Transverse (global Fx)

Column Number	**Fx kips**	Fy kips	Fz kips	Mx K-FT	Mz K-FT
5	**1.0**	-75.0	0.0	0.0	5.0

Max Longitudinal (global Fz)

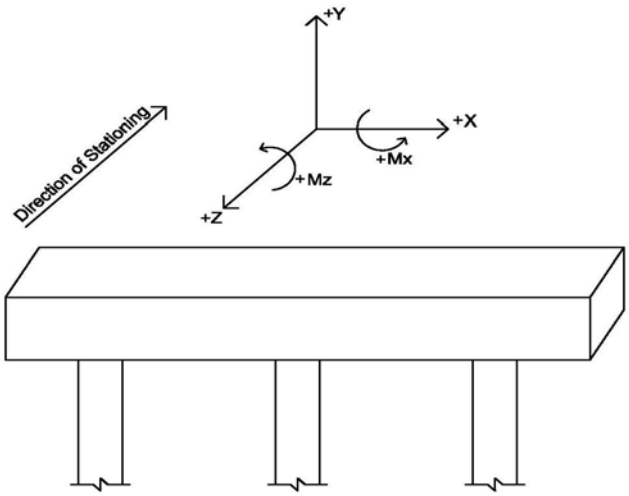
Column Number	Fx kips	Fy kips	**Fz kips**	Mx K-FT	Mz K-FT
1	-0.1	-133.0	**-2.5**	-28.0	-3.0

Max moment about cap axis (global Mx)

Column Number	Fx kips	Fy kips	Fz kips	**Mx K-FT**	Mz K-FT
5	-0.1	-121.0	-2.5	**-30.0**	2.0

Max moment about normal to cl cap axis (global Mz)

Column Number	Fx kips	Fy kips	Fz kips	Mx K-FT	**Mz K-FT**
1	0.3	-112.0	-1.5	-16.0	**5.0**



ICE
4505 Falls of Neuse Road
Raleigh, NC 27603
PH: (984)-255-0410

JOB: I-95 Bridge over Bagshaw Swamp- Final

SHEET NO. 1 OF 1
CALCULATED BY: NR DATE: 6/23/2021
CHECKED BY: PRH DATE: 6/28/2021

Top of Pile / Bottom of Cap Loads (Impact NOT Included)

FINAL CONDITION 9 Piles at 7.75 ft cc on 68.75' long cap

*Column 20X20 Concrete Pile

Top of Pile	El.	22.00	Top Pile-Top Pile Bent [FT]=	0.00
Top of Pile Bent	El.	22.00	Top Pile-Fixity [FT]=	30.00
Fixity	El.	-8.00	Top Pile-Fixity [FT]=	30.00

STRENGTH REACTIONS BENT #2

Max Axial (global Fy)

Column Number	Fx K	**Fy K**	Fz K	Mx K-FT	Mz K-FT
1	-0.3	**-231.2**	-2.0	-10.0	-6.0

Max Transverse (global Fx)

Column Number	**Fx kips**	Fy kips	Fz kips	Mx K-FT	Mz K-FT
9	**-1.5**	-110.0	-0.4	-3.0	-20.0

Max Longitudinal (global Fz)

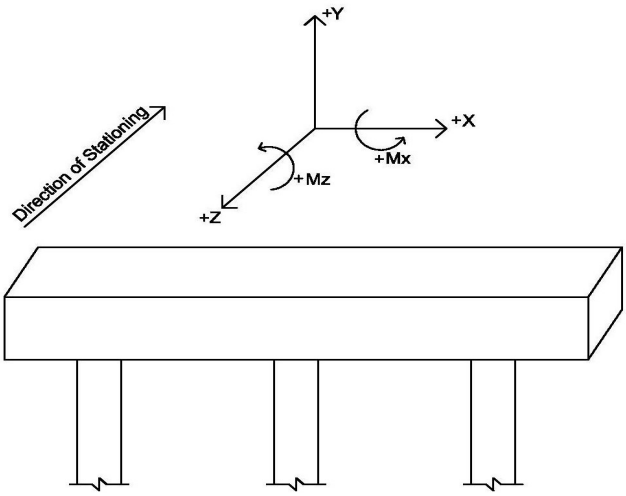
Column Number	Fx kips	Fy kips	**Fz kips**	Mx K-FT	Mz K-FT
1	0.5	-180.0	**-3.0**	-15.0	11.0

Max moment about cap axis (global Mx)

Column Number	Fx kips	Fy kips	Fz kips	**Mx K-FT**	Mz K-FT
5	-0.4	-193.0	-2.0	**-32.0**	-7.0

Max moment about normal to cl cap axis (global Mz)

Column Number	Fx kips	Fy kips	Fz kips	Mx K-FT	**Mz K-FT**
9	-1.5	-110.0	-0.4	-3.0	**-20.0**



Project: Bagshaw Swamp
Subject: Seismic Geotech Results
By: KLC **Chk'd By:**
Date: 10/1/2021 **Date:**

INFRASTRUCTURE CONSULTING & ENGINEERING

All deflections and rotations in local axes.
Positive axial load reflects compression in member.
All results taken at top of piles.

1 SEE Model

Displacements (in)			Axial Force
Bent	Long.	Trans.	kips
1	8.31	1.73	410.00
2	7.93	1.22	70.00
3	7.41	0.98	50.00
4	9.25	0.81	75.00
5	9.41	0.86	365.00

2 FEE Model

Displacements (in)			Axial Force
Bent	Long.	Trans.	kips
1	4.63	0.32	340.00
2	3.99	0.24	85.00
3	1.73	0.22	30.00
4	4.51	0.18	80.00
5	5.02	0.22	325.00

3 SEE Model - Liquefied

Displacements (in)			Axial Force
Bent	Long.	Trans.	kips
1	11.11	1.70	380.00
2	10.37	1.59	60.00
3	8.61	2.12	35.00
4	9.93	3.29	50.00
5	10.61	4.54	415.00

4 FEE Model - Liquified

Displacements (in)			Axial Force
Bent	Long.	Trans.	kips
1	5.59	0.39	360.00
2	4.45	0.28	90.00
3	2.08	0.24	35.00
4	5.47	0.17	100.00
5	6.41	0.17	340.00

Load Combinations Input into LPILE:

EBs:
11.11 in. 415 kips (Long.)
4.54 in. 415 kips (Trans.)

IBs:
10.37 in. 60 kips (Long.)
3.29 in. 60 kips (Trans.)

Maximum Axial Loads under EEI:

EB1: 410 kips
IB2: 90 kips
IB3: 50 kips
IB4: 100 kips
EB5: 415 kips

EXHIBIT C-5: AXIAL ANALYSIS OF FOUNDATIONS

Site Variability Calculation

Project: I-95 Bridge Replacement
Terracon Project No.: EN175299
Computed By: A. Fekrat
Checked By: D. Corley
Date: 7/26/2021
SCDOT Project ID: P030260
Location: I-95 Bridge over Bagshaw Swamp

Boring Number :	BS-STB1	BS-STB3
Elevation (ft. NAVD88) :	28.0	28.0

Elevation (ft. NAVD88) :		**N_{60}**		**Average (N_{60})**	**Standard Deviation**	**COV**
from	**to**					
26.8	24.8	12	4	8	5.50	0.71
24.8	22.8	29	4	16	17.42	1.07
22.8	20.8	8	14	11	4.58	0.42
20.8	18.8	16	18	17	1.83	0.11
18.8	14.5	5	10	8	3.67	0.47
14.5	9.5	19	4	12	11.00	0.94
9.5	4.5	3	14	8	8.25	0.98
4.5	-0.5	6	19	13	9.17	0.71
-0.5	-5.5	18	26	22	5.50	0.25
-5.5	-10.5	27	19	23	5.50	0.24
-10.5	-15.5	16	14	15	0.92	0.06
-15.5	-20.5	23	30	27	4.58	0.17
-20.5	-25.5	26	22	24	2.75	0.11
-25.5	-30.5	29	27	28	0.92	0.03
-30.5	-35.5	35	21	28	10.09	0.36
-35.5	-40.5	25	18	21	4.58	0.21
-40.5	-45.5	25	17	21	5.50	0.27
-45.5	-50.5	22	29	25	4.58	0.18
-50.5	-55.5	45	16	30	21.09	0.69
-55.5	-60.5	22	32	27	7.34	0.27
-60.5	-65.5	60	36	48	16.50	0.34
-65.5	-70.5	130	30	80	70.60	0.89
-70.5	-75.5	14	17	16	1.83	0.12
-75.5	-80.5	--	130	130	0.00	0.00
-80.5	-85.5	--	19	19	0.00	0.00

Average COV = 0.38
Site Variability at Bridge Location = **Medium**

0.40 ≤ COV Divide sites until COV < 0.40
0.25 ≤ COV < 0.39
COV < 0.24

Note: Red values are rounded to the nearest foot

Site Variability Calculation

Project: I-95 Bridge Replacement
Terracon Project No.: EN175300
Computed By: A. Fekrat
Checked By: D. Corley
Date: 7/26/2021
SCDOT Project ID: P030261
Location: I-95 Bridge over Bagshaw Swamp

Boring Number :	BS-STB2	BS-STB10	BS-STB11	BS-STB13	BS-STB14	BS-STB15
Elevation (ft. NAVD88) :	15.0	15.0	15.0	15.0	15.0	15.0

Elevation (ft. NAVD88) :								**Average (N_{60})**	**Standard Deviation**	**COV**
from	**to**									
14.0	12.0	20	7	11	8	11	5	10	5.28	0.52
12.0	10.0	15	13	14	8	23	20	16	5.39	0.34
10.0	8.0	25	12	18	14	25	23	19	5.76	0.30
8.0	6.0	16	20	16	15	20	21	18	2.48	0.14
6.0	1.5	20	7	14	12	25	19	16	6.25	0.39
1.5	-3.5	13	5	21	5	5	28	13	9.90	0.77
-3.5	-8.5	26	26	28	12	27	34	26	7.16	0.28
-8.5	-13.5	33	21	21	16	21	31	24	6.37	0.27
-13.5	-18.5	40	34	36	30	43	42	38	5.12	0.14
-18.5	-23.5	36	52	23	25	40	60	39	14.48	0.37
-23.5	-28.5	81	42	35	30	57	57	51	18.68	0.37
-28.5	-33.5	56	34	33	30	63	46	44	13.76	0.31
-33.5	-38.5	38	35	25	41	33	73	41	16.65	0.41
-38.5	-43.5	49	55	32	16	74	117	57	35.43	0.62
-43.5	-48.5	42	59	50	37	29	55	45	11.28	0.25
-48.5	-53.5	83	--	101	31	117	--	83	37.21	0.45
-53.5	-58.5	35	--	27	38	34	--	34	4.79	0.14
-58.5	-63.5	63	--	70	22	79	--	59	25.23	0.43
-63.5	-68.5	117	--	117	89	36	--	90	38.17	0.42
-68.5	-73.5	33	--	117	137	46	--	83	51.57	0.62
-73.5	-78.5	117	--	117	94	117	--	112	11.46	0.10
-78.5	-83.5	29	--	32	21	26	--	27	4.85	0.18
-83.5	-88.5	32	--	32	137	35	--	59	52.02	0.88
-88.5	-93.5	73	--	66	25	56	--	55	21.24	0.39
-93.5	-98.5	35	--	36	137	35	--	61	50.62	0.83
-98.5	-103.5	49	--	34	37	33	--	38	7.53	0.20
-103.5	-108.5	47	--	54	22	56	--	45	15.77	0.35
-108.5	-113.5	67	--	61	27	52	--	52	17.41	0.34

Average COV = 0.39
Site Variability at Bridge Location = **Medium**

Note: Red values are rounded to the nearest foot

0.40 ≤ COV
0.25 ≤ COV < 0.40
COV < 0.25

Divide sites until COV < 0.40

Site Variability Summary

Site	Locations	Borings	Piles / Site	Site Variability	No. of Test Piles / Site*	Pile ID No. to perform PDA
1	End Bent 1	BS-STB1 thru BS-STB3, BS-STB10, BS-STB11, BS-STB13 thru BS-STB15	9	Medium	2	1, 6
2	Interior Bent 2		9	Medium	2	2, 7
3	Interior Bent 3		9	Medium	2	3, 8
4	Interior Bent 4		9	Medium	2	4, 9
5	End Bent 5		9	Medium	2	1, 5

*Source: SCDOT GDM 2019, Table 9-3

APILE Results and Pile Settlement
End Bents 1 and 5

Axial Capacity Analysis – End Bents 1 and 5

Analysis Methodology	
Analysis Type	Axial Capacity and Settlement of Driven Piles
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	End Bents 1 and 5
Soil Boring Model	Refer to Exhibit C-3 for Subsurface Soil Parameters and soil column stratigraphy changes with respect to depth and elevation
Analysis Method	Axial capacities of driven piles were calculated using the computer software APILE 2019 by Ensoft. The FHWA analysis method was used in APILE which generally follows the methods outlined in Section 10 of the AASHTO *LRFD Bridge Design Specifications*. APILE uses soil strength parameters to estimate the pile's side friction and end resistance. The soil strength parameters are estimated based on index properties such as fines content, Atterberg limits, and $N_{1,60}$ values per SCDOT GDM Chapter 7. The APILE output file is attached to Analysis Methodology Summary.
Design Notes	• Calculated axial capacities are factored resistances. APILE output presents unfactored resistances. • The efficiency factor η for reducing the pile group capacity based on spacing for the trestle bent is determined based on Section 16.3.3 of GDM. Nominal spacing (7'-9") (Exhibit C-4) divided by pile diameter (or width 14.7") = 6.3 > 2.5 => η = 1.0 • Steel Modulus of Elasticity is 29,000,000 psi. • Side resistance above the hard bearing layer (Elev. -12 ft NAVD88) is included as a driving force upon the pile when estimating the liquefaction downdrag load. • For conservative purposes, the liquefaction downdrag load has been estimated based on peak static effective strength properties and total unit weights for estimating post-liquefaction downdrag loads. • Static Downdrag loads were not considered in the axial capacity of the piles. As seen in boring logs, the soils above bearing layer is primarily sands and significant fill is not expected (Exhibit C-4).
Design Vertical Loads	• Service Load used for Settlement = 143 kips (Exhibit C-4 – same as Strength assumed) • Required Factored Strength Load at top of pile = 143 kips (Exhibit C-4) • Required Extreme Event Vertical Dead Load = 410 kips (EB1), 415 kips (EB5). (Exhibit C-4)
Scour	As seen on plans (Exhibit C-4), scour is not expected to affect the end bents. Also, end bents are protected by means of RipRap.
Resistance Factor	Φ=0.65 from SCDOT GDM, Section 9.5.1, Table 9-2
Load Factors	γ = 1.0 for Liquefaction Downdrag Load (SCDOT GDM, Section 8.7, Table 8-5) γ = 1.4 for Permanent Downdrag Load (SCDOT GDM, Section 8.7, Table 8-6)
Site Variability	Refer to attached site variability calculation sheet for definition. For each strata encountered in soil test borings listed above an average N_{60} value, Standard Deviation, and Coefficient of Variation (COV) are estimated.

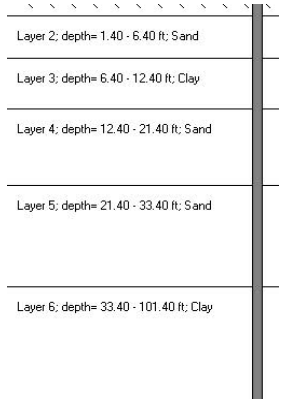
Pile Input Parameters				
Pile Type	**Tip Area**	**Top of Pile Elevation**	**Perimeter Analysis**	**Tip Analysis**
HP 14x89	26.1 in^2	21.41 (0 feet as input)	Box Perimeter = 57.0 in	Box Area = 202.86 in^2

END BENT 1 Axial Loading: HP 14x89 STEEL PILE

Pavement Elev. : 28.0 ft
Top of Pile/Load Elev. : 21.4 ft
Top of Bearing Layer : -12.0 ft
Groundwater Elev.: 15.0 ft

Subsurface Model : See Exhibit C-3
100-yr Scour Elev. : N.A.

Layer Name	Model	Permanent Downdrag?	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)
			APILE INPUT						
Existing FILL	Sand	No	0.0	1.4	21.4	20.0	120	36	--
	Sand	No	1.4	6.4	20.0	15.0	120	30	--
ALLUVIUM	Clay	No	6.4	12.4	15.0	9.0	125 - 62.6	--	1.2
	Sand	No	12.4	21.4	9.0	0.0	37.6	28	--
	Sand	No	21.4	33.4	0.0	-12.0	57.6	36	--
	Clay	No	33.4	101.4	-12.0	-80.0	52.6	--	3.5



20.0 ft
15.0 ft
9.0 ft
0.0 ft
-12.0 ft

Modeled Pile Embedment into the Bearing Layer : 53.6 ft
Estimated Tip Elevation : -65.6 ft
Estimated Pile Length : 87.0 ft

Zero Friction Length above Scour Elev. : N.A. = Top of Pile Elev. - 100-yr Scour Elev.
Liquefied Soil Thickness : 27.0 ft = Groundwater Elev. - Top of Bearing Layer

EARTHQUAKE

Nominal Side Resistance : 563.0 kips
Nominal Tip Resistance : 44.4 kips
Resistance Factor : 1.00

Unfactored Liquefaction Downdrag Load : 194.1 kips
Downdrag Load Factor : 1.00

Total Nominal Resistance[1] : 607.4 kips
Total Factored Resistance[1] : 607.4 kips

Resistance from Liquefiable Soils : 194.1 kips
Req'd Top of Pile EEI Load : 410.0 kips
Req'd Min. Driving (Factored) Resistance[2] : 604.1 kips
Sufficient Resistance? : Pass

STRENGTH

Nominal Side Resistance : 563.0 kips
Nominal Tip Resistance : 44.4 kips
Resistance Factor : 0.65

Unfactored Permanent Downdrag Load : 0.0 kips
Downdrag Load Factor : 1.40

Total Nominal Resistance[1] : 607.4 kips
Total Factored Resistance[1] : 394.8 kips

Resistance from Scourable Soils : 0.0 kips
Req'd Top of Pile Strength Load : 143.0 kips
Req'd Min. Driving (Factored) Resistance[2] : 143.0 kips
Sufficient Resistance? : Pass

1. Excludes resistance within downdrag layers
2. Includes factored downdrag load

Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

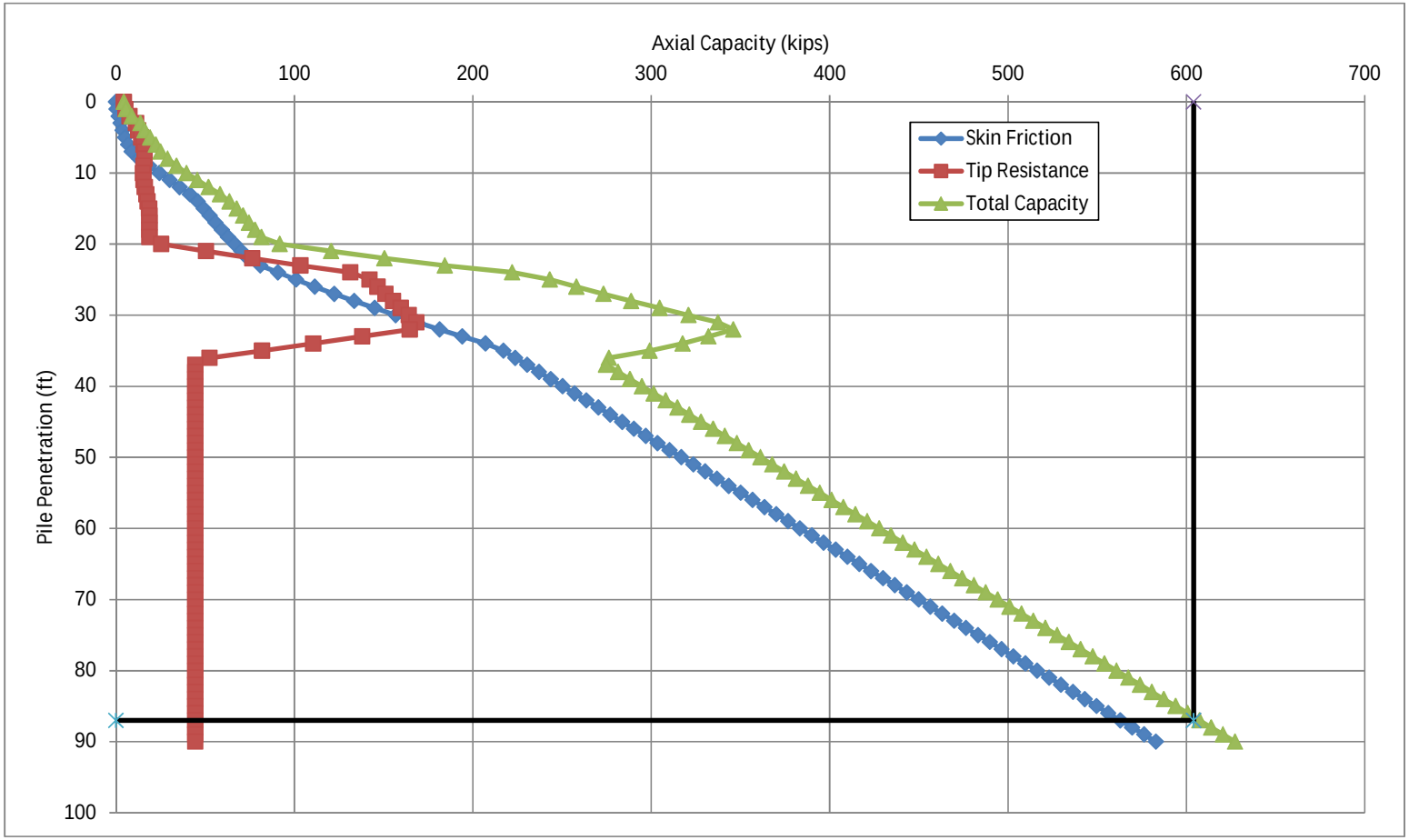
Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
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PH: (843) 884-1234 Fax. (843) 884-9234

AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

END BENT 1 AXIAL LOADING: HP 14x89 STEEL PILE



Total Nominal Resistance : 607.3 kips
Estimated Pile Penetration Beneath Pile Cap : 87.0 ft
Estimated Tip Elevation : -65.6 ft

Negative Skin Friction (Permanent DD) : 0.0 kips
Resistance from Scourable Soils : 0.0 kips
Resistance from Liquefiable Soils : 194.1 kips
Pile Stick up : 0.0 ft

Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	

Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

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AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **SOUTH CAROLINA**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

END BENT 5 Axial Loading: HP 14x89 STEEL PILE

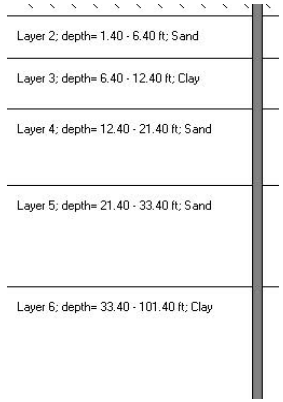
Pavement Elev. : 28.0 ft
Top of Pile/Load Elev. : 21.4 ft
Top of Bearing Layer : -12.0 ft
Groundwater Elev.: 15.0 ft

Subsurface Model : See Exhibit C-3
100-yr Scour Elev. : N.A.

APILE INPUT

Layer Name	Model	Permanent Downdrag?	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)
Existing FILL	Sand	No	0.0	1.4	21.4	20.0	120	36	--
	Sand	No	1.4	6.4	20.0	15.0	120	30	--
ALLUVIUM	Clay	No	6.4	12.4	15.0	9.0	125 - 62.6	--	1.2
	Sand	No	12.4	21.4	9.0	0.0	37.6	28	--
	Sand	No	21.4	33.4	0.0	-12.0	57.6	36	--
	Clay	No	33.4	101.4	-12.0	-80.0	52.6	--	3.5

APILE does not permit overriding the adhesion factor alpha. A Su of 5ksf was input to acheive unit side resist. of about 3.5ksf, consistent with SHAFT.



20.0 ft
15.0 ft
9.0 ft
0.0 ft
-12.0 ft

Modeled Pile Embedment into the Bearing Layer : 54.6 ft
Estimated Tip Elevation : -66.6 ft
Estimated Pile Length : 88.0 ft

Zero Friction Length above Scour Elev. : N.A. = Top of Pile Elev. - 100-yr Scour Elev.
Liquefied Soil Thickness : 27.0 ft = Groundwater Elev. - Top of Bearing Layer

EARTHQUAKE	STRENGTH
Nominal Side Resistance : 569.6 kips	Nominal Side Resistance : 569.6 kips
Nominal Tip Resistance : 44.4 kips	Nominal Tip Resistance : 44.4 kips
Resistance Factor : 1.00	Resistance Factor : 0.65
Unfactored Liquefaction Downdrag Load : 194.1 kips	Unfactored Permanent Downdrag Load : 0.0 kips
Downdrag Load Factor : 1.00	Downdrag Load Factor : 1.40
Total Nominal Resistance[1] : 614.0 kips	Total Nominal Resistance[1] : 614.0 kips
Total Factored Resistance[1] : 614.0 kips	**Total Factored Resistance[1] : 399.1 kips**
Resistance from Liquefiable Soils : 194.1 kips	Resistance from Scourable Soils : 0.0 kips
Req'd Top of Pile EEI Load : 415.0 kips	Req'd Top of Pile Strength Load : 143.0 kips
Req'd Min. Driving (Factored) Resistance[2] : 609.1 kips	Req'd Min. Driving (Factored) Resistance[2] : 143.0 kips
Sufficient Resistance? : Pass	Sufficient Resistance? : Pass

1. Excludes resistance within downdrag layers
2. Includes factored downdrag load

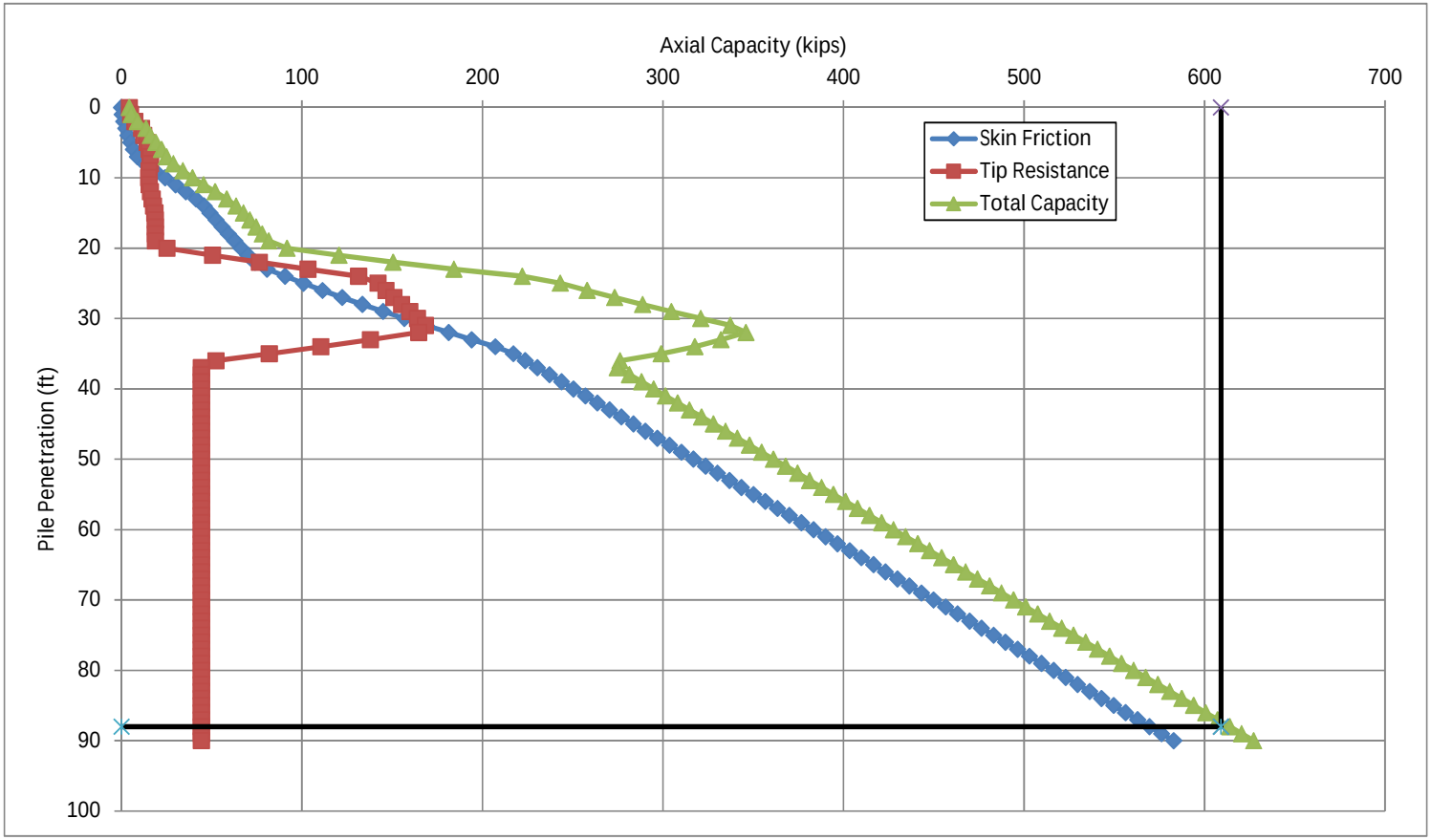
Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS
Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
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AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

END BENT 5 AXIAL LOADING: HP 14x89 STEEL PILE



Total Nominal Resistance : 614.0 kips
Estimated Pile Penetration Beneath Pile Cap : 88.0 ft
Estimated Tip Elevation : -66.6 ft

Negative Skin Friction (Permanent DD) : 0.0 kips
Resistance from Scourable Soils : 0.0 kips
Resistance from Liquefiable Soils : 194.1 kips
Pile Stick up : 0.0 ft

Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	

Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
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AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **SOUTH CAROLINA**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

APILE for Windows, Version 2019.9.3

Serial Number : 506768014

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
(c) Copyright ENSOFT, Inc., 1987-2015
All Rights Reserved

This program is licensed to :

Terracon, Inc.
APILE Global, Global License

Path to file locations : N:\Projects\2017\EN175299\Working Files\Calculations-Analyses\Final\BS\Axial\APILE\
Name of input data file : HP14x89_EBs_Bagshaw.ap9d
Name of output file : HP14x89_EBs_Bagshaw.ap9o
Name of plot output file : HP14x89_EBs_Bagshaw.ap9p

Time and Date of Analysis

Date: October 08, 2021 Time: 15:40:39

1

****
* INPUT INFORMATION *
****

HP 14x89 Axial Analysis - Bagshaw Swamp: EB1, EB2

DESIGNER : Terracon (A. Fekrat)

JOB NUMBER : EN175299

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
  Reduced Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :

H-Pile/Steel Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 202.86 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 90.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 57.00 IN.
- TIP AREA OF PILE = 202.86 IN2
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.80*	120.00	36.00	42.00**
1.40	SAND	0.80*	120.00	36.00	42.00**

1.40	SAND	0.80*	120.00	30.00	20.00**
6.40	SAND	0.80*	120.00	30.00	20.00**
6.40	CLAY	0.80*	125.00	0.00	8.00**
12.40	CLAY	0.80*	62.60	0.00	8.00**
12.40	SAND	0.80*	37.60	28.00	16.80**
21.40	SAND	0.80*	37.60	28.00	16.80**
21.40	SAND	0.80*	57.60	36.00	42.00**
33.40	SAND	0.80*	57.60	36.00	42.00**
33.40	CLAY	0.80*	52.60	0.00	8.00**
101.40	CLAY	0.80*	52.60	0.00	8.00**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
1.40	1.000	1.000
1.40	1.000	1.000
6.40	1.000	1.000
6.40	1.000	1.000
12.40	1.000	1.000

12.40	1.000	1.000
21.40	1.000	1.000
21.40	1.000	1.000
33.40	1.000	1.000
33.40	1.000	1.000
101.40	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	4.4	4.4
1.00	0.3	5.2	5.5
2.00	1.3	7.6	8.9
3.00	2.5	11.2	13.7
4.00	3.6	12.4	16.0
5.00	5.1	14.2	19.2
6.00	6.8	15.4	22.3
7.00	8.9	16.0	25.0
8.00	12.9	16.0	28.9
9.00	18.6	15.4	34.0
10.00	24.3	15.2	39.5
11.00	30.0	15.4	45.5
12.00	35.7	16.2	51.9
13.00	41.4	17.0	58.4
14.00	45.9	17.8	63.6
15.00	49.1	18.6	67.6
16.00	52.4	18.8	71.2
17.00	55.8	18.8	74.6
18.00	59.3	18.8	78.0
19.00	62.8	18.8	81.6
20.00	66.5	25.3	91.8
21.00	70.2	50.4	120.6
22.00	74.0	76.4	150.5
23.00	80.8	103.4	184.3
24.00	90.7	131.4	222.1
25.00	100.9	142.2	243.2

26.00	111.5	146.6	258.1
27.00	122.3	151.0	273.3
28.00	133.5	155.3	288.8
29.00	145.0	159.7	304.7
30.00	156.8	164.1	320.9
31.00	168.9	168.4	337.4
32.00	181.4	164.7	346.0
33.00	194.1	138.0	332.2
34.00	207.2	110.5	317.7
35.00	217.2	81.9	299.1
36.00	223.8	52.4	276.3
37.00	230.5	44.4	274.8
38.00	237.1	44.4	281.5
39.00	243.8	44.4	288.1
40.00	250.4	44.4	294.8
41.00	257.1	44.4	301.4
42.00	263.7	44.4	308.1
43.00	270.4	44.4	314.7
44.00	277.0	44.4	321.4
45.00	283.7	44.4	328.0
46.00	290.3	44.4	334.7
47.00	297.0	44.4	341.3
48.00	303.6	44.4	348.0
49.00	310.3	44.4	354.6
50.00	316.9	44.4	361.3
51.00	323.6	44.4	367.9
52.00	330.2	44.4	374.6
53.00	336.9	44.4	381.2
54.00	343.5	44.4	387.9
55.00	350.2	44.4	394.5
56.00	356.8	44.4	401.2
57.00	363.5	44.4	407.8
58.00	370.1	44.4	414.5
59.00	376.8	44.4	421.1
60.00	383.4	44.4	427.8
61.00	390.1	44.4	434.4
62.00	396.7	44.4	441.1
63.00	403.4	44.4	447.7
64.00	410.0	44.4	454.4
65.00	416.7	44.4	461.0
66.00	423.3	44.4	467.7
67.00	430.0	44.4	474.3
68.00	436.6	44.4	481.0
69.00	443.3	44.4	487.6
70.00	449.9	44.4	494.3
71.00	456.6	44.4	500.9
72.00	463.2	44.4	507.6
73.00	469.9	44.4	514.2
74.00	476.5	44.4	520.9

75.00	483.2	44.4	527.5
76.00	489.8	44.4	534.2
77.00	496.5	44.4	540.8
78.00	503.1	44.4	547.5
79.00	509.8	44.4	554.1
80.00	516.4	44.4	560.8
81.00	523.1	44.4	567.4
82.00	529.7	44.4	574.1
83.00	536.4	44.4	580.7
84.00	543.0	44.4	587.4
85.00	549.7	44.4	594.0
86.00	556.3	44.4	600.7
87.00	563.0	44.4	607.3
88.00	569.6	44.4	614.0
89.00	576.3	44.4	620.6
90.00	582.9	44.4	627.3

EB1

EB5

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.2903E-01
			0.0000E+00	0.5625E-01
			0.0000E+00	0.1034E+00
			0.0000E+00	0.1451E+00
			0.0000E+00	0.1814E+00
			0.0000E+00	0.3629E+00
			0.0000E+00	0.5443E+00
			0.0000E+00	0.9072E+00
			0.0000E+00	0.3629E+01
2	10	0.7250E+00		
			0.0000E+00	0.0000E+00
			0.2110E+00	0.2903E-01
			0.3516E+00	0.5625E-01

		0.5274E+00	0.1034E+00
		0.6329E+00	0.1451E+00
		0.7032E+00	0.1814E+00
		0.7032E+00	0.3629E+00
		0.7032E+00	0.5443E+00
		0.7032E+00	0.9072E+00
		0.7032E+00	0.3629E+01
3	10	0.1358E+01	
		0.0000E+00	0.0000E+00
		0.3953E+00	0.2903E-01
		0.6588E+00	0.5625E-01
		0.9882E+00	0.1034E+00
		0.1186E+01	0.1451E+00
		0.1318E+01	0.1814E+00
		0.1318E+01	0.3629E+00
		0.1318E+01	0.5443E+00
		0.1318E+01	0.9072E+00
		0.1318E+01	0.3629E+01
4	10	0.1400E+01	
		0.0000E+00	0.0000E+00
		0.4074E+00	0.2903E-01
		0.6790E+00	0.5625E-01
		0.1018E+01	0.1034E+00
		0.1222E+01	0.1451E+00
		0.1358E+01	0.1814E+00
		0.1358E+01	0.3629E+00
		0.1358E+01	0.5443E+00
		0.1358E+01	0.9072E+00
		0.1358E+01	0.3629E+01
5	10	0.3925E+01	
		0.0000E+00	0.0000E+00
		0.5572E+00	0.2903E-01
		0.9286E+00	0.5625E-01
		0.1393E+01	0.1034E+00
		0.1671E+01	0.1451E+00
		0.1857E+01	0.1814E+00
		0.1857E+01	0.3629E+00
		0.1857E+01	0.5443E+00
		0.1857E+01	0.9072E+00
		0.1857E+01	0.3629E+01
6	10	0.6358E+01	
		0.0000E+00	0.0000E+00
		0.9026E+00	0.2903E-01
		0.1504E+01	0.5625E-01
		0.2256E+01	0.1034E+00
		0.2708E+01	0.1451E+00
		0.3009E+01	0.1814E+00
		0.3009E+01	0.3629E+00
		0.3009E+01	0.5443E+00

		0.3009E+01	0.9072E+00
		0.3009E+01	0.3629E+01
7	10	0.6400E+01	
		0.0000E+00	0.0000E+00
		0.9085E+00	0.2903E-01
		0.1514E+01	0.5625E-01
		0.2271E+01	0.1034E+00
		0.2725E+01	0.1451E+00
		0.3028E+01	0.1814E+00
		0.2725E+01	0.3629E+00
		0.2725E+01	0.5443E+00
		0.2725E+01	0.9072E+00
		0.2725E+01	0.3629E+01
8	10	0.9425E+01	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.2903E-01
		0.4167E+01	0.5625E-01
		0.6250E+01	0.1034E+00
		0.7500E+01	0.1451E+00
		0.8333E+01	0.1814E+00
		0.7500E+01	0.3629E+00
		0.7500E+01	0.5443E+00
		0.7500E+01	0.9072E+00
		0.7500E+01	0.3629E+01
9	10	0.1236E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.2903E-01
		0.4167E+01	0.5625E-01
		0.6250E+01	0.1034E+00
		0.7500E+01	0.1451E+00
		0.8333E+01	0.1814E+00
		0.7500E+01	0.3629E+00
		0.7500E+01	0.5443E+00
		0.7500E+01	0.9072E+00
		0.7500E+01	0.3629E+01
10	10	0.1240E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.2903E-01
		0.4167E+01	0.5625E-01
		0.6250E+01	0.1034E+00
		0.7500E+01	0.1451E+00
		0.8333E+01	0.1814E+00
		0.8333E+01	0.3629E+00
		0.8333E+01	0.5443E+00
		0.8333E+01	0.9072E+00
		0.8333E+01	0.3629E+01
11	10	0.1693E+02	
		0.0000E+00	0.0000E+00
		0.1504E+01	0.2903E-01

			0.2506E+01	0.5625E-01
			0.3759E+01	0.1034E+00
			0.4511E+01	0.1451E+00
			0.5012E+01	0.1814E+00
			0.5012E+01	0.3629E+00
			0.5012E+01	0.5443E+00
			0.5012E+01	0.9072E+00
			0.5012E+01	0.3629E+01
12	10	0.2136E+02		
			0.0000E+00	0.0000E+00
			0.1669E+01	0.2903E-01
			0.2782E+01	0.5625E-01
			0.4173E+01	0.1034E+00
			0.5008E+01	0.1451E+00
			0.5564E+01	0.1814E+00
			0.5564E+01	0.3629E+00
			0.5564E+01	0.5443E+00
			0.5564E+01	0.9072E+00
			0.5564E+01	0.3629E+01
13	10	0.2140E+02		
			0.0000E+00	0.0000E+00
			0.1671E+01	0.2903E-01
			0.2785E+01	0.5625E-01
			0.4177E+01	0.1034E+00
			0.5012E+01	0.1451E+00
			0.5569E+01	0.1814E+00
			0.5569E+01	0.3629E+00
			0.5569E+01	0.5443E+00
			0.5569E+01	0.9072E+00
			0.5569E+01	0.3629E+01
14	10	0.2743E+02		
			0.0000E+00	0.0000E+00
			0.4889E+01	0.2903E-01
			0.8149E+01	0.5625E-01
			0.1222E+02	0.1034E+00
			0.1467E+02	0.1451E+00
			0.1630E+02	0.1814E+00
			0.1630E+02	0.3629E+00
			0.1630E+02	0.5443E+00
			0.1630E+02	0.9072E+00
			0.1630E+02	0.3629E+01
15	10	0.3336E+02		
			0.0000E+00	0.0000E+00
			0.5718E+01	0.2903E-01
			0.9530E+01	0.5625E-01
			0.1430E+02	0.1034E+00
			0.1715E+02	0.1451E+00
			0.1906E+02	0.1814E+00
			0.1906E+02	0.3629E+00

			0.1906E+02	0.5443E+00
			0.1906E+02	0.9072E+00
			0.1906E+02	0.3629E+01
16	10	0.3340E+02		
			0.0000E+00	0.0000E+00
			0.5724E+01	0.2903E-01
			0.9540E+01	0.5625E-01
			0.1431E+02	0.1034E+00
			0.1717E+02	0.1451E+00
			0.1908E+02	0.1814E+00
			0.1717E+02	0.3629E+00
			0.1717E+02	0.5443E+00
			0.1717E+02	0.9072E+00
			0.1717E+02	0.3629E+01
17	10	0.6743E+02		
			0.0000E+00	0.0000E+00
			0.2917E+01	0.2903E-01
			0.4861E+01	0.5625E-01
			0.7292E+01	0.1034E+00
			0.8750E+01	0.1451E+00
			0.9722E+01	0.1814E+00
			0.8750E+01	0.3629E+00
			0.8750E+01	0.5443E+00
			0.8750E+01	0.9072E+00
			0.8750E+01	0.3629E+01
18	10	0.1014E+03		
			0.0000E+00	0.0000E+00
			0.2917E+01	0.2903E-01
			0.4861E+01	0.5625E-01
			0.7292E+01	0.1034E+00
			0.8750E+01	0.1451E+00
			0.9722E+01	0.1814E+00
			0.8750E+01	0.3629E+00
			0.8750E+01	0.5443E+00
			0.8750E+01	0.9072E+00
			0.8750E+01	0.3629E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.2773E+01	0.9072E-02
0.5547E+01	0.1814E-01
0.1109E+02	0.3629E-01
0.2219E+02	0.2359E+00
0.3328E+02	0.7620E+00
0.3994E+02	0.1324E+01

0.4438E+02	0.1814E+01
0.4438E+02	0.2722E+01
0.4438E+02	0.3629E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7523E+00	0.1715E-03	0.3057E-01	0.1000E-03
0.7523E+01	0.1715E-02	0.3057E+00	0.1000E-02
0.3762E+02	0.8574E-02	0.1529E+01	0.5000E-02
0.7523E+02	0.1715E-01	0.3057E+01	0.1000E-01
0.1503E+03	0.3430E-01	0.6114E+01	0.2000E-01
0.3082E+03	0.7999E-01	0.1186E+02	0.5000E-01
0.4129E+03	0.1202E+00	0.1352E+02	0.8000E-01
0.4718E+03	0.1462E+00	0.1464E+02	0.1000E+00
0.5963E+03	0.2600E+00	0.2019E+02	0.2000E+00
0.5694E+03	0.5572E+00	0.2776E+02	0.5000E+00
0.5753E+03	0.8583E+00	0.3373E+02	0.8000E+00
0.5777E+03	0.1059E+01	0.3610E+02	0.1000E+01
0.5860E+03	0.2060E+01	0.4438E+02	0.2000E+01

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT Project ID:	P030260
Date:	10/8/2021

Settlement of Bridge Foundations at Service Limit State: End Bent 1

Total settlement of a pile can be estimated as

$\Delta_v = S_t = S_i+S_c+S_s+\Delta_E$ Eq 16-6 (SCDOT GDM 2019)

$\Delta_E = Q_aL/(AE)$ Eq 16-7 (SCDOT GDM 2019)

Pile type: HP 14x89

Pile Section:	HP
Pile size (in):	14.0
E (ksi):	29,000

Elastic Compression

Construction Stage	Pile Section	Length(ft)	Area (in^2)	Q_a (kips)	Δ_E (in)
Construction	HP	87	26.1	143	0.20

Pile Group Settlement

10.7.2.3.2 of AASHTO LRFD Bridge Design Spec., 2017.

L (ft):	68.8	Length of Pile Cap
B (ft):	1.2	Smallest dimension of pile group

Number of piles per construction stage: 9

D_b (ft):	53.6	Embedment into the Bearing Layer
D' (ft):	35.7	

$$\rho = \frac{qI\sqrt{B}}{(N_1)_{60}}$$

Eq. 10.7.2.3.2-1 (AASHTO LRFD, 2017)

$$I = 1 - 0.125\frac{D'}{B} \geq 0.5$$

Eq. 10.7.2.3.2-3 (AASHTO LRFD, 2017)

Construction Stage	I	$(N_1)_{60}$ [1]	q (ksf)	ρ (in)	Total Settlement (in)
Construction	0.50	32	16.28	0.27	0.47

Notes: 1. $(N_1)_{60}$ values are an average calculated using values in Appendix C-3

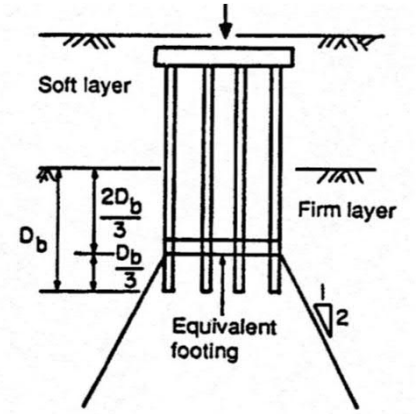


Figure 10.7.2.3.1-2 Location of Eq. Footing (AASHTO LRFD Bridge Design Spec., 2017)

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT Project ID:	P030260
Date:	10/8/2021

Settlement of Bridge Foundations at Service Limit State: End Bent 5

Total settlement of a pile can be estimated as

$\Delta_v = S_t = S_i+S_c+S_s+\Delta_E$ Eq 16-6 (SCDOT GDM 2019)

$\Delta_E = Q_aL/(AE)$ Eq 16-7 (SCDOT GDM 2019)

Pile type: HP 14x89

Pile Section:	HP
Pile size (in):	14.0
E (ksi):	29,000

Elastic Compression

Construction Stage	Pile Section	Length(ft)	Area (in^2)	Q_a (kips)	Δ_E (in)
Construction	HP	88	26.1	143	0.20

Pile Group Settlement

10.7.2.3.2 of AASHTO LRFD Bridge Design Spec., 2017.

L (ft):	68.8	Length of Pile Cap
B (ft):	1.2	Smallest dimension of pile group

Number of piles per construction stage: 9

D_b (ft):	54.6	Embedment into the Bearing Layer
D' (ft):	36.4	

$$\rho = \frac{qI\sqrt{B}}{(N_1)_{60}}$$

Eq. 10.7.2.3.2-1 (AASHTO LRFD, 2017)

$$I = 1 - 0.125\frac{D'}{B} \geq 0.5$$

Eq. 10.7.2.3.2-3 (AASHTO LRFD, 2017)

Construction Stage	I	$(N_1)_{60}$ [1]	q (ksf)	ρ (in)	Total Settlement (in)
Construction	0.50	32	16.28	0.27	0.47

Notes: 1. $(N_1)_{60}$ values are an average calculated using values in Appendix C-3

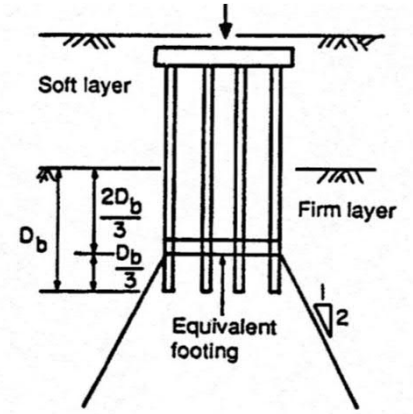


Figure 10.7.2.3.1-2 Location of Eq. Footing (AASHTO LRFD Bridge Design Spec., 2017)

APILE Results and Pile Settlement
Interior Bents 2, 3, and 4

Axial Capacity Analysis – Interior Bents 2, 3, 4

Analysis Methodology	
Analysis Type	Axial Capacity and Settlement of Driven Piles
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	Interior Bents 2, 3, 4
Soil Boring Model	Refer to Exhibit C-3 for Subsurface Soil Parameters and soil column stratigraphy changes with respect to depth and elevation
Analysis Method	Axial capacities of driven piles were calculated using the computer software APILE 2019 by Ensoft. The FHWA analysis method was used in APILE which generally follows the methods outlined in Section 10 of the AASHTO *LRFD Bridge Design Specifications*. APILE uses soil strength parameters to estimate the pile's side friction and end resistance. The soil strength parameters are estimated based on index properties such as fines content, Atterberg limits, and $N_{1,60}$ values per SCDOT GDM Chapter 7. The APILE output file is attached to Analysis Methodology Summary.
Design Notes	• Calculated axial capacities are factored resistances. APILE output presents unfactored resistances. • The efficiency factor η for reducing the pile group capacity based on spacing for the trestle bent is determined based on Section 16.3.3 of GDM. Nominal spacing (7'-9") (Exhibit C-4) divided by pile diameter (or width 20") = 4.65 > 2.5 => η = 1.0 • Concrete Modulus of Elasticity is 3,605,000 psi. • Side resistance above the hard bearing layer (Elev. -12 ft NAVD88) is included as a driving force upon the pile when estimating the liquefaction downdrag load. • For conservative purposes, the liquefaction downdrag load has been estimated based on peak static effective strength properties and total unit weights for estimating post-liquefaction downdrag loads. • Static Downdrag loads were not considered in the axial capacity of the piles. As seen in boring logs, the soils above bearing layer is primarily sands and significant fill is not expected (Exhibit C-4).
Design Vertical Loads	• Service Load used for Settlement = 231.2 kips (Exhibit C-4 – same as Strength assumed) • Required Factored Strength Load at top of pile = 231.2 kips (Exhibit C-4) • Required Extreme Event Vertical Dead Load = 90 kips (IB2), 50 kips (IB3), 100 kips (IB4). (Exhibit C-4) • Extreme Event II was not evaluated. Per coordination with Structural Engineer, the check flood (500-yr flow event) will pass by inspection.
Scour	As seen on plans (Exhibit C-4), scour has been included as follows: 100-Year Scour Profile: Elev. 11 ft (Used for scour analysis under Strength Loads) 500-Year Scour Profile: Elev. 9 ft.
Resistance Factor	Φ=0.65 from SCDOT GDM, Section 9.5.1, Table 9-2
Load Factors	γ = 1.0 for Liquefaction Downdrag Load (SCDOT GDM, Section 8.7, Table 8-5) γ = 1.4 for Permanent Downdrag Load (SCDOT GDM, Section 8.7, Table 8-6)
Site Variability	Refer to attached site variability calculation sheet for definition. For each strata encountered in soil test borings listed above an average N_{60} value, Standard Deviation, and Coefficient of Variation (COV) are estimated.

Pile Input Parameters				
Pile Type	**Tip Area**	**Top of Pile Elevation**	**Perimeter Analysis**	**Tip Analysis**
PSC 20-inch Concrete	400 in^2	22 (0 feet as input)	Box Perimeter = 80 in	Box Area = 400 in^2

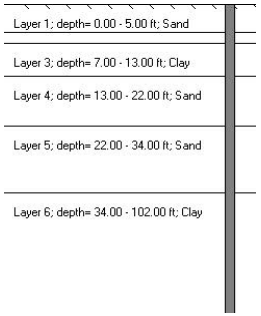
INTERIOR BENT 2 AXIAL LOADING: PSC 20-INCH CONCRETE PILE

Pavement Elev. : 28.0 ft
Top of Pile/Load Elev. : 22.0 ft
Top of Bearing Layer : -12.0 ft
Groundwater Elev.: 15.0 ft

Subsurface Model : See Exhibit C-3
Mudline Elev. 17.0 ft
100-yr Scour Elev. : 11.0 ft

Layer Name	Model	Permanent Downdrag?	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)
			APILE INPUT						
Existing FILL	Sand	No	5.0	7.0	17.0	15.0	120	30	--
ALLUVIUM	Clay	No	7.0	13.0	15.0	9.0	125 - 62.6	--	1.2
	Sand	No	13.0	22.0	9.0	0.0	37.6	28	--
	Sand	No	22.0	34.0	0.0	-12.0	57.6	36	--
	Clay	No	34.0	102.0	-12.0	-80.0	52.6	--	3.5

A Reduction factor of 1E-14 was introduced for the top 5 feet to model the stick-up length of pile.



Modeled Pile Embedment into the Bearing Layer : 16.0 ft
Estimated Tip Elevation : -28.0 ft
Estimated Pile Length : 50.0 ft

Zero Friction Length above Scour Elev. : 11.0 ft = Top of Pile Elev. - 100-yr Scour Elev.
Liquefied Soil Thickness : 27.0 ft = Groundwater Elev. - Top of Bearing Layer

EARTHQUAKE

Nominal Side Resistance : 524.1 kips
Nominal Tip Resistance : 87.5 kips
Resistance Factor : 1.00

Unfactored Liquefaction Downdrag Load : 286.9 kips
Downdrag Load Factor : 1.00

Total Nominal Resistance[1] : 611.6 kips
Total Factored Resistance[1] : 611.6 kips

Resistance from Liquefiable Soils : 286.9 kips
Req'd Top of Pile EEI Load : 90.0 kips
Req'd Min. Driving (Factored) Resistance[2] : 376.9 kips
Sufficient Resistance? : Pass

STRENGTH

Nominal Side Resistance : 524.1 kips
Nominal Tip Resistance : 87.5 kips
Resistance Factor : 0.65

Unfactored Permanent Downdrag Load : 0.0 kips
Downdrag Load Factor : 1.40

Total Nominal Resistance[1] : 611.6 kips
Total Factored Resistance[1] : 373.6 kips

Resistance from Scourable Soils : 36.9 kips
Req'd Top of Pile Strength Load : 231.2 kips
Req'd Min. Driving (Factored) Resistance[2] : 268.1 kips
Sufficient Resistance? : Pass

1. Excludes resistance within downdrag layers
2. Includes factored downdrag load

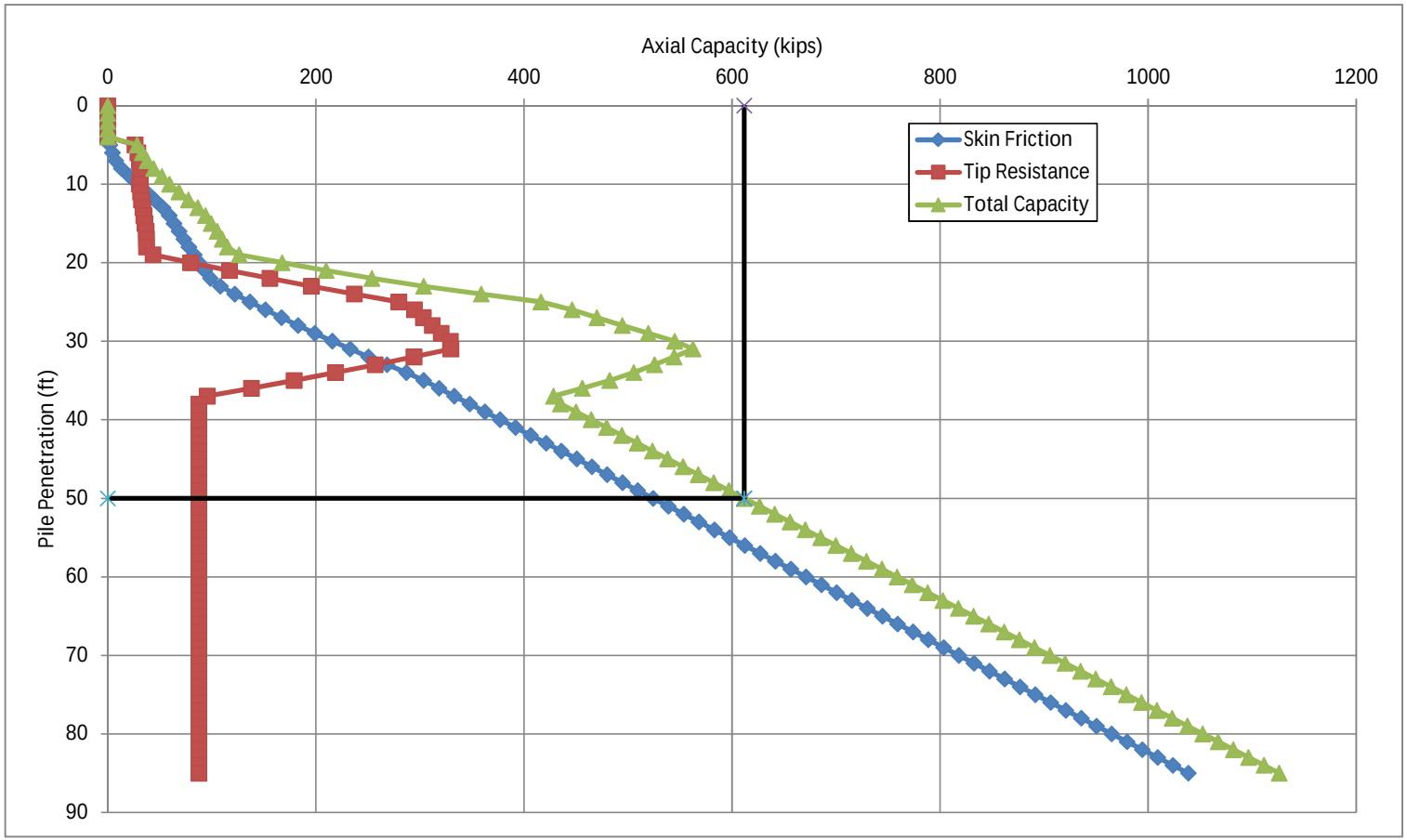
Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS
Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

INTERIOR BENT 2 AXIAL LOADING: PSC 20-INCH CONCRETE PILE



Total Nominal Resistance : 611.6 kips
Estimated Pile Penetration Beneath Pile Cap : 50.0 ft
Estimated Tip Elevation : -28.0 ft

Negative Skin Friction (Permanent DD) : 0.0 kips
Resistance from Scourable Soils : 36.9 kips
Resistance from Liquefiable Soils : 286.9 kips
Pile Stick up : 5.0 ft

Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	

Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **SOUTH CAROLINA**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

APILE for Windows, Version 2019.9.3

Serial Number : 506768014

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.

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This program is licensed to :

Terracon, Inc.
APILE Global, Global License

Path to file locations : C:\Users\aqfekrat\OneDrive - Terracon Consultants Inc\Documents\Temporary\EN175299\BS\Axial\APILE\
Name of input data file : PSC SQ 20_IB2_Bagshaw.ap9d
Name of output file : PSC SQ 20_IB2_Bagshaw.ap9o
Name of plot output file : PSC SQ 20_IB2_Bagshaw.ap9p

Time and Date of Analysis

Date: July 27, 2021 Time: 09:13:04

1

****
* INPUT INFORMATION *
****

I-95 BRO Bagshaw Swamp - Interior Bent 2

DESIGNER : Terracon (A. Fekrat)

JOB NUMBER : EN175299

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
  Reduced Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :

Precast concrete pile (Square/Rectangular/Orthogonal)

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.360E+07 PSI
- CROSS SECTION AREA = 400.00 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 85.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 80.00 IN.
- TIP AREA OF PILE = 400.00 IN2
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.80*	120.00	30.00	20.00**
5.00	SAND	0.80*	120.00	30.00	20.00**

5.00	SAND	0.80*	120.00	30.00	20.00**
7.00	SAND	0.80*	120.00	30.00	20.00**
7.00	CLAY	0.80*	125.00	0.00	8.00**
13.00	CLAY	0.80*	62.60	0.00	8.00**
13.00	SAND	0.80*	37.60	28.00	16.80**
22.00	SAND	0.80*	37.60	28.00	16.80**
22.00	SAND	0.80*	57.60	36.00	42.00**
34.00	SAND	0.80*	57.60	36.00	42.00**
34.00	CLAY	0.80*	52.60	0.00	8.00**
102.00	CLAY	0.80*	52.60	0.00	8.00**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	0.000	0.000
5.00	0.000	0.000
5.00	1.000	1.000
7.00	1.000	1.000
7.00	1.000	1.000
13.00	1.000	1.000

13.00	1.000	1.000
22.00	1.000	1.000
22.00	1.000	1.000
34.00	1.000	1.000
34.00	1.000	1.000
102.00	1.000	1.000

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****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0	0.0
1.00	0.0	0.0	0.0
2.00	0.0	0.0	0.0
3.00	0.0	0.0	0.0
4.00	0.0	0.0	0.0
5.00	2.0	26.1	28.1
6.00	4.4	28.7	33.1
7.00	7.3	30.4	37.7
8.00	12.9	31.2	44.0
9.00	20.9	31.0	51.9
10.00	28.9	30.4	59.3
11.00	36.9	31.3	68.2
12.00	44.9	32.4	77.3
13.00	52.9	33.5	86.4
14.00	59.1	34.6	93.7
15.00	63.6	35.7	99.3
16.00	68.2	36.8	105.0
17.00	72.9	37.0	109.9
18.00	77.8	37.0	114.8
19.00	82.8	43.4	126.2
20.00	87.8	79.4	167.3
21.00	93.0	116.8	209.8
22.00	98.4	155.5	253.8
23.00	108.0	195.5	303.5
24.00	122.0	236.9	358.9
25.00	136.5	279.7	416.2

26.00	151.4	294.7	446.1
27.00	166.8	303.3	470.1
28.00	182.7	311.9	494.5
29.00	198.9	320.5	519.4
30.00	215.6	329.1	544.7
31.00	232.8	329.7	562.5
32.00	250.4	294.1	544.4
33.00	268.4	257.0	525.5
34.00	286.9	218.7	505.6
35.00	303.6	178.9	482.5
36.00	318.3	137.9	456.1
37.00	333.0	95.4	428.4
38.00	347.7	87.5	435.2
39.00	362.4	87.5	449.9
40.00	377.1	87.5	464.6
41.00	391.8	87.5	479.3
42.00	406.5	87.5	494.0
43.00	421.2	87.5	508.7
44.00	435.9	87.5	523.4
45.00	450.6	87.5	538.1
46.00	465.3	87.5	552.8
47.00	480.0	87.5	567.5
48.00	494.7	87.5	582.2
49.00	509.4	87.5	596.9
50.00	524.1	87.5	611.6
51.00	538.8	87.5	626.3
52.00	553.5	87.5	641.0
53.00	568.2	87.5	655.7
54.00	582.9	87.5	670.4
55.00	597.6	87.5	685.1
56.00	612.3	87.5	699.8
57.00	627.0	87.5	714.5
58.00	641.7	87.5	729.2
59.00	656.4	87.5	743.9
60.00	671.1	87.5	758.6
61.00	685.8	87.5	773.3
62.00	700.5	87.5	788.0
63.00	715.2	87.5	802.7
64.00	729.9	87.5	817.4
65.00	744.6	87.5	832.1
66.00	759.2	87.5	846.7
67.00	773.9	87.5	861.4
68.00	788.6	87.5	876.1
69.00	803.3	87.5	890.8
70.00	818.0	87.5	905.5
71.00	832.7	87.5	920.2
72.00	847.4	87.5	934.9
73.00	862.1	87.5	949.6
74.00	876.8	87.5	964.3

75.00	891.5	87.5	979.0
76.00	906.2	87.5	993.7
77.00	920.9	87.5	1008.4
78.00	935.6	87.5	1023.1
79.00	950.3	87.5	1037.8
80.00	965.0	87.5	1052.5
81.00	979.7	87.5	1067.2
82.00	994.4	87.5	1081.9
83.00	1009.1	87.5	1096.6
84.00	1023.8	87.5	1111.3
85.00	1038.5	87.5	1126.0

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.4074E-01
			0.0000E+00	0.7894E-01
			0.0000E+00	0.1451E+00
			0.0000E+00	0.2037E+00
			0.0000E+00	0.2546E+00
			0.0000E+00	0.5093E+00
			0.0000E+00	0.7639E+00
			0.0000E+00	0.1273E+01
			0.0000E+00	0.5093E+01
2	10	0.2525E+01		
			0.0000E+00	0.0000E+00
			0.3496E+00	0.4074E-01
			0.5827E+00	0.7894E-01
			0.8741E+00	0.1451E+00
			0.1049E+01	0.2037E+00
			0.1165E+01	0.2546E+00
			0.1165E+01	0.5093E+00
			0.1165E+01	0.7639E+00

		0.1165E+01	0.1273E+01
		0.1165E+01	0.5093E+01
3	10	0.4958E+01	
		0.0000E+00	0.0000E+00
		0.6866E+00	0.4074E-01
		0.1144E+01	0.7894E-01
		0.1716E+01	0.1451E+00
		0.2060E+01	0.2037E+00
		0.2289E+01	0.2546E+00
		0.2289E+01	0.5093E+00
		0.2289E+01	0.7639E+00
		0.2289E+01	0.1273E+01
		0.2289E+01	0.5093E+01
4	10	0.5000E+01	
		0.0000E+00	0.0000E+00
		0.6923E+00	0.4074E-01
		0.1154E+01	0.7894E-01
		0.1731E+01	0.1451E+00
		0.2077E+01	0.2037E+00
		0.2308E+01	0.2546E+00
		0.2308E+01	0.5093E+00
		0.2308E+01	0.7639E+00
		0.2308E+01	0.1273E+01
		0.2308E+01	0.5093E+01
5	10	0.6025E+01	
		0.0000E+00	0.0000E+00
		0.8342E+00	0.4074E-01
		0.1390E+01	0.7894E-01
		0.2086E+01	0.1451E+00
		0.2503E+01	0.2037E+00
		0.2781E+01	0.2546E+00
		0.2781E+01	0.5093E+00
		0.2781E+01	0.7639E+00
		0.2781E+01	0.1273E+01
		0.2781E+01	0.5093E+01
6	10	0.6958E+01	
		0.0000E+00	0.0000E+00
		0.9635E+00	0.4074E-01
		0.1606E+01	0.7894E-01
		0.2409E+01	0.1451E+00
		0.2890E+01	0.2037E+00
		0.3212E+01	0.2546E+00
		0.3212E+01	0.5093E+00
		0.3212E+01	0.7639E+00
		0.3212E+01	0.1273E+01
		0.3212E+01	0.5093E+01
7	10	0.7000E+01	
		0.0000E+00	0.0000E+00
		0.9693E+00	0.4074E-01

		0.1615E+01	0.7894E-01
		0.2423E+01	0.1451E+00
		0.2908E+01	0.2037E+00
		0.3231E+01	0.2546E+00
		0.2908E+01	0.5093E+00
		0.2908E+01	0.7639E+00
		0.2908E+01	0.1273E+01
		0.2908E+01	0.5093E+01
8	10	0.1003E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.7500E+01	0.5093E+00
		0.7500E+01	0.7639E+00
		0.7500E+01	0.1273E+01
		0.7500E+01	0.5093E+01
9	10	0.1296E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.7500E+01	0.5093E+00
		0.7500E+01	0.7639E+00
		0.7500E+01	0.1273E+01
		0.7500E+01	0.5093E+01
10	10	0.1300E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.8333E+01	0.5093E+00
		0.8333E+01	0.7639E+00
		0.8333E+01	0.1273E+01
		0.8333E+01	0.5093E+01
11	10	0.1753E+02	
		0.0000E+00	0.0000E+00
		0.1517E+01	0.4074E-01
		0.2528E+01	0.7894E-01
		0.3792E+01	0.1451E+00
		0.4551E+01	0.2037E+00
		0.5057E+01	0.2546E+00
		0.5057E+01	0.5093E+00

			0.5057E+01	0.7639E+00
			0.5057E+01	0.1273E+01
			0.5057E+01	0.5093E+01
12	10	0.2196E+02		
			0.0000E+00	0.0000E+00
			0.1678E+01	0.4074E-01
			0.2796E+01	0.7894E-01
			0.4194E+01	0.1451E+00
			0.5033E+01	0.2037E+00
			0.5593E+01	0.2546E+00
			0.5593E+01	0.5093E+00
			0.5593E+01	0.7639E+00
			0.5593E+01	0.1273E+01
			0.5593E+01	0.5093E+01
13	10	0.2200E+02		
			0.0000E+00	0.0000E+00
			0.1679E+01	0.4074E-01
			0.2799E+01	0.7894E-01
			0.4198E+01	0.1451E+00
			0.5038E+01	0.2037E+00
			0.5598E+01	0.2546E+00
			0.5598E+01	0.5093E+00
			0.5598E+01	0.7639E+00
			0.5598E+01	0.1273E+01
			0.5598E+01	0.5093E+01
14	10	0.2803E+02		
			0.0000E+00	0.0000E+00
			0.5018E+01	0.4074E-01
			0.8363E+01	0.7894E-01
			0.1254E+02	0.1451E+00
			0.1505E+02	0.2037E+00
			0.1673E+02	0.2546E+00
			0.1673E+02	0.5093E+00
			0.1673E+02	0.7639E+00
			0.1673E+02	0.1273E+01
			0.1673E+02	0.5093E+01
15	10	0.3396E+02		
			0.0000E+00	0.0000E+00
			0.5839E+01	0.4074E-01
			0.9731E+01	0.7894E-01
			0.1460E+02	0.1451E+00
			0.1752E+02	0.2037E+00
			0.1946E+02	0.2546E+00
			0.1946E+02	0.5093E+00
			0.1946E+02	0.7639E+00
			0.1946E+02	0.1273E+01
			0.1946E+02	0.5093E+01
16	10	0.3400E+02		
			0.0000E+00	0.0000E+00

			0.5845E+01	0.4074E-01
			0.9741E+01	0.7894E-01
			0.1461E+02	0.1451E+00
			0.1753E+02	0.2037E+00
			0.1948E+02	0.2546E+00
			0.1753E+02	0.5093E+00
			0.1753E+02	0.7639E+00
			0.1753E+02	0.1273E+01
			0.1753E+02	0.5093E+01
17	10	0.6803E+02		
			0.0000E+00	0.0000E+00
			0.4593E+01	0.4074E-01
			0.7655E+01	0.7894E-01
			0.1148E+02	0.1451E+00
			0.1378E+02	0.2037E+00
			0.1531E+02	0.2546E+00
			0.1378E+02	0.5093E+00
			0.1378E+02	0.7639E+00
			0.1378E+02	0.1273E+01
			0.1378E+02	0.5093E+01
18	10	0.1020E+03		
			0.0000E+00	0.0000E+00
			0.4593E+01	0.4074E-01
			0.7655E+01	0.7894E-01
			0.1148E+02	0.1451E+00
			0.1378E+02	0.2037E+00
			0.1531E+02	0.2546E+00
			0.1378E+02	0.5093E+00
			0.1378E+02	0.7639E+00
			0.1378E+02	0.1273E+01
			0.1378E+02	0.5093E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5469E+01	0.1273E-01
0.1094E+02	0.2546E-01
0.2187E+02	0.5093E-01
0.4375E+02	0.3310E+00
0.6562E+02	0.1070E+01
0.7875E+02	0.1859E+01
0.8750E+02	0.2546E+01
0.8750E+02	0.3820E+01
0.8750E+02	0.5093E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1681E+01	0.6561E-03	0.4295E-01	0.1000E-03
0.1681E+02	0.6561E-02	0.4295E+00	0.1000E-02
0.8502E+02	0.3301E-01	0.2148E+01	0.5000E-02
0.1687E+03	0.6607E-01	0.4295E+01	0.1000E-01
0.3144E+03	0.1284E+00	0.8590E+01	0.2000E-01
0.6071E+03	0.2736E+00	0.2148E+02	0.5000E-01
0.7678E+03	0.3723E+00	0.2415E+02	0.8000E-01
0.8435E+03	0.4270E+00	0.2571E+02	0.1000E+00
0.1035E+04	0.6303E+00	0.3352E+02	0.2000E+00
0.1012E+04	0.9247E+00	0.4875E+02	0.5000E+00
0.1021E+04	0.1231E+01	0.5764E+02	0.8000E+00
0.1027E+04	0.1435E+01	0.6357E+02	0.1000E+01
0.1044E+04	0.2447E+01	0.8055E+02	0.2000E+01

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT Project ID:	P030260
Date:	10/8/2021

Settlement of Bridge Foundations at Service Limit State: Interior Bent 2

Total settlement of a pile can be estimated as

$\Delta_v = S_t = S_i+S_c+S_s+\Delta_E$ Eq 16-6 (SCDOT GDM 2019)

$\Delta_E = Q_aL/(AE)$ Eq 16-7 (SCDOT GDM 2019)

Pile type: PSC 20-inch

Pile Section:	SQ
Pile size (in):	20.0
E (ksi):	3,605

Elastic Compression

Construction Stage	Pile Section	Length(ft)	Area (in^2)	Q_a (kips)	Δ_E (in)
Construction	PSC SQ	50	400	231.2	0.10

Pile Group Settlement

10.7.2.3.2 of AASHTO LRFD Bridge Design Spec., 2017.

L (ft): 68.8 Length of Pile Cap

B (ft): 1.7 Smallest dimension of pile group

Number of piles per construction stage: 9

D_b (ft): 16.0 Embedment into the Bearing Layer

D' (ft): 10.7

$$\rho = \frac{qI\sqrt{B}}{(N_1)_{60}}$$

Eq. 10.7.2.3.2-1 (AASHTO LRFD, 2017)

$$I = 1 - 0.125\frac{D'}{B} \geq 0.5$$

Eq. 10.7.2.3.2-3 (AASHTO LRFD, 2017)

Construction Stage	I	$(N_1)_{60}$ [1]	q (ksf)	ρ (in)	Total Settlement (in)
Construction	0.50	32	18.16	0.37	0.47

Notes: 1. $(N_1)_{60}$ values are an average calculated using values in Appendix C-3

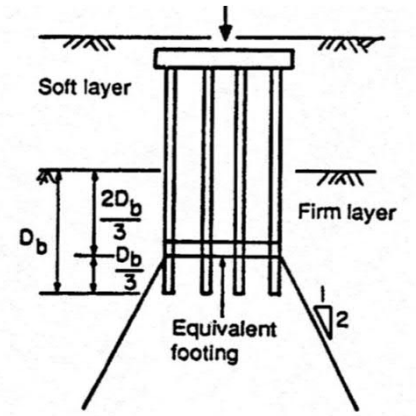


Figure 10.7.2.3.1-2 Location of Eq. Footing (AASHTO LRFD Bridge Design Spec., 2017)

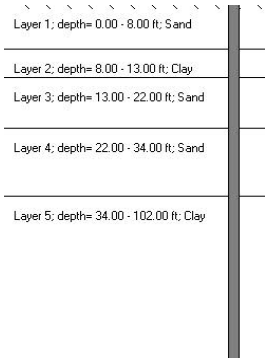
INTERIOR BENT 3 AXIAL LOADING: PSC 20-INCH CONCRETE PILE

Pavement Elev. :	28.0 ft	Subsurface Model :	See Exhibit C-3
Top of Pile/Load Elev. :	22.0 ft	Mudline Elev.	14.0 ft
Top of Bearing Layer :	-12.0 ft	100-yr Scour Elev. :	11.0 ft
Groundwater Elev.:	15.0 ft		

APILE INPUT

Layer Name	Model	Permanent Downdrag?	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)
ALLUVIUM	Clay	No	8.0	13.0	14.0	9.0	125 - 62.6	--	1.2
	Sand	No	13.0	22.0	9.0	0.0	37.6	28	--
	Sand	No	22.0	34.0	0.0	-12.0	57.6	36	--
	Clay	No	34.0	102.0	-12.0	-80.0	52.6	--	3.5

A Reduction factor of 1E-14 was introduced for the top 8 feet to model the stick-up length of pile.



Modeled Pile Embedment into the Bearing Layer : 16.0 ft
Estimated Tip Elevation : -28.0 ft
Estimated Pile Length : 50.0 ft

Zero Friction Length above Scour Elev. : N.A. = Top of Pile Elev. - 100-yr Scour Elev.
Liquefied Soil Thickness : 27.0 ft = Groundwater Elev. - Top of Bearing Layer

EARTHQUAKE

Nominal Side Resistance : 518.4 kips
Nominal Tip Resistance : 87.5 kips
Resistance Factor : 1.00

Unfactored Liquefaction Downdrag Load : 278.2 kips
Downdrag Load Factor : 1.00

Total Nominal Resistance[1] : 605.9 kips
Total Factored Resistance[1] : 605.9 kips

Resistance from Liquefiable Soils : 278.2 kips
Req'd Top of Pile EEI Load : 50.0 kips
Req'd Min. Driving (Factored) Resistance[2] : 328.2 kips
Sufficient Resistance? : Pass

STRENGTH

Nominal Side Resistance : 518.4 kips
Nominal Tip Resistance : 87.5 kips
Resistance Factor : 0.65

Unfactored Permanent Downdrag Load : 0.0 kips
Downdrag Load Factor : 1.40

Total Nominal Resistance[1] : 605.9 kips
Total Factored Resistance[1] : 377.5 kips

Resistance from Scourable Soils : 25.1 kips
Req'd Top of Pile Strength Load : 231.2 kips
Req'd Min. Driving (Factored) Resistance[2] : 256.3 kips
Sufficient Resistance? : Pass

1. Excludes resistance within downdrag layers
2. Includes factored downdrag load

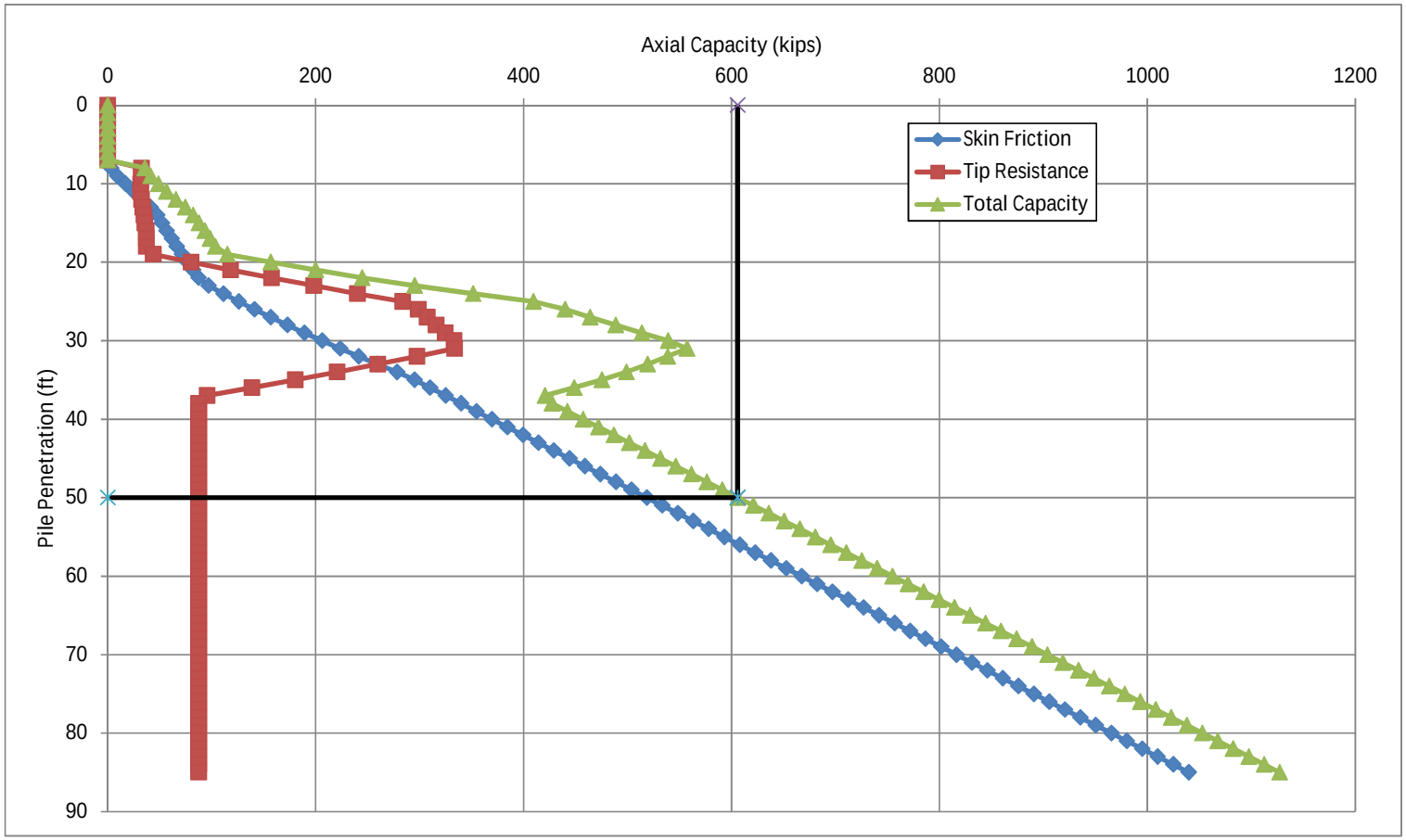
Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS
Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

INTERIOR BENT 3 AXIAL LOADING: PSC 20-INCH CONCRETE PILE



Total Nominal Resistance : 605.9 kips
Estimated Pile Penetration Beneath Pile Cap : 50.0 ft
Estimated Tip Elevation : -28.0 ft

Negative Skin Friction (Permanent DD) : 0.0 kips
Resistance from Scourable Soils : 25.1 kips
Resistance from Liquefiable Soils : 278.2 kips
Pile Stick up : 8.0 ft

Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	

Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **SOUTH CAROLINA**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

```
==========================================================================

                 APILE for Windows, Version 2019.9.3

                  Serial Number :  506768014

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                 (c) Copyright ENSOFT, Inc., 1987-2015
                       All Rights Reserved

==========================================================================

     This program is licensed to :

     Terracon, Inc.
     APILE Global, Global License

     Path to file locations      : C:\Users\aqfekrat\OneDrive - Terracon Consultants
Inc\Documents\Temporary\EN175299\BS\Axial\APILE\
     Name of input data file     : PSC SQ 20_IB3_Bagshaw.ap9d
     Name of output file         : PSC SQ 20_IB3_Bagshaw.ap9o
     Name of plot output file    : PSC SQ 20_IB3_Bagshaw.ap9p

     --------------------------------------------------------------------
                         Time and Date of Analysis
     --------------------------------------------------------------------

               Date:  July 27, 2021     Time:  09:16:25


1
          *********************
          * INPUT INFORMATION *
          *********************


          I-95 BRO Bagshaw Swamp - Interior Bent 3

          DESIGNER   : Terracon (A. Fekrat)

          JOB NUMBER : EN175299


          METHOD FOR UNIT LOAD TRANSFERS :
```



```
- FHWA (Federal Highway Administration)
  Reduced Unit Side Friction and Unit Side Resistance are used.


COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)


TYPE OF LOADING :
- COMPRESSION


PILE TYPE :

Precast concrete pile (Square/Rectangular/Orthogonal)


DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.360E+07 PSI
- CROSS SECTION AREA        =    400.00 IN2


NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL     =     85.00 FT.
- BATTER ANGLE              =      0.00 DEG
- PILE STICKUP LENGTH, PSL  =      0.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- PERIMETER OF PILE         =     80.00 IN.
- TIP AREA OF PILE          =    400.00 IN2
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.


SOIL INFORMATIONS :
```

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.80*	120.00	30.00	20.00**
8.00	SAND	0.80*	120.00	30.00	20.00**

8.00	CLAY	0.80*	125.00	0.00	8.00**
13.00	CLAY	0.80*	62.60	0.00	8.00**
13.00	SAND	0.80*	37.60	28.00	16.80**
22.00	SAND	0.80*	37.60	28.00	16.80**
22.00	SAND	0.80*	57.60	36.00	42.00**
34.00	SAND	0.80*	57.60	36.00	42.00**
34.00	CLAY	0.80*	52.60	0.00	8.00**
102.00	CLAY	0.80*	52.60	0.00	8.00**

```
*  VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE
```

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00

```
* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.
```

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	0.000	0.000
8.00	0.000	0.000
8.00	1.000	1.000
13.00	1.000	1.000
13.00	1.000	1.000
22.00	1.000	1.000
22.00	1.000	1.000
34.00	1.000	1.000
34.00	1.000	1.000
102.00	1.000	1.000


```
1
          *********************
          * COMPUTATION RESULT *
          *********************


                    **********************
                    *  FED. HWY. METHOD  *
                    **********************
```

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0	0.0
1.00	0.0	0.0	0.0
2.00	0.0	0.0	0.0
3.00	0.0	0.0	0.0
4.00	0.0	0.0	0.0
5.00	0.0	0.0	0.0
6.00	0.0	0.0	0.0
7.00	0.0	0.0	0.0
8.00	3.3	32.3	35.6
9.00	9.1	32.1	41.2
10.00	17.1	31.5	48.6
11.00	25.1	31.5	56.6
12.00	33.1	32.4	65.5
13.00	41.1	33.5	74.6
14.00	47.4	34.6	82.0
15.00	51.9	35.7	87.6
16.00	56.6	36.8	93.4
17.00	61.5	37.0	98.5
18.00	66.4	37.0	103.4
19.00	71.4	43.6	115.0
20.00	76.6	80.2	156.8
21.00	81.9	118.1	200.0
22.00	87.3	157.4	244.7
23.00	97.0	198.1	295.1
24.00	111.3	240.1	351.4
25.00	126.0	283.5	409.4
26.00	141.1	298.6	439.7
27.00	156.7	307.2	463.9
28.00	172.7	315.8	488.5
29.00	189.2	324.4	513.6
30.00	206.1	333.0	539.1
31.00	223.5	333.5	557.0

32.00	241.3	297.3	538.5
33.00	259.5	259.6	519.1
34.00	278.2	220.6	498.8
35.00	295.1	180.3	475.3
36.00	310.0	138.6	448.5
37.00	324.9	95.5	420.4
38.00	339.7	87.5	427.2
39.00	354.6	87.5	442.1
40.00	369.5	87.5	457.0
41.00	384.4	87.5	471.9
42.00	399.3	87.5	486.8
43.00	414.2	87.5	501.7
44.00	429.1	87.5	516.6
45.00	444.0	87.5	531.5
46.00	458.9	87.5	546.4
47.00	473.8	87.5	561.3
48.00	488.7	87.5	576.2
49.00	503.5	87.5	591.0
50.00	518.4	87.5	605.9
51.00	533.3	87.5	620.8
52.00	548.2	87.5	635.7
53.00	563.1	87.5	650.6
54.00	578.0	87.5	665.5
55.00	592.9	87.5	680.4
56.00	607.8	87.5	695.3
57.00	622.7	87.5	710.2
58.00	637.6	87.5	725.1
59.00	652.5	87.5	740.0
60.00	667.3	87.5	754.8
61.00	682.2	87.5	769.7
62.00	697.1	87.5	784.6
63.00	712.0	87.5	799.5
64.00	726.9	87.5	814.4
65.00	741.8	87.5	829.3
66.00	756.7	87.5	844.2
67.00	771.6	87.5	859.1
68.00	786.5	87.5	874.0
69.00	801.4	87.5	888.9
70.00	816.3	87.5	903.8
71.00	831.1	87.5	918.6
72.00	846.0	87.5	933.5
73.00	860.9	87.5	948.4
74.00	875.8	87.5	963.3
75.00	890.7	87.5	978.2
76.00	905.6	87.5	993.1
77.00	920.5	87.5	1008.0
78.00	935.4	87.5	1022.9
79.00	950.3	87.5	1037.8
80.00	965.2	87.5	1052.7

81.00	980.1	87.5	1067.6
82.00	994.9	87.5	1082.4
83.00	1009.8	87.5	1097.3
84.00	1024.7	87.5	1112.2
85.00	1039.6	87.5	1127.1

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

```
   ************************************************
   * COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
   * CURVES FOR AXIAL LOADING                      *
   ************************************************
```

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.4074E-01
			0.0000E+00	0.7894E-01
			0.0000E+00	0.1451E+00
			0.0000E+00	0.2037E+00
			0.0000E+00	0.2546E+00
			0.0000E+00	0.5093E+00
			0.0000E+00	0.7639E+00
			0.0000E+00	0.1273E+01
			0.0000E+00	0.5093E+01
2	10	0.4025E+01		
			0.0000E+00	0.0000E+00
			0.5573E+00	0.4074E-01
			0.9289E+00	0.7894E-01
			0.1393E+01	0.1451E+00
			0.1672E+01	0.2037E+00
			0.1858E+01	0.2546E+00
			0.1858E+01	0.5093E+00
			0.1858E+01	0.7639E+00
			0.1858E+01	0.1273E+01
			0.1858E+01	0.5093E+01
3	10	0.7958E+01		
			0.0000E+00	0.0000E+00
			0.1102E+01	0.4074E-01
			0.1837E+01	0.7894E-01

		0.2755E+01	0.1451E+00
		0.3306E+01	0.2037E+00
		0.3673E+01	0.2546E+00
		0.3673E+01	0.5093E+00
		0.3673E+01	0.7639E+00
		0.3673E+01	0.1273E+01
		0.3673E+01	0.5093E+01
4	10	0.8000E+01	
		0.0000E+00	0.0000E+00
		0.1108E+01	0.4074E-01
		0.1846E+01	0.7894E-01
		0.2769E+01	0.1451E+00
		0.3323E+01	0.2037E+00
		0.3692E+01	0.2546E+00
		0.3323E+01	0.5093E+00
		0.3323E+01	0.7639E+00
		0.3323E+01	0.1273E+01
		0.3323E+01	0.5093E+01
5	10	0.1053E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.7500E+01	0.5093E+00
		0.7500E+01	0.7639E+00
		0.7500E+01	0.1273E+01
		0.7500E+01	0.5093E+01
6	10	0.1296E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.7500E+01	0.5093E+00
		0.7500E+01	0.7639E+00
		0.7500E+01	0.1273E+01
		0.7500E+01	0.5093E+01
7	10	0.1300E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.8333E+01	0.5093E+00
		0.8333E+01	0.7639E+00

		0.8333E+01	0.1273E+01
		0.8333E+01	0.5093E+01
8	10	0.1753E+02	
		0.0000E+00	0.0000E+00
		0.1542E+01	0.4074E-01
		0.2570E+01	0.7894E-01
		0.3856E+01	0.1451E+00
		0.4627E+01	0.2037E+00
		0.5141E+01	0.2546E+00
		0.5141E+01	0.5093E+00
		0.5141E+01	0.7639E+00
		0.5141E+01	0.1273E+01
		0.5141E+01	0.5093E+01
9	10	0.2196E+02	
		0.0000E+00	0.0000E+00
		0.1703E+01	0.4074E-01
		0.2838E+01	0.7894E-01
		0.4258E+01	0.1451E+00
		0.5109E+01	0.2037E+00
		0.5677E+01	0.2546E+00
		0.5677E+01	0.5093E+00
		0.5677E+01	0.7639E+00
		0.5677E+01	0.1273E+01
		0.5677E+01	0.5093E+01
10	10	0.2200E+02	
		0.0000E+00	0.0000E+00
		0.1705E+01	0.4074E-01
		0.2841E+01	0.7894E-01
		0.4261E+01	0.1451E+00
		0.5114E+01	0.2037E+00
		0.5682E+01	0.2546E+00
		0.5682E+01	0.5093E+00
		0.5682E+01	0.7639E+00
		0.5682E+01	0.1273E+01
		0.5682E+01	0.5093E+01
11	10	0.2803E+02	
		0.0000E+00	0.0000E+00
		0.5081E+01	0.4074E-01
		0.8468E+01	0.7894E-01
		0.1270E+02	0.1451E+00
		0.1524E+02	0.2037E+00
		0.1694E+02	0.2546E+00
		0.1694E+02	0.5093E+00
		0.1694E+02	0.7639E+00
		0.1694E+02	0.1273E+01
		0.1694E+02	0.5093E+01
12	10	0.3396E+02	
		0.0000E+00	0.0000E+00
		0.5902E+01	0.4074E-01

			0.9836E+01	0.7894E-01
			0.1475E+02	0.1451E+00
			0.1771E+02	0.2037E+00
			0.1967E+02	0.2546E+00
			0.1967E+02	0.5093E+00
			0.1967E+02	0.7639E+00
			0.1967E+02	0.1273E+01
			0.1967E+02	0.5093E+01
13	10	0.3400E+02		
			0.0000E+00	0.0000E+00
			0.5908E+01	0.4074E-01
			0.9846E+01	0.7894E-01
			0.1477E+02	0.1451E+00
			0.1772E+02	0.2037E+00
			0.1969E+02	0.2546E+00
			0.1772E+02	0.5093E+00
			0.1772E+02	0.7639E+00
			0.1772E+02	0.1273E+01
			0.1772E+02	0.5093E+01
14	10	0.6803E+02		
			0.0000E+00	0.0000E+00
			0.4653E+01	0.4074E-01
			0.7756E+01	0.7894E-01
			0.1163E+02	0.1451E+00
			0.1396E+02	0.2037E+00
			0.1551E+02	0.2546E+00
			0.1396E+02	0.5093E+00
			0.1396E+02	0.7639E+00
			0.1396E+02	0.1273E+01
			0.1396E+02	0.5093E+01
15	10	0.1020E+03		
			0.0000E+00	0.0000E+00
			0.4653E+01	0.4074E-01
			0.7756E+01	0.7894E-01
			0.1163E+02	0.1451E+00
			0.1396E+02	0.2037E+00
			0.1551E+02	0.2546E+00
			0.1396E+02	0.5093E+00
			0.1396E+02	0.7639E+00
			0.1396E+02	0.1273E+01
			0.1396E+02	0.5093E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5469E+01	0.1273E-01

0.1094E+02	0.2546E-01
0.2187E+02	0.5093E-01
0.4375E+02	0.3310E+00
0.6562E+02	0.1070E+01
0.7875E+02	0.1859E+01
0.8750E+02	0.2546E+01
0.8750E+02	0.3820E+01
0.8750E+02	0.5093E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1695E+01	0.6644E-03	0.4295E-01	0.1000E-03
0.1695E+02	0.6644E-02	0.4295E+00	0.1000E-02
0.8569E+02	0.3343E-01	0.2148E+01	0.5000E-02
0.1701E+03	0.6691E-01	0.4295E+01	0.1000E-01
0.3169E+03	0.1299E+00	0.8590E+01	0.2000E-01
0.6119E+03	0.2765E+00	0.2148E+02	0.5000E-01
0.7742E+03	0.3761E+00	0.2415E+02	0.8000E-01
0.8507E+03	0.4312E+00	0.2571E+02	0.1000E+00
0.1044E+04	0.6353E+00	0.3352E+02	0.2000E+00
0.1020E+04	0.9294E+00	0.4875E+02	0.5000E+00
0.1029E+04	0.1236E+01	0.5764E+02	0.8000E+00
0.1035E+04	0.1440E+01	0.6357E+02	0.1000E+01
0.1052E+04	0.2452E+01	0.8055E+02	0.2000E+01

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT Project ID:	P030260
Date:	10/8/2021

Settlement of Bridge Foundations at Service Limit State: Interior Bent 3

Total settlement of a pile can be estimated as

$\Delta_v = S_t = S_i+S_c+S_s+\Delta_E$ Eq 16-6 (SCDOT GDM 2019)

$\Delta_E = Q_aL/(AE)$ Eq 16-7 (SCDOT GDM 2019)

Pile type: PSC 20-inch

Pile Section:	SQ
Pile size (in):	20.0
E (ksi):	3,605

Elastic Compression

Construction Stage	Pile Section	Length(ft)	Area (in^2)	Q_a (kips)	Δ_E (in)
Construction	PSC SQ	50	400	231.2	0.10

Pile Group Settlement

10.7.2.3.2 of AASHTO LRFD Bridge Design Spec., 2017.

L (ft): 68.8 Length of Pile Cap

B (ft): 1.7 Smallest dimension of pile group

Number of piles per construction stage: 9

D_b (ft): 16.0 Embedment into the Bearing Layer

D' (ft): 10.7

$$\rho = \frac{qI\sqrt{B}}{(N_1)_{60}}$$

Eq. 10.7.2.3.2-1 (AASHTO LRFD, 2017)

$$I = 1 - 0.125\frac{D'}{B} \geq 0.5$$

Eq. 10.7.2.3.2-3 (AASHTO LRFD, 2017)

Construction Stage	I	$(N_1)_{60}$ [1]	q (ksf)	ρ (in)	Total Settlement (in)
Construction	0.50	32	18.16	0.37	0.47

Notes: 1. $(N_1)_{60}$ values are an average calculated using values in Appendix C-3

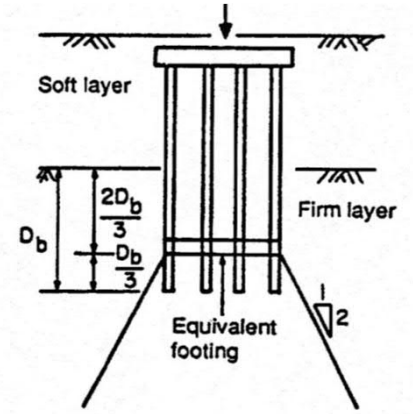


Figure 10.7.2.3.1-2 Location of Eq. Footing (AASHTO LRFD Bridge Design Spec., 2017)

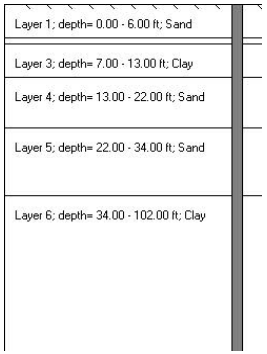
INTERIOR BENT 4 AXIAL LOADING: PSC 20-INCH CONCRETE PILE

Pavement Elev. : 28.0 ft
Top of Pile/Load Elev. : 22.0 ft
Top of Bearing Layer : -12.0 ft
Groundwater Elev.: 15.0 ft

Subsurface Model : See Exhibit C-3
Mudline Elev. 16.0 ft
100-yr Scour Elev. : 11.0 ft

Layer Name	Model	Permanent Downdrag?	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)
			APILE INPUT						
Existing FILL	Sand	No	6.0	7.0	16.0	15.0	120	30	--
ALLUVIUM	Clay	No	7.0	13.0	15.0	9.0	125 - 62.6	--	1.2
	Sand	No	13.0	22.0	9.0	0.0	37.6	28	--
	Sand	No	22.0	34.0	0.0	-12.0	57.6	36	--
	Clay	No	34.0	102.0	-12.0	-80.0	52.6	--	3.5

A Reduction factor of 1E-14 was introduced for the top 6 feet to model the stick-up length of pile.



Modeled Pile Embedment into the Bearing Layer : 16.0 ft
Estimated Tip Elevation : -28.0 ft
Estimated Pile Length : 50.0 ft

Zero Friction Length above Scour Elev. : N.A. = Top of Pile Elev. - 100-yr Scour Elev.
Liquefied Soil Thickness : 27.0 ft = Groundwater Elev. - Top of Bearing Layer

EARTHQUAKE

Nominal Side Resistance : 522.1 kips
Nominal Tip Resistance : 87.5 kips
Resistance Factor : 1.00

Unfactored Liquefaction Downdrag Load : 284.9 kips
Downdrag Load Factor : 1.00

Total Nominal Resistance[1] : 609.6 kips
Total Factored Resistance[1] : 609.6 kips

Resistance from Liquefiable Soils : 284.9 kips
Req'd Top of Pile EEI Load : 100.0 kips
Req'd Min. Driving (Factored) Resistance[2] : 384.9 kips
Sufficient Resistance? : Pass

STRENGTH

Nominal Side Resistance : 522.1 kips
Nominal Tip Resistance : 87.5 kips
Resistance Factor : 0.65

Unfactored Permanent Downdrag Load : 0.0 kips
Downdrag Load Factor : 1.40

Total Nominal Resistance[1] : 609.6 kips
Total Factored Resistance[1] : 373.6 kips

Resistance from Scourable Soils : 34.9 kips
Req'd Top of Pile Strength Load : 231.2 kips
Req'd Min. Driving (Factored) Resistance[2] : 266.1 kips
Sufficient Resistance? : Pass

1. Excludes resistance within downdrag layers
2. Includes factored downdrag load

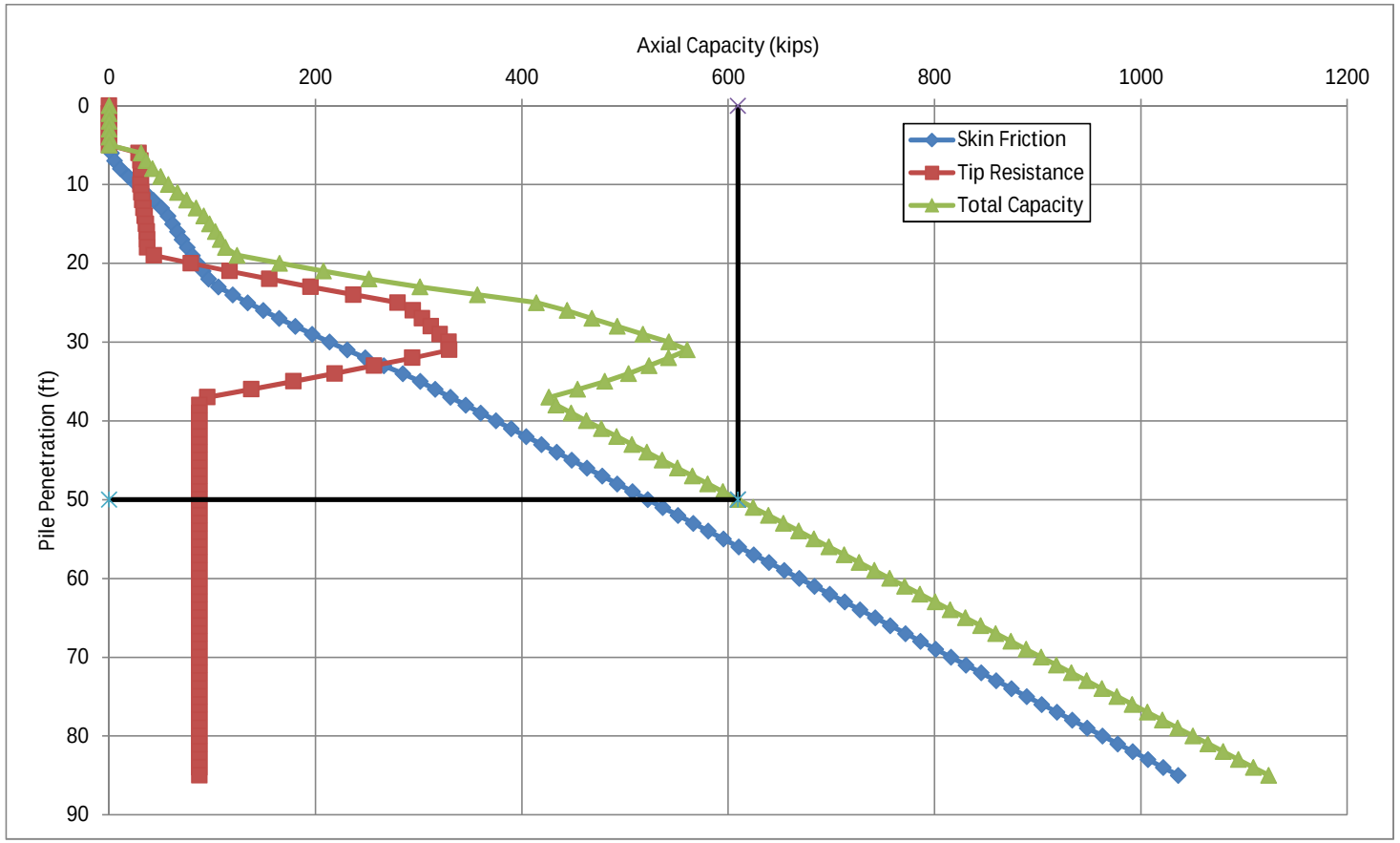
Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS
Terracon Project No.	EN205030
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

INTERIOR BENT 4 AXIAL LOADING: PSC 20-INCH CONCRETE PILE



Total Nominal Resistance : 609.6 kips
Estimated Pile Penetration Beneath Pile Cap : 50.0 ft
Estimated Tip Elevation : -28.0 ft

Negative Skin Friction (Permanent DD) : 0.0 kips
Resistance from Scourable Soils : 34.9 kips
Resistance from Liquefiable Soils : 284.9 kips
Pile Stick up : 6.0 ft

Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	

Terracon Project No.	EN205030
Scale:	NTS
Date:	10/11/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

AXIAL FOUNDATION ANALYSIS
I-95 Bridge Replacement over Bagshaw Swamp
Jasper County **SOUTH CAROLINA**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-5

APILE for Windows, Version 2019.9.3

Serial Number : 506768014

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
(c) Copyright ENSOFT, Inc., 1987-2015
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This program is licensed to :

Terracon, Inc.
APILE Global, Global License

Path to file locations : C:\Users\aqfekrat\OneDrive - Terracon Consultants Inc\Documents\Temporary\EN175299\BS\Axial\APILE\
Name of input data file : PSC SQ 20_IB4_Bagshaw.ap9d
Name of output file : PSC SQ 20_IB4_Bagshaw.ap9o
Name of plot output file : PSC SQ 20_IB4_Bagshaw.ap9p

Time and Date of Analysis

Date: July 27, 2021 Time: 09:25:25

1

****
* INPUT INFORMATION *
****

I-95 BRO Bagshaw Swamp - Interior Bent 4

DESIGNER : Terracon (A. Fekrat)

JOB NUMBER : EN175299

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)
  Reduced Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :

Precast concrete pile (Square/Rectangular/Orthogonal)

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.360E+07 PSI
- CROSS SECTION AREA = 400.00 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 85.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 80.00 IN.
- TIP AREA OF PILE = 400.00 IN2
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.80*	120.00	30.00	20.00**
6.00	SAND	0.80*	120.00	30.00	20.00**

6.00	SAND	0.80*	120.00	30.00	20.00**
7.00	SAND	0.80*	120.00	30.00	20.00**
7.00	CLAY	0.80*	125.00	0.00	8.00**
13.00	CLAY	0.80*	62.60	0.00	8.00**
13.00	SAND	0.80*	37.60	28.00	16.80**
22.00	SAND	0.80*	37.60	28.00	16.80**
22.00	SAND	0.80*	57.60	36.00	42.00**
34.00	SAND	0.80*	57.60	36.00	42.00**
34.00	CLAY	0.80*	52.60	0.00	8.00**
102.00	CLAY	0.80*	52.60	0.00	8.00**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.20	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.50	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	0.000	0.000
6.00	0.000	0.000
6.00	1.000	1.000
7.00	1.000	1.000
7.00	1.000	1.000
13.00	1.000	1.000

13.00	1.000	1.000
22.00	1.000	1.000
22.00	1.000	1.000
34.00	1.000	1.000
34.00	1.000	1.000
102.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0	0.0
1.00	0.0	0.0	0.0
2.00	0.0	0.0	0.0
3.00	0.0	0.0	0.0
4.00	0.0	0.0	0.0
5.00	0.0	0.0	0.0
6.00	2.4	28.7	31.1
7.00	5.3	30.4	35.7
8.00	10.9	31.2	42.0
9.00	18.9	31.0	49.9
10.00	26.9	30.4	57.3
11.00	34.9	31.3	66.2
12.00	42.9	32.4	75.3
13.00	50.9	33.5	84.4
14.00	57.1	34.6	91.7
15.00	61.6	35.7	97.3
16.00	66.2	36.8	103.0
17.00	70.9	37.0	107.9
18.00	75.8	37.0	112.8
19.00	80.8	43.4	124.2
20.00	85.9	79.4	165.3
21.00	91.1	116.8	207.8
22.00	96.4	155.5	251.8
23.00	106.0	195.5	301.5
24.00	120.0	236.9	356.9
25.00	134.5	279.7	414.2

26.00	149.5	294.7	444.1
27.00	164.8	303.3	468.1
28.00	180.7	311.9	492.5
29.00	196.9	320.5	517.4
30.00	213.6	329.1	542.7
31.00	230.8	329.7	560.5
32.00	248.4	294.1	542.4
33.00	266.4	257.0	523.5
34.00	284.9	218.7	503.6
35.00	301.6	178.9	480.5
36.00	316.3	137.9	454.2
37.00	331.0	95.4	426.4
38.00	345.7	87.5	433.2
39.00	360.4	87.5	447.9
40.00	375.1	87.5	462.6
41.00	389.8	87.5	477.3
42.00	404.5	87.5	492.0
43.00	419.2	87.5	506.7
44.00	433.9	87.5	521.4
45.00	448.6	87.5	536.1
46.00	463.3	87.5	550.8
47.00	478.0	87.5	565.5
48.00	492.7	87.5	580.2
49.00	507.4	87.5	594.9
50.00	522.1	87.5	609.6
51.00	536.8	87.5	624.3
52.00	551.5	87.5	639.0
53.00	566.2	87.5	653.7
54.00	580.9	87.5	668.4
55.00	595.6	87.5	683.1
56.00	610.3	87.5	697.8
57.00	625.0	87.5	712.5
58.00	639.7	87.5	727.2
59.00	654.4	87.5	741.9
60.00	669.1	87.5	756.6
61.00	683.8	87.5	771.3
62.00	698.5	87.5	786.0
63.00	713.2	87.5	800.7
64.00	727.9	87.5	815.4
65.00	742.6	87.5	830.1
66.00	757.3	87.5	844.8
67.00	772.0	87.5	859.5
68.00	786.7	87.5	874.2
69.00	801.4	87.5	888.9
70.00	816.1	87.5	903.6
71.00	830.7	87.5	918.2
72.00	845.4	87.5	932.9
73.00	860.1	87.5	947.6
74.00	874.8	87.5	962.3

75.00	889.5	87.5	977.0
76.00	904.2	87.5	991.7
77.00	918.9	87.5	1006.4
78.00	933.6	87.5	1021.1
79.00	948.3	87.5	1035.8
80.00	963.0	87.5	1050.5
81.00	977.7	87.5	1065.2
82.00	992.4	87.5	1079.9
83.00	1007.1	87.5	1094.6
84.00	1021.8	87.5	1109.3
85.00	1036.5	87.5	1124.0

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.4074E-01
			0.0000E+00	0.7894E-01
			0.0000E+00	0.1451E+00
			0.0000E+00	0.2037E+00
			0.0000E+00	0.2546E+00
			0.0000E+00	0.5093E+00
			0.0000E+00	0.7639E+00
			0.0000E+00	0.1273E+01
			0.0000E+00	0.5093E+01
2	10	0.3025E+01		
			0.0000E+00	0.0000E+00
			0.4189E+00	0.4074E-01
			0.6981E+00	0.7894E-01
			0.1047E+01	0.1451E+00
			0.1257E+01	0.2037E+00
			0.1396E+01	0.2546E+00
			0.1396E+01	0.5093E+00
			0.1396E+01	0.7639E+00

		0.1396E+01	0.1273E+01
		0.1396E+01	0.5093E+01
3	10	0.5958E+01	
		0.0000E+00	0.0000E+00
		0.8250E+00	0.4074E-01
		0.1375E+01	0.7894E-01
		0.2063E+01	0.1451E+00
		0.2475E+01	0.2037E+00
		0.2750E+01	0.2546E+00
		0.2750E+01	0.5093E+00
		0.2750E+01	0.7639E+00
		0.2750E+01	0.1273E+01
		0.2750E+01	0.5093E+01
4	10	0.6000E+01	
		0.0000E+00	0.0000E+00
		0.8308E+00	0.4074E-01
		0.1385E+01	0.7894E-01
		0.2077E+01	0.1451E+00
		0.2492E+01	0.2037E+00
		0.2769E+01	0.2546E+00
		0.2769E+01	0.5093E+00
		0.2769E+01	0.7639E+00
		0.2769E+01	0.1273E+01
		0.2769E+01	0.5093E+01
5	10	0.6525E+01	
		0.0000E+00	0.0000E+00
		0.9035E+00	0.4074E-01
		0.1506E+01	0.7894E-01
		0.2259E+01	0.1451E+00
		0.2710E+01	0.2037E+00
		0.3012E+01	0.2546E+00
		0.3012E+01	0.5093E+00
		0.3012E+01	0.7639E+00
		0.3012E+01	0.1273E+01
		0.3012E+01	0.5093E+01
6	10	0.6958E+01	
		0.0000E+00	0.0000E+00
		0.9635E+00	0.4074E-01
		0.1606E+01	0.7894E-01
		0.2409E+01	0.1451E+00
		0.2890E+01	0.2037E+00
		0.3212E+01	0.2546E+00
		0.3212E+01	0.5093E+00
		0.3212E+01	0.7639E+00
		0.3212E+01	0.1273E+01
		0.3212E+01	0.5093E+01
7	10	0.7000E+01	
		0.0000E+00	0.0000E+00
		0.9693E+00	0.4074E-01

		0.1615E+01	0.7894E-01
		0.2423E+01	0.1451E+00
		0.2908E+01	0.2037E+00
		0.3231E+01	0.2546E+00
		0.2908E+01	0.5093E+00
		0.2908E+01	0.7639E+00
		0.2908E+01	0.1273E+01
		0.2908E+01	0.5093E+01
8	10	0.1003E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.7500E+01	0.5093E+00
		0.7500E+01	0.7639E+00
		0.7500E+01	0.1273E+01
		0.7500E+01	0.5093E+01
9	10	0.1296E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.7500E+01	0.5093E+00
		0.7500E+01	0.7639E+00
		0.7500E+01	0.1273E+01
		0.7500E+01	0.5093E+01
10	10	0.1300E+02	
		0.0000E+00	0.0000E+00
		0.2500E+01	0.4074E-01
		0.4167E+01	0.7894E-01
		0.6250E+01	0.1451E+00
		0.7500E+01	0.2037E+00
		0.8333E+01	0.2546E+00
		0.8333E+01	0.5093E+00
		0.8333E+01	0.7639E+00
		0.8333E+01	0.1273E+01
		0.8333E+01	0.5093E+01
11	10	0.1753E+02	
		0.0000E+00	0.0000E+00
		0.1517E+01	0.4074E-01
		0.2528E+01	0.7894E-01
		0.3792E+01	0.1451E+00
		0.4551E+01	0.2037E+00
		0.5057E+01	0.2546E+00
		0.5057E+01	0.5093E+00

			0.5057E+01	0.7639E+00
			0.5057E+01	0.1273E+01
			0.5057E+01	0.5093E+01
12	10	0.2196E+02		
			0.0000E+00	0.0000E+00
			0.1678E+01	0.4074E-01
			0.2796E+01	0.7894E-01
			0.4194E+01	0.1451E+00
			0.5033E+01	0.2037E+00
			0.5593E+01	0.2546E+00
			0.5593E+01	0.5093E+00
			0.5593E+01	0.7639E+00
			0.5593E+01	0.1273E+01
			0.5593E+01	0.5093E+01
13	10	0.2200E+02		
			0.0000E+00	0.0000E+00
			0.1679E+01	0.4074E-01
			0.2799E+01	0.7894E-01
			0.4198E+01	0.1451E+00
			0.5038E+01	0.2037E+00
			0.5598E+01	0.2546E+00
			0.5598E+01	0.5093E+00
			0.5598E+01	0.7639E+00
			0.5598E+01	0.1273E+01
			0.5598E+01	0.5093E+01
14	10	0.2803E+02		
			0.0000E+00	0.0000E+00
			0.5018E+01	0.4074E-01
			0.8363E+01	0.7894E-01
			0.1254E+02	0.1451E+00
			0.1505E+02	0.2037E+00
			0.1673E+02	0.2546E+00
			0.1673E+02	0.5093E+00
			0.1673E+02	0.7639E+00
			0.1673E+02	0.1273E+01
			0.1673E+02	0.5093E+01
15	10	0.3396E+02		
			0.0000E+00	0.0000E+00
			0.5839E+01	0.4074E-01
			0.9731E+01	0.7894E-01
			0.1460E+02	0.1451E+00
			0.1752E+02	0.2037E+00
			0.1946E+02	0.2546E+00
			0.1946E+02	0.5093E+00
			0.1946E+02	0.7639E+00
			0.1946E+02	0.1273E+01
			0.1946E+02	0.5093E+01
16	10	0.3400E+02		
			0.0000E+00	0.0000E+00

			0.5845E+01	0.4074E-01
			0.9741E+01	0.7894E-01
			0.1461E+02	0.1451E+00
			0.1753E+02	0.2037E+00
			0.1948E+02	0.2546E+00
			0.1753E+02	0.5093E+00
			0.1753E+02	0.7639E+00
			0.1753E+02	0.1273E+01
			0.1753E+02	0.5093E+01
17	10	0.6803E+02		
			0.0000E+00	0.0000E+00
			0.4593E+01	0.4074E-01
			0.7655E+01	0.7894E-01
			0.1148E+02	0.1451E+00
			0.1378E+02	0.2037E+00
			0.1531E+02	0.2546E+00
			0.1378E+02	0.5093E+00
			0.1378E+02	0.7639E+00
			0.1378E+02	0.1273E+01
			0.1378E+02	0.5093E+01
18	10	0.1020E+03		
			0.0000E+00	0.0000E+00
			0.4593E+01	0.4074E-01
			0.7655E+01	0.7894E-01
			0.1148E+02	0.1451E+00
			0.1378E+02	0.2037E+00
			0.1531E+02	0.2546E+00
			0.1378E+02	0.5093E+00
			0.1378E+02	0.7639E+00
			0.1378E+02	0.1273E+01
			0.1378E+02	0.5093E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5469E+01	0.1273E-01
0.1094E+02	0.2546E-01
0.2187E+02	0.5093E-01
0.4375E+02	0.3310E+00
0.6562E+02	0.1070E+01
0.7875E+02	0.1859E+01
0.8750E+02	0.2546E+01
0.8750E+02	0.3820E+01
0.8750E+02	0.5093E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1681E+01	0.6561E-03	0.4295E-01	0.1000E-03
0.1681E+02	0.6561E-02	0.4295E+00	0.1000E-02
0.8502E+02	0.3301E-01	0.2148E+01	0.5000E-02
0.1687E+03	0.6607E-01	0.4295E+01	0.1000E-01
0.3144E+03	0.1284E+00	0.8590E+01	0.2000E-01
0.6071E+03	0.2736E+00	0.2148E+02	0.5000E-01
0.7678E+03	0.3723E+00	0.2415E+02	0.8000E-01
0.8435E+03	0.4270E+00	0.2571E+02	0.1000E+00
0.1035E+04	0.6303E+00	0.3352E+02	0.2000E+00
0.1012E+04	0.9247E+00	0.4875E+02	0.5000E+00
0.1021E+04	0.1231E+01	0.5764E+02	0.8000E+00
0.1027E+04	0.1435E+01	0.6357E+02	0.1000E+01
0.1044E+04	0.2447E+01	0.8055E+02	0.2000E+01

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT Project ID:	P030260
Date:	10/8/2021

Settlement of Bridge Foundations at Service Limit State: Interior Bent 4

Total settlement of a pile can be estimated as

$\Delta_v = S_t = S_i+S_c+S_s+\Delta_E$ Eq 16-6 (SCDOT GDM 2019)

$\Delta_E = Q_aL/(AE)$ Eq 16-7 (SCDOT GDM 2019)

Pile type: PSC 20-inch

Pile Section:	SQ
Pile size (in):	20.0
E (ksi):	3,605

Elastic Compression

Construction Stage	Pile Section	Length(ft)	Area (in^2)	Q_a (kips)	Δ_E (in)
Construction	PSC SQ	50	400	231.2	0.10

Pile Group Settlement

10.7.2.3.2 of AASHTO LRFD Bridge Design Spec., 2017.

L (ft): 68.8 Length of Pile Cap

B (ft): 1.7 Smallest dimension of pile group

Number of piles per construction stage: 9

D_b (ft): 16.0 Embedment into the Bearing Layer

D' (ft): 10.7

$$\rho = \frac{qI\sqrt{B}}{(N_1)_{60}}$$

Eq. 10.7.2.3.2-1 (AASHTO LRFD, 2017)

$$I = 1 - 0.125\frac{D'}{B} \geq 0.5$$

Eq. 10.7.2.3.2-3 (AASHTO LRFD, 2017)

Construction Stage	I	$(N_1)_{60}$ [1]	q (ksf)	ρ (in)	Total Settlement (in)
Construction	0.50	32	18.16	0.37	0.47

Notes: 1. $(N_1)_{60}$ values are an average calculated using values in Appendix C-3

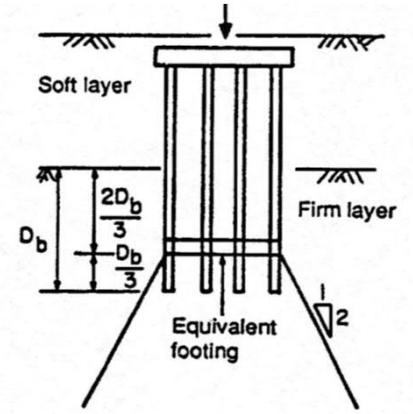


Figure 10.7.2.3.1-2 Location of Eq. Footing (AASHTO LRFD Bridge Design Spec., 2017)

EXHIBIT C-6: PILE DRIVABILITY ANALYSIS

Analysis Methodology

Analysis Methodology	
Analysis Type	Pile Driveability Analysis
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	End Bent 1 and End Bent 5
Soil Boring Model	See Exhibit C-3.
Analysis Method	A Wave Equation Analysis of Piles (WEAP) was conducted for the proposed HP14x89, 50 ksi steel piles equipped with driving shoes for End Bent 1 and End Bent 5. WEAP was conducted using the proprietary software program GRLWEAP™ (Version 2010-7) developed by GRL Engineers Inc. This driveability analysis was conducted using the representative soil profiles described above. Terracon used the soil parameters calculated from APile, recommended GRLWEAP shaft and toe gain loss factors, and typical quake and damping factors were utilized in the analysis. WEAP analysis pile stresses are acceptable while seating the piles in the Hard Sandy Silt material for the pile hammer energy range recommended. HP14x89 equipped with driving shoes and with yield strength of 50 ksi is required to avoid overstressing the piles. GRLWEAP estimates the shape distribution factor based on the entered soil profile. These are listed below for each bent. End Bents 1 and 5: 0 at surface to 0.5 at 6.4 ft, 1.2 at 6.4 ft to 1.2 at 12.4 ft, 0.7 at 12.4 ft to 0.8 at 21.4 ft, 0.4 at 21.4 ft to 2.8 at 33.4 ft, 1.5 at 33.4 ft to 1.5 at 101.4 ft
Design Notes	Structural Limit State of HP 14x89: $s_{da} = 0.9 \times f_y = 0.9 \times (1.0) \times 50$ ksi = 45 ksi If HP 14x89 cross section area (A_s) equals 21.4 in^2, driving resistance structural limit state is $s_{da} \times A_s$ = 963 kips.

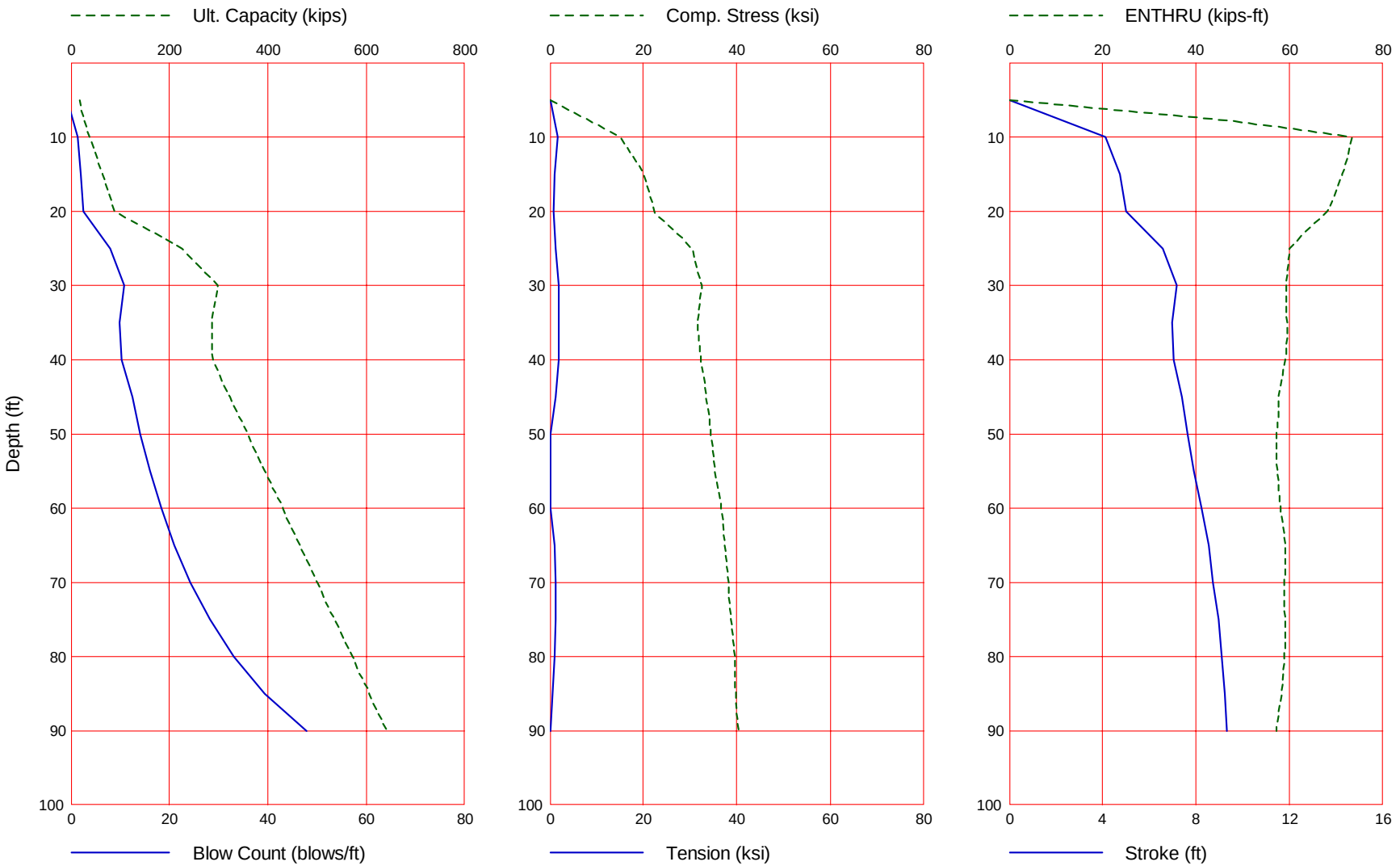
Parameters for Drivability Analysis	
Skin Quake (QS)	0.10 in
Toe Quake (QT)	0.10 in
Skin Damping (SD)	0.15 s/ft
Toe Damping (TD)	0.15 s/ft
% Skin Friction for End Bents	100 %
Distribution Shape	Variable
Est. Driving Resistances for End Bents 1 and 5	607.4 and 614 kips
Pile Penetration for End Bents	100%
Hammer Energy Range	110 to 130 ft-kips Delmag D46-32 Open Ended Diesel Hammer with a rated energy of 122.2 ft-kips was assumed for the analyses
Driving resistance structural limit state check:	
Est. Dvg. Res. for End Bent 1 < Dvg Res. Structural Limit Þ 607.4.0 kips < 963 kips \ Section Satisfactory	
Est. Dvg. Res. for End Bent 5 < Dvg Res. Structural Limit Þ 614 kips < 963 kips \ Section Satisfactory	

End Bents 1 and 5
Delmag D46-32

TSVC, INC. - Jacksonville
HP 14x89 Axial Analysis - Bagshaw EB1_5

Oct 08 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



End Bents 1 and 5
Delmag D46-32

TSVC, INC. - Jacksonville
HP 14x89 Axial Analysis - Bagshaw EB1_5

Oct 08 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	17.5	5.0	12.5	-1.0	0.000	0.000	0.00	0.0
10.0	37.4	23.9	13.5	1.3	15.071	-1.539	4.13	73.4
15.0	64.7	48.2	16.5	2.0	20.265	-0.988	4.74	71.3
20.0	87.8	65.3	22.5	2.6	22.398	-0.815	5.02	68.1
25.0	225.1	99.2	125.9	8.0	30.318	-1.230	6.60	60.1
30.0	299.7	154.0	145.6	10.8	32.519	-1.803	7.17	59.5
35.0	286.2	213.6	72.5	9.8	31.780	-1.749	6.96	59.7
40.0	288.3	249.1	39.2	10.3	32.307	-1.834	7.06	59.2
45.0	323.7	284.5	39.2	12.4	33.404	-1.273	7.40	57.8
50.0	359.2	320.0	39.2	14.1	34.547	0.000	7.67	57.3
55.0	394.7	355.5	39.2	16.2	35.231	0.000	7.91	57.4
60.0	430.1	390.9	39.2	18.4	36.574	0.000	8.26	58.2
65.0	465.6	426.4	39.2	20.9	37.353	-1.061	8.55	59.2
70.0	501.1	461.9	39.2	24.3	38.251	-1.235	8.74	59.0
75.0	536.5	497.3	39.2	28.2	38.731	-1.217	8.96	59.2
80.0	572.0	532.8	39.2	33.1	39.648	-0.854	9.13	58.9
85.0	607.4	568.2	39.2	39.4	39.786	-0.442	9.25	58.3
90.0	642.9	603.7	39.2	47.9	40.513	-0.138	9.33	57.3

Total Continuous Driving Time 34.00 minutes; Total Number of Blows 1374 (starting at penetration 5.0 ft)

Analysis Methodology

Analysis Methodology	
Analysis Type	Pile Driveability Analysis
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	Interior Bent 2
Soil Boring Model	See Exhibit C-3
Analysis Method	A Wave Equation Analysis of Piles (WEAP) was conducted for the proposed 20-inch square, pre-stressed concrete (PSC) piles for the Interior Bent 2. WEAP was conducted using the proprietary software program GRLWEAP™ (Version 2010-7) developed by GRL Engineers Inc. This driveability analysis was conducted using the representative soil profiles described above. Terracon used the soil parameters calculated from APile, recommended GRLWEAP shaft and toe gain loss factors, and typical quake and damping factors were utilized in the analysis. WEAP analysis pile stresses are acceptable while seating the piles in the Hard Sandy Silt material for the pile hammer energy range recommended. The 20-inch square PSC piles with an assumed 28-day compressive strength (f'c) of 5,000 psi is required to avoid overstressing the piles. GRLWEAP estimates the shape distribution factor based on the entered soil profile. These are listed below for the subject bent. Interior Bent 2: 0 at surface to 0.5 at 7.0 ft, 1.2 at 7.0 ft to 1.2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft, 2.1 at 22.0 ft to 2.8 at 34.0 ft , 2.2 at 34.0 ft to 2.2 at 102.0 ft
Design Notes	Structural Limit State of 20-inch Square PSC piles assuming 28-day compressive strength (f'c) of 5,000 psi and effective prestressing stress (f_{pe}) of 800 psi: · Compression: $s_{da} = f_{da} \times (0.85 f'_c - f_{pe}) = 1.0 \times (0.85 \times 5{,}000 - 800) = 3{,}450$ psi Compression Limit = $(s_{da})(A_s) = 3{,}450$ psi (400 in^2) = 1,380 kips · Tension: $s_{da} = f_{da} \times [0.095 \times \sqrt{(f'_c)} + f_{pe}] = (1.0) \times [0.095 (\sqrt{5{,}000}) + 800)] = 806$ psi Tension Limit = $(s_{da})(A_s) = 806$ psi (400 in^2) = 322 kips

Parameters for Drivability Analysis	
Skin Quake (QS)	0.10 in
Toe Quake (QT)	0.10 in
Skin Damping (SD)	0.15 s/ft
Toe Damping (TD)	0.15 s/ft
% Skin Friction	82%
Distribution Shape	Variable
Est. Driving Resistance	611.6 kips
Pile Penetration	89%
Hammer Energy Range	80 to 100 ft-kips APE D36-32 Open Ended Diesel Hammer with a rated energy of 89.3 ft-kips was assumed for the analyses

Driving resistance structural limit state check:

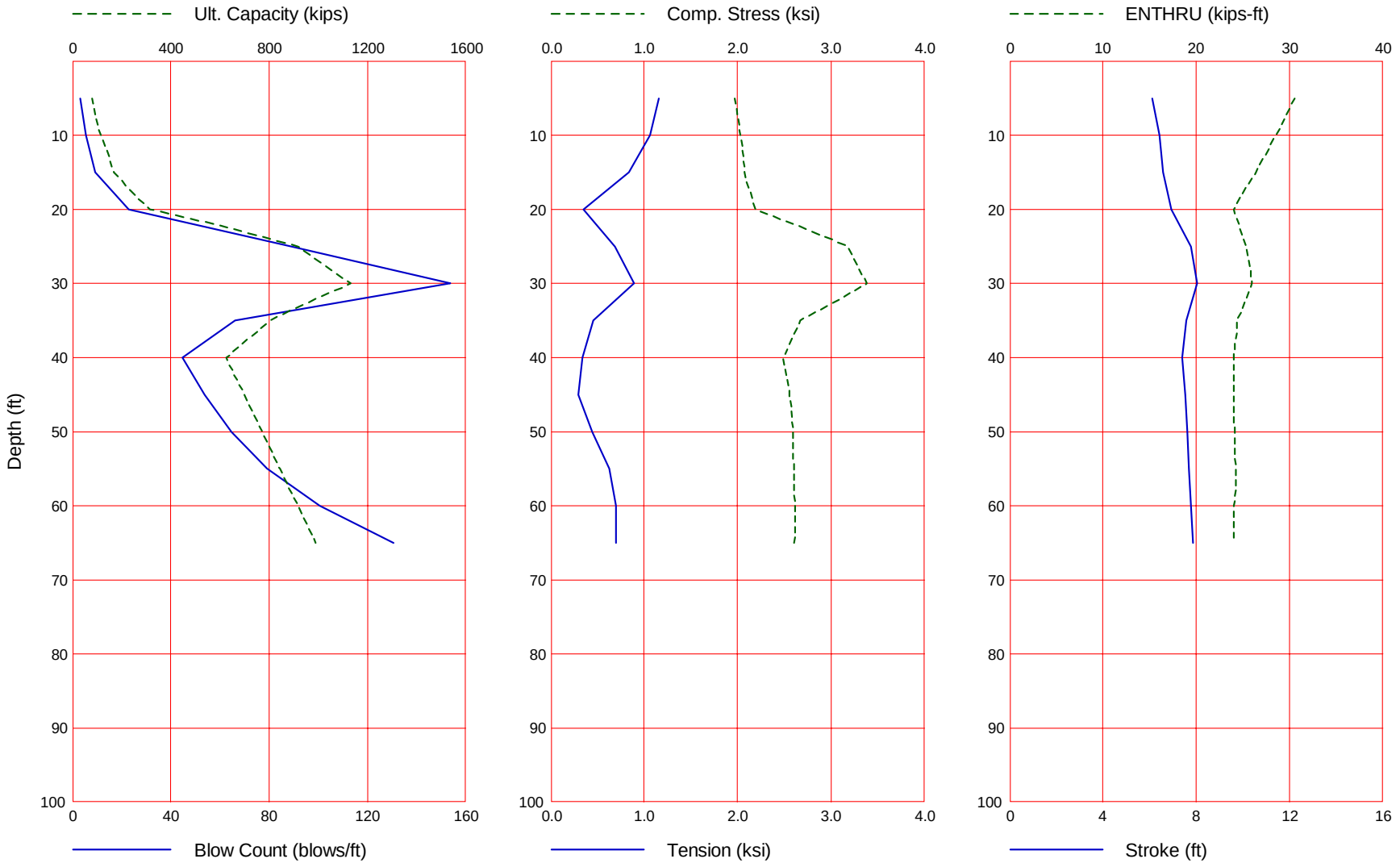
Est. Dvg. Res. for Interior Bent 2 < Dvg Res. Structural Limit Þ 611.6 kips < 1380 kips \ Section Satisfactory

Interior Bent 2
APE D36-32

TSVC, INC. - Jacksonville
I-95 BRO Bagshaw Swamp - Interior Bent 2

Jul 27 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Interior Bent 2
APE D36-32

TSVC, INC. - Jacksonville
I-95 BRO Bagshaw Swamp - Interior Bent 2

Jul 27 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	78.0	5.5	72.5	3.1	1.963	-1.161	6.14	30.6
10.0	116.8	32.4	84.4	5.6	2.031	-1.056	6.44	28.5
15.0	166.3	67.1	99.2	9.3	2.070	-0.842	6.58	26.4
20.0	311.9	91.4	220.6	22.8	2.188	-0.348	6.93	24.1
25.0	917.9	140.1	777.8	89.5	3.189	-0.690	7.80	25.3
30.0	1133.1	219.2	913.9	153.6	3.386	-0.892	8.06	26.0
35.0	804.4	307.2	497.2	66.3	2.675	-0.457	7.56	24.4
40.0	623.9	380.8	243.1	44.8	2.486	-0.338	7.41	24.0
45.0	697.6	454.5	243.1	53.8	2.551	-0.290	7.51	24.0
50.0	771.2	528.2	243.1	64.8	2.601	-0.446	7.62	24.2
55.0	844.9	601.8	243.1	79.3	2.603	-0.620	7.72	24.3
60.0	918.5	675.5	243.1	100.5	2.616	-0.698	7.78	24.1
65.0	992.2	749.1	243.1	130.8	2.612	-0.697	7.89	24.1

Total Continuous Driving Time 89.00 minutes; Total Number of Blows 3786 (starting at penetration 5.0 ft)

Analysis Methodology

Analysis Methodology	
Analysis Type	Pile Driveability Analysis
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	Interior Bent 3
Soil Boring Model	See Exhibit C-3
Analysis Method	A Wave Equation Analysis of Piles (WEAP) was conducted for the proposed 20-inch square, pre-stressed concrete (PSC) piles for the Interior Bent 3. WEAP was conducted using the proprietary software program GRLWEAP™ (Version 2010-7) developed by GRL Engineers Inc. This driveability analysis was conducted using the representative soil profiles described above. Terracon used the soil parameters calculated from APile, recommended GRLWEAP shaft and toe gain loss factors, and typical quake and damping factors were utilized in the analysis. WEAP analysis pile stresses are acceptable while seating the piles in the Hard Sandy Silt material for the pile hammer energy range recommended. The 20-inch square PSC piles with an assumed 28-day compressive strength (f'c) of 5,000 psi is required to avoid overstressing the piles. GRLWEAP estimates the shape distribution factor based on the entered soil profile. These are listed below for the subject bent. Interior Bent 3: 0 at surface to 1.2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft, 2.1 at 22.0 ft to 2.8 at 34.0 ft , 2.2 at 34.0 ft to 2.2 at 102.0 ft
Design Notes	Structural Limit State of 20-inch Square PSC piles assuming 28-day compressive strength (f'c) of 5,000 psi and effective prestressing stress (f_{pe}) of 800 psi: · Compression: $s_{da} = f_{da} \times (0.85f'_c - f_{pe}) = 1.0 \times (0.85 \times 5{,}000 - 800) = 3{,}450$ psi Compression Limit = $(s_{da})(A_s) = 3{,}450$ psi $(400\ in^2) = 1{,}380$ kips · Tension: $s_{da} = f_{da} \times [0.095 \times \sqrt{}(f'_c) + f_{pe}] = (1.0) \times [0.095\ (\sqrt{}(5{,}000) + 800)] = 806$ psi Tension Limit = $(s_{da})(A_s) = 806$ psi $(400\ in^2) = 322$ kips

Parameters for Drivability Analysis	
Skin Quake (QS)	0.10 in
Toe Quake (QT)	0.10 in
Skin Damping (SD)	0.15 s/ft
Toe Damping (TD)	0.15 s/ft
% Skin Friction	83%
Distribution Shape	Variable
Est. Driving Resistance	605.9 kips
Pile Penetration	85%
Hammer Energy Range	80 to 100 ft-kips APE D36-32 Open Ended Diesel Hammer with a rated energy of 89.3 ft-kips was assumed for the analyses

Driving resistance structural limit state check:

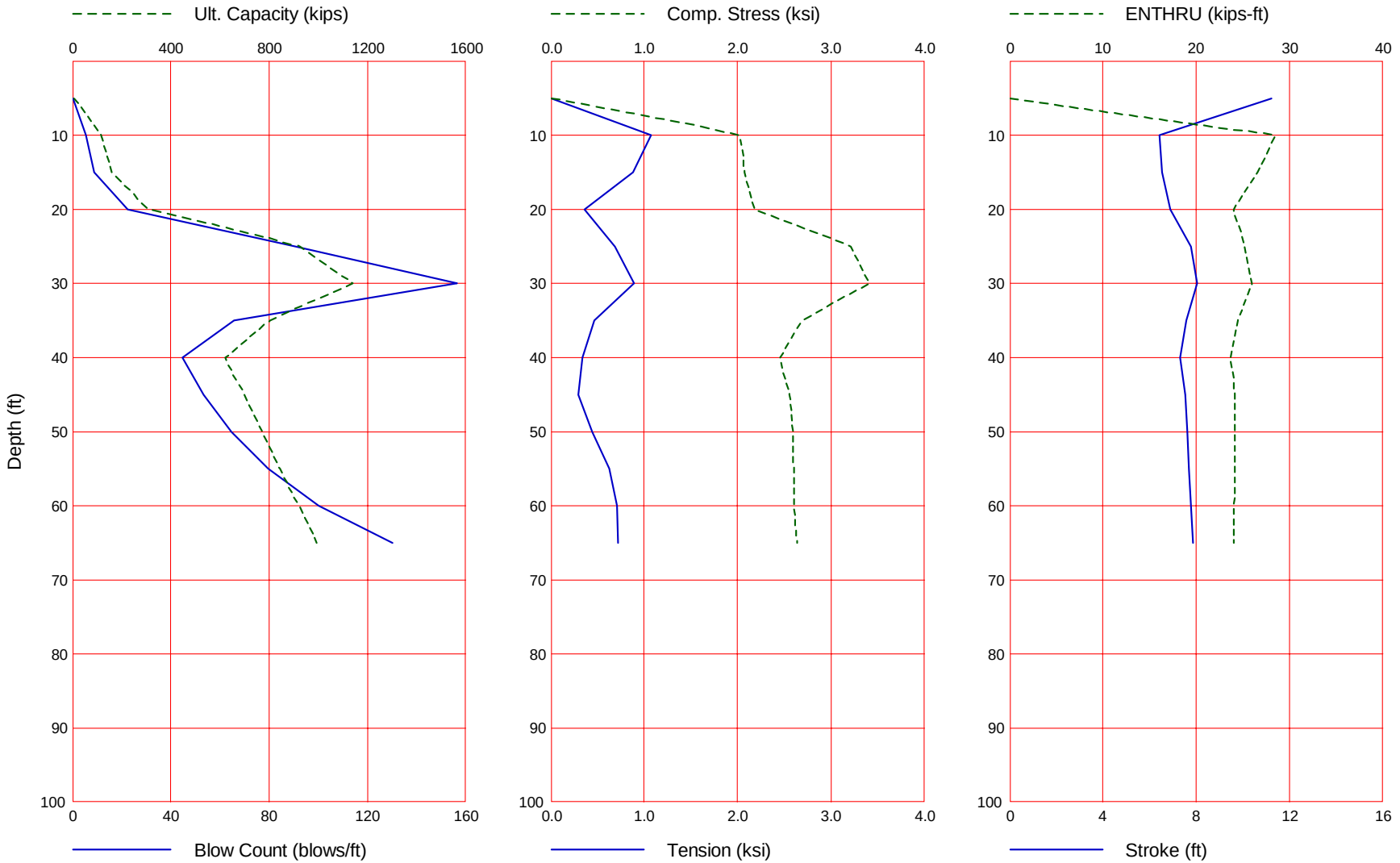
Est. Dvg. Res. for Interior Bent 3 < Dvg Res. Structural Limit Þ 605.9 kips < 1380 kips \ Section Satisfactory

Interior Bent 3
APE D36-32

TSVC, INC. - Jacksonville
I-95 BRO Bagshaw- Interior Bent 3-D36

Jul 27 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Interior Bent 3
APE D36-32

TSVC, INC. - Jacksonville
I-95 BRO Bagshaw- Interior Bent 3-D36

Jul 27 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	5.5	5.5	0.0	0.0	0.000	0.000	11.25	0.0
10.0	115.4	27.9	87.5	5.4	2.026	-1.072	6.43	28.5
15.0	162.0	62.8	99.2	8.9	2.072	-0.877	6.57	26.6
20.0	310.2	87.4	222.8	22.4	2.184	-0.361	6.91	24.1
25.0	925.7	136.8	788.9	91.0	3.215	-0.692	7.80	25.2
30.0	1141.9	216.9	925.0	156.6	3.415	-0.892	8.06	26.0
35.0	805.9	305.9	500.0	66.0	2.697	-0.460	7.56	24.5
40.0	623.3	380.3	243.1	44.9	2.463	-0.339	7.33	23.7
45.0	697.6	454.6	243.1	53.2	2.550	-0.291	7.51	24.2
50.0	772.0	528.9	243.1	64.5	2.595	-0.440	7.62	24.2
55.0	846.3	603.2	243.1	79.4	2.608	-0.619	7.71	24.2
60.0	920.6	677.6	243.1	100.4	2.613	-0.708	7.78	24.1
65.0	994.9	751.9	243.1	130.4	2.635	-0.716	7.88	24.1

Total Continuous Driving Time 89.00 minutes; Total Number of Blows 3789 (starting at penetration 5.0 ft)

Analysis Methodology

Analysis Methodology	
Analysis Type	Pile Driveability Analysis
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	Interior Bent 4
Soil Boring Model	See Exhibit C-3
Analysis Method	A Wave Equation Analysis of Piles (WEAP) was conducted for the proposed 20-inch square, pre-stressed concrete (PSC) piles for the Interior Bent 4. WEAP was conducted using the proprietary software program GRLWEAP™ (Version 2010-7) developed by GRL Engineers Inc. This driveability analysis was conducted using the representative soil profiles described above. Terracon used the soil parameters calculated from APile, recommended GRLWEAP shaft and toe gain loss factors, and typical quake and damping factors were utilized in the analysis. WEAP analysis pile stresses are acceptable while seating the piles in the Hard Sandy Silt material for the pile hammer energy range recommended. The 20-inch square PSC piles with an assumed 28-day compressive strength (f'c) of 5,000 psi is required to avoid overstressing the piles. GRLWEAP estimates the shape distribution factor based on the entered soil profile. These are listed below for the subject bent. Interior Bent 4: 0 at surface to 0.5 at 7.0 ft, 1,2 at 7.0 ft to 1,2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft , 2.1 at 22 ft to 2.8 at 34 ft, 2.2 at 34.0 ft to 2.2 at 102.0 ft
Design Notes	Structural Limit State of 20-inch Square PSC piles assuming 28-day compressive strength (f'c) of 5,000 psi and effective prestressing stress (f_{pe}) of 800 psi: · Compression: $s_{da} = f_{da} \times (0.85f'_c - f_{pe}) = 1.0 \times (0.85 \times 5{,}000 - 800) = 3{,}450$ psi Compression Limit = $(s_{da})(A_s) = 3{,}450$ psi $(400\ in^2) = 1{,}380$ kips · Tension: $s_{da} = f_{da} \times [0.095 \times \sqrt{f'_c} + f_{pe}] = (1.0) \times [0.095 (\sqrt{5{,}000}) + 800)] = 806$ psi Tension Limit = $(s_{da})(A_s) = 806$ psi $(400\ in^2) = 322$ kips

Parameters for Drivability Analysis	
Skin Quake (QS)	0.10 in
Toe Quake (QT)	0.10 in
Skin Damping (SD)	0.15 s/ft
Toe Damping (TD)	0.15 s/ft
% Skin Friction	82%
Distribution Shape	Variable
Est. Driving Resistance	609.6 kips
Pile Penetration	87%
Hammer Energy Range	80 to 100 ft-kips APE D36-32 Open Ended Diesel Hammer with a rated energy of 89.3 ft-kips was assumed for the analyses

Driving resistance structural limit state check:

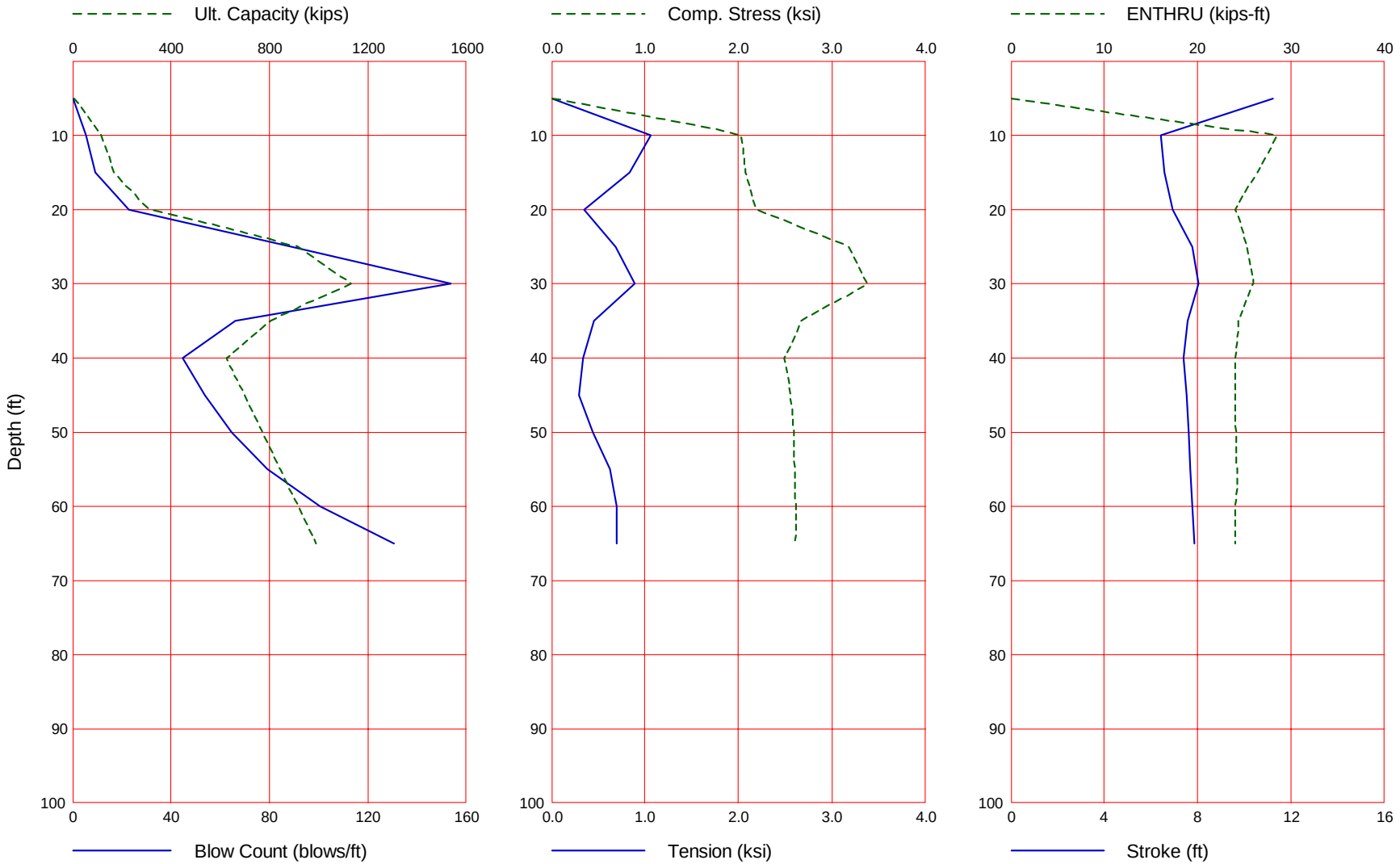
Est. Dvg. Res. for Interior Bent 4 < Dvg Res. Structural Limit Þ 609.6 kips < 1380 kips \ Section Satisfactory

Interior Bent 4
APE D36-32

TSVC, INC. - Jacksonville
I-95 BRO Bagshaw - Interior Bent 4 D36

Jul 27 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Interior Bent 4
APE D36-32

TSVC, INC. - Jacksonville
I-95 BRO Bagshaw - Interior Bent 4 D36

Jul 27 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	5.5	5.5	0.0	0.0	0.000	0.000	11.25	0.0
10.0	116.8	32.4	84.4	5.6	2.031	-1.056	6.44	28.5
15.0	166.3	67.1	99.2	9.3	2.070	-0.842	6.58	26.4
20.0	311.9	91.4	220.6	22.8	2.188	-0.348	6.93	24.1
25.0	917.9	140.1	777.8	89.5	3.189	-0.690	7.80	25.3
30.0	1133.1	219.2	913.9	153.6	3.386	-0.892	8.06	26.0
35.0	804.4	307.2	497.2	66.3	2.675	-0.457	7.56	24.4
40.0	623.9	380.8	243.1	44.8	2.486	-0.338	7.41	24.0
45.0	697.6	454.5	243.1	53.8	2.551	-0.290	7.51	24.0
50.0	771.2	528.2	243.1	64.8	2.601	-0.446	7.62	24.2
55.0	844.9	601.8	243.1	79.3	2.603	-0.620	7.72	24.3
60.0	918.5	675.5	243.1	100.5	2.616	-0.698	7.78	24.1
65.0	992.2	749.1	243.1	130.8	2.612	-0.697	7.89	24.1

Total Continuous Driving Time 89.00 minutes; Total Number of Blows 3778 (starting at penetration 5.0 ft)

EXHIBIT C-7: LATERAL ANALYSIS OF FOUNDATIONS

Group Reduction Factor for Lateral Pile and Shaft Analysis

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project Number:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
Date:	7/27/2021
Reference:	Table 10.7.2.4.1- Pile P-Multipliers (also 10.8.2.3), Pm for Multiple Row Shading (averaged from Hannigan et al., 2006), AASHTO LRFD BDS, 2010

Structure: End Bents		
Number Piles per Bent:	9	*Single row*
End Bent Type:	Steel HP14x89 Pile	*Strong Axis (Transverse)*
Pile Dia (B) =	14.7	inches
Pile Spacing at End Bent (S) =	7.75	feet
S/B ratio at End Bent =	6.33	
Weighted Pm used for Bent Analysis =	**0.97**	

Structure: Interior Bents		
Number Pile's per Bent:	9	*Single row*
Bent Type:	SQ PSC Piles	*(Transverse)*
Pile Diameter (B) =	20.0	inches
Spacing at Bent (S) =	7.75	feet
S/B ratio at Interior Bent =	4.65	
Weighted Pm used for Bent Analysis =	**0.68**	

	Pile CTC Spacing	P-Multipliers, Pm		
		Row 1	Row 2	Row 3 or more rows
AASHTO Coefficients	3	0.80	0.40	0.30
	5	1.00	0.85	0.70
End Bent Transverse	6.33	1.00	1.00	0.97
Interior Bent Transverse	4.65	0.97	0.77	0.63

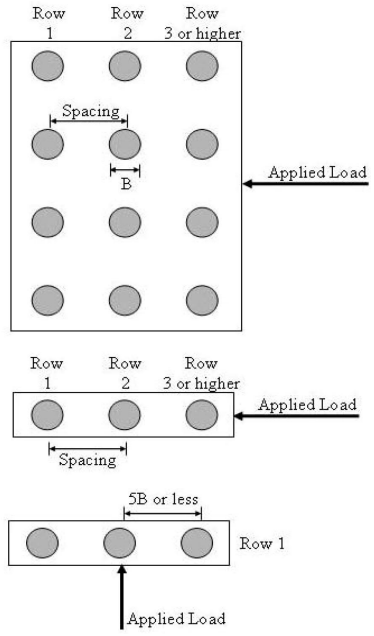


Figure. Definition of Loading Direction and Spacing for Group Effects (AASHTO Figure 10.7.2.4-1)

Analysis Methodology – End Bents 1 and 5

Analysis Methodology	
Analysis Type	Lateral Analysis of Foundations
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	End Bents 1 and 5
Soil Boring Model	Refer to Exhibit C-3 for Subsurface Soil Parameters and soil column stratigraphy changes with respect to depth and elevation
Analysis Method	Lateral loading analyses were performed using the software program LPile version 2019 based upon the load reactions and structural information provided by Mead & Hunt as shown in Exhibit C-4. The steel piles are analyzed as strong and weak-axis H-Piles.
Group Reduction	Group Reduction: • Longitudinal Group reduction factor = 1.0. See Group Reduction Factor analysis. • Transverse Group reduction factor = 0.97. See Group Reduction Factor analysis.
Scour Depth	• As shown on the plans (Exhibit C-4), scour is not expected at the end bents. Also, end bents are protected by RipRap.
Design Notes	• Strong axis is assumed in the longitudinal and weak axis is in the transverse direction.
Foundation Element	• Steel H-Pile HP 14x89
Loading Conditions	• Strength limit states were analyzed under loads provided by ICE. (See Exhibit C-4) • Extreme Event I (Earthquake) Limit State was analyzed under lateral displacements and axial loads provided by ICE. See Exhibit C-4. • The critical depth to achieve lateral stability was determined as the pile length at which the pile head deflection is approximately constant when increasing pile length.
Performance Limit	GDM 2019 Section 10.2.1 states that Performance Objectives and Performance Limits for bridge structures at the Strength, Service and Extreme Event limit states shall be developed by the SEOR. Lateral analysis with geotechnical input into LPILE was provided to the structural engineer in order to achieve consistent displacements.

END BENTS 1 AND 5
SOIL PROFILE

Pavement Elev. : 28.0 ft Subsurface Model : See Exhibit C-3
Top of Pile/Load Elev. : 21.4 ft
Top of Bearing Layer Elev. : -12.0 ft 500-yr Scour Elev. : N.A.
Groundwater Elev.: 15.0 ft

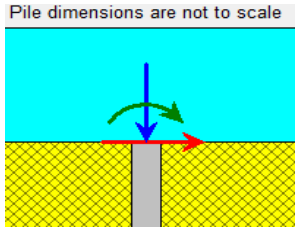
Layer Name	Model	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)
		LPILE INPUT						**Static**
Existing FILL	Sand (Reese, et al.)	0.0	1.4	21.4	20.0	120	36	--
	Sand (Reese, et al.)	1.4	6.4	20.0	15.0	120	30	--
ALLUVIUM	Mod. Stiff clay w/o free water	6.4	12.4	15.0	9.0	125 - 62.6	--	1.2
	Sand (Reese, et al.)	12.4	21.4	9.0	0.0	37.6	28	--
	Sand (Reese, et al.)	21.4	33.4	0.0	-12.0	57.6	36	--
	Stiff clay w/o free water	33.4	101.4	-12.0	-80.0	52.6	--	3.5

Default values were used for E50 for clay layers and k for sand layers.

							ϕ_{rl}	τ_{rl}	**SSL**
ALLUVIUM	Soft Clay (Matlock)	12.4	15.4	9	6	37.6	3	0.125	
	Soft Clay (Matlock)	15.4	19.4	6	2	37.6	6	0.125	
	Soft Clay (Matlock)	19.4	23.4	2	-2	37.6	5	0.125	
	Soft Clay (Matlock)	23.4	31.4	-2	-10	37.6	7	0.3	
	Soft Clay (Matlock)	31.4	33.4	-10	-12	37.6	16	1.3	

Input as one stratum into LPILE with undrained cohesion of 125 psf.

Loading Diagram



Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

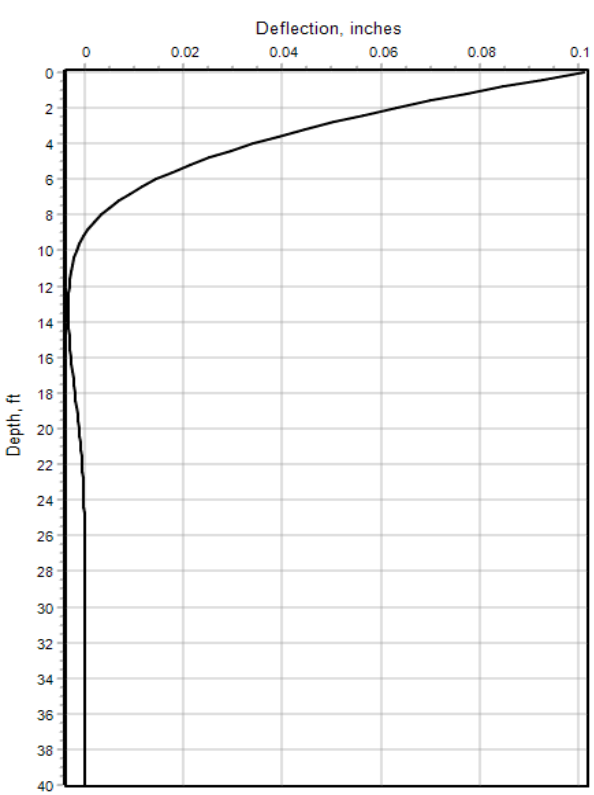
Terracon Project No. EN175299
Scale: NTS
Date: 7/27/2021

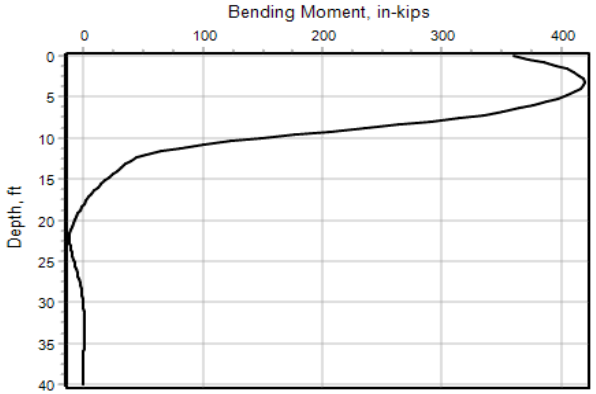
Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

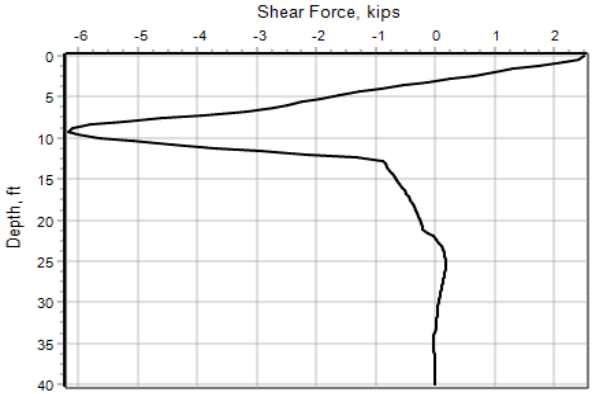
I-95 Bridge Replacement over Bagshaw Swamp
Lateral Analyis of Piles
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

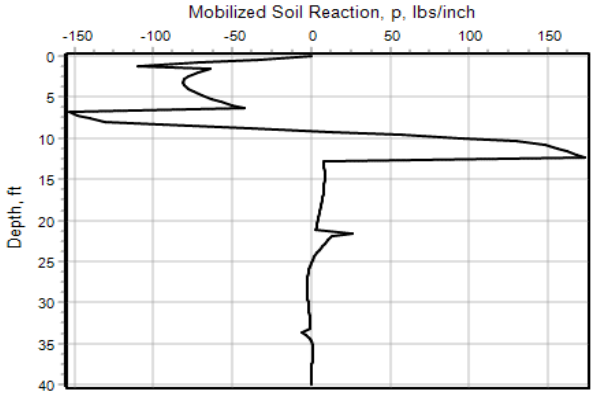
EXHIBIT C-7

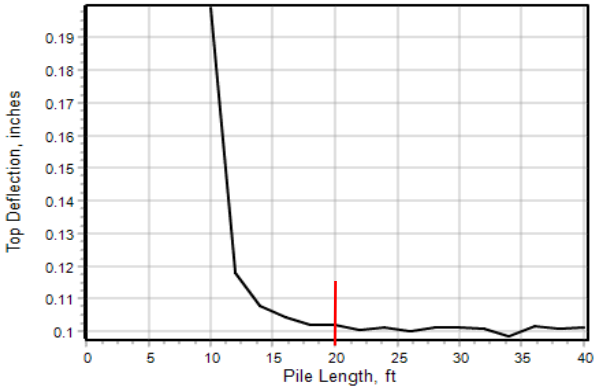
END BENTS 1 AND 5
Loading: Strength, Longitudinal (Strong Axis), Pm = 1.0







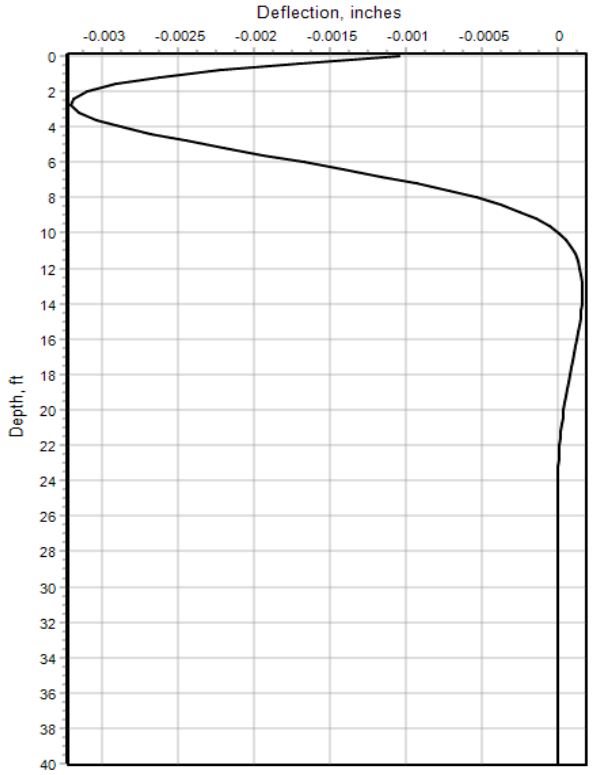


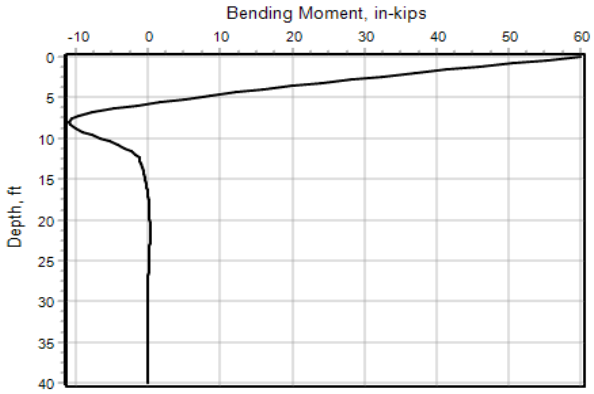


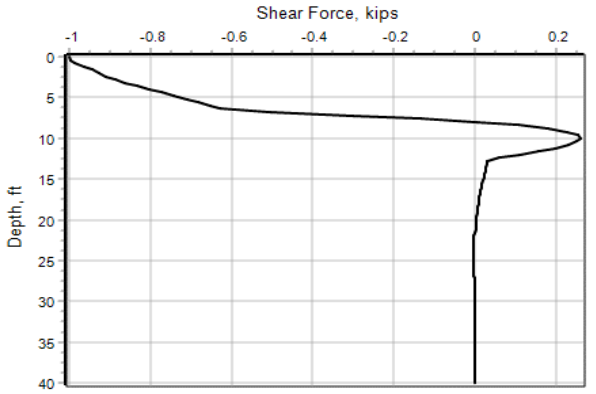
Critical Length=20 feet,
Axial Controlling

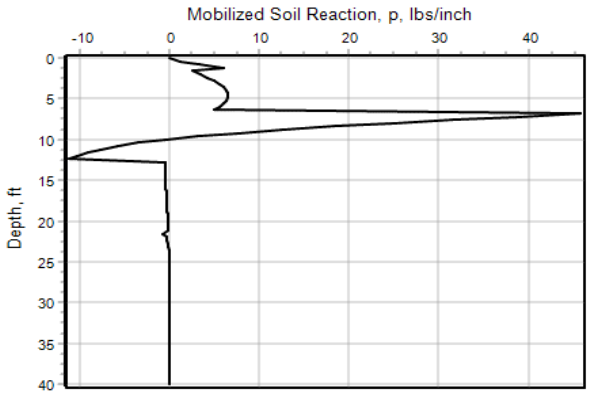
Project Mgr: HJC	Terracon Project No. EN175299	Terracon 1450 FIFTH STREET WEST NORTH CHARLESTON, SC PH: (843) 884-1234 Fax. (843) 884-9234	**I-95 Bridge Replacement over Bagshaw Swamp** **Lateral Analyis of Piles** **Jasper County** **South Carolina** **SCDOT File No: P030260** **Client: ICE, PLLC**	**EXHIBIT** **C-7**
Prepared by: AQF				
Checked by: DJC	Scale: NTS			
Approved by: TCS	Date: 10/8/2021			

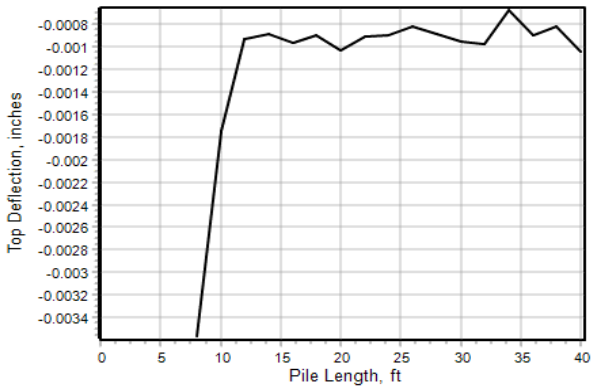
END BENTS 1 AND 5
Loading: Strength, Transverse (Weak Axis), Pm=0.97











Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

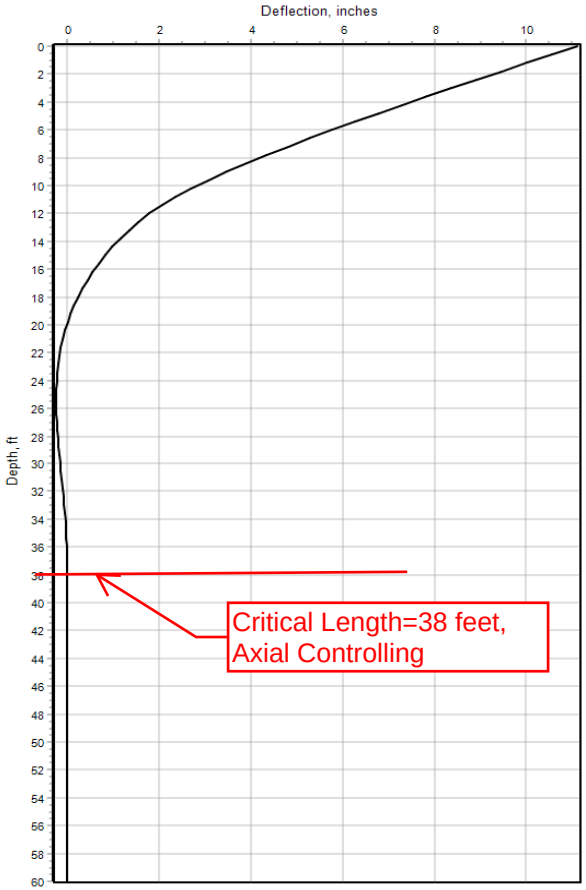
Jasper County **South Carolina**

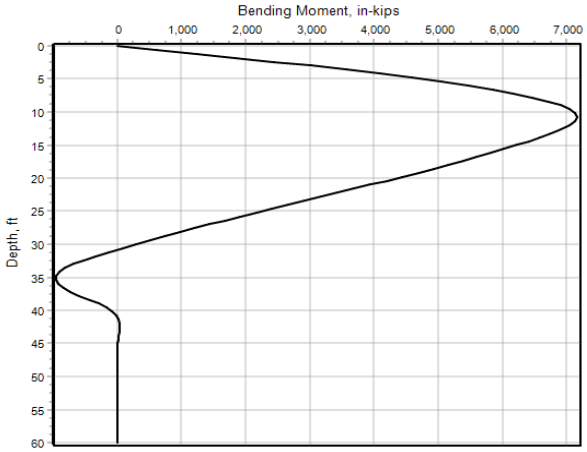
SCDOT File No: P030260 **Client: ICE, PLLC**

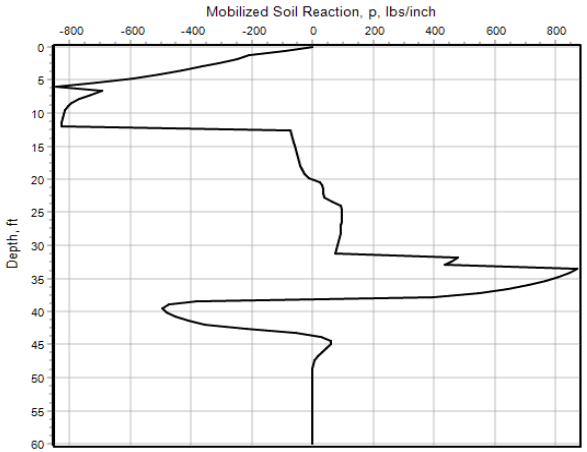
EXHIBIT

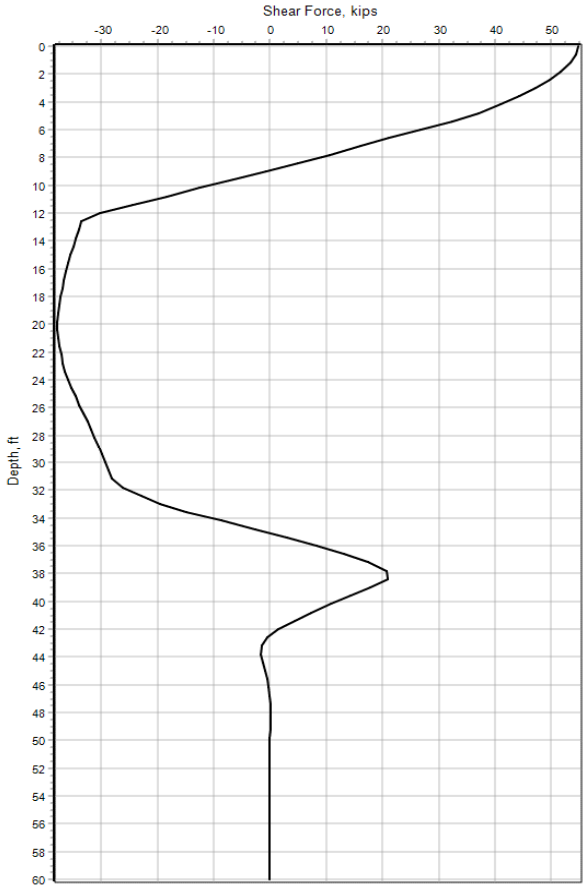
C-7

END BENTS 1 AND 5
Loading: EE I (SEE), Longitudinal (Strong Axis), Pm=1.0









Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/11/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

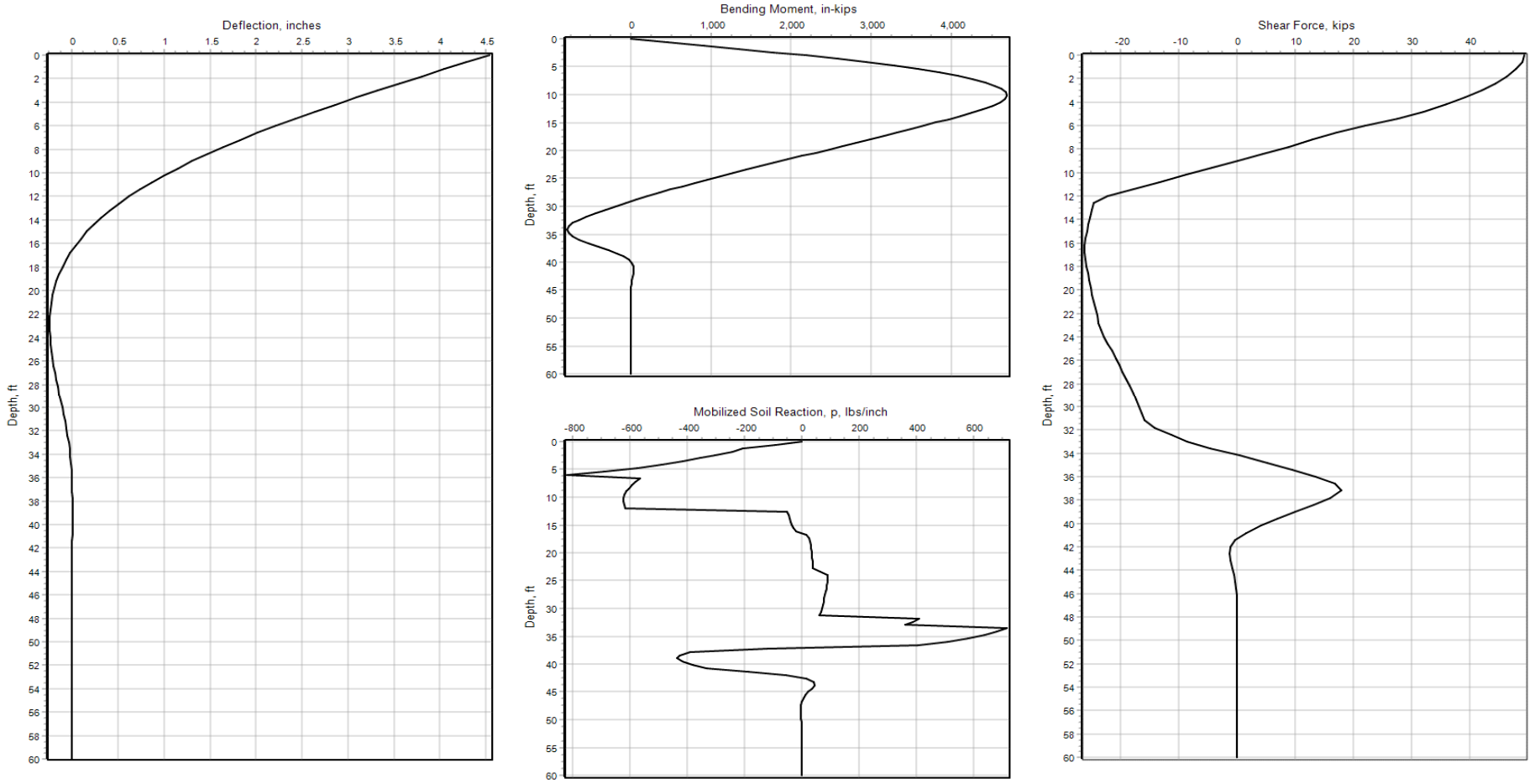
Jasper County **South Carolina**

SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT

C-7

END BENTS 1 AND 5
Loading: EE I (SEE), Transverse (Weak Axis), Pm=0.97



Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/11/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

Jasper County **South Carolina**

SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT

C-7

Analysis Methodology – Interior Bents 2, 3, 4

Analysis Methodology	
Analysis Type	Lateral Analysis of Foundations
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	Interior Bents 2, 3, 4
Soil Boring Model	Refer to Exhibit C-3 for Subsurface Soil Parameters and soil column stratigraphy changes with respect to depth and elevation
Analysis Method	Lateral loading analyses were performed using the software program LPile version 2019 based upon the load reactions and structural information provided by Mead & Hunt. The drilled shafts are analyzed as elastic non-yielding section members.
Group Reduction	Group Reduction: • Longitudinal Group reduction factor = 1.0. See Group Reduction Factor analysis. • Transverse Group reduction factor = 0.68. See Group Reduction Factor analysis.
Scour Depth	As shown on the plans (Exhibit C-4), scour profile is as follows: • 100-year scour profile: Elev. 11 ft. • 500-year scour profile: Elev. 9 ft.
Design Notes	• Lateral forces and moments along with axial forces from Exhibit C-4 have been input into LPILE.
Foundation Element	• Prestressed Concrete Piles: PSC 20-inch Square
Loading Conditions	• Service and strength loads were analyzed as shown in Exhibit C-4. • Earthquake Extreme Event Limit State was analyzed based on the SEE and FEE forces provided by ICE at the bottom of cap/top of pile. • SSL condition has been included as detailed in Exhibit C-3. • Extreme Event II was not analyzed. Based on direction from ICE, the check flood (500-year flow event) will pass by inspection since it is only 2 feet lower than the 100-year scour profile. • The critical depth to achieve lateral stability was determined as the pile length at which the pile head deflection is approximately constant when increasing pile length.
Performance Limit	GDM 2019 Section 10.2.1 states that Performance Objectives and Performance Limits for bridge structures at the Strength, Service and Extreme Event limit states shall be developed by the SEOR. Lateral analysis with geotechnical input into LPILE was provided to the structural engineer in order to achieve consistent displacements. The load elevation at the interior bent provided by ICE is at the base of column or top of pile- Elev. 22 ft.

INTERIOR BENT 2
SOIL PROFILE

Pavement Elev. :	28.0 ft	Subsurface Model :	See Exhibit C-3
Top of Pile/Load Elev. :	22.0 ft	Mudline Elev.	17.0 ft
Top of Bearing Layer Elev. :	-12.0 ft	100-yr Scour Elev. :	11.0 ft
Groundwater Elev.:	15.0 ft		

Layer Name	Model	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)	Static
		LPILE INPUT							
Existing FILL	Sand (Reese, et al.)	The scourable soils above Elev. 11 ft have been excluded.							
ALLUVIUM	Mod. Stiff clay w/o free water	11.0	13.0	11.0	9.0	62.6	--	1.2	
	Sand (Reese, et al.)	13.0	22.0	9.0	0.0	37.6	28	--	
	Sand (Reese, et al.)	22.0	34.0	0.0	-12.0	57.6	36	--	
	Stiff clay w/o free water	34.0	102.0	-12.0	-80.0	52.6	--	3.5	

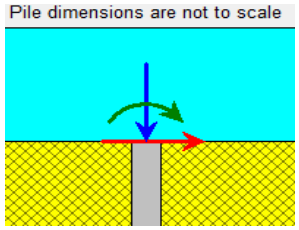
Default values were used for E50 for clay layers and k for sand layers.

							ϕ_{rl}	τ_{rl}	SSL
ALLUVIUM	Soft Clay (Matlock)	13.0	16.0	9	6	37.6	3	0.125	
	Soft Clay (Matlock)	16.0	20.0	6	2	37.6	6	0.125	
	Soft Clay (Matlock)	20.0	24.0	2	-2	37.6	5	0.125	
	Soft Clay (Matlock)	24.0	32.0	-2	-10	37.6	7	0.3	
	Soft Clay (Matlock)	32.0	34.0	-10	-12	37.6	16	1.3	

Resistance from the scourable soils have been included in the EE1 loading condition. (Depth: 8 - 13 feet: Existing FILL modeled by Sand (Reese, et al.) model)

Input as one stratum into LPILE with undrained cohesion of 125 psf.

Loading Diagram



Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS
Terracon Project No.	EN175299
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp
Lateral Analyis of Piles
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT
C-7

INTERIOR BENT 3
SOIL PROFILE

Pavement Elev. :	28.0 ft	Subsurface Model :	See Exhibit C-3
Top of Pile/Load Elev. :	22.0 ft	Mudline Elev.	14.0 ft
Top of Bearing Layer Elev. :	-12.0 ft	100-yr Scour Elev. :	11.0 ft
Groundwater Elev.:	15.0 ft		

Layer Name	Model	LPILE INPUT Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)	Static
ALLUVIUM	Mod. Stiff clay w/o free water	11.0	13.0	11.0	9.0	62.6	--	1.2	
	Sand (Reese, et al.)	13.0	22.0	9.0	0.0	37.6	28	--	
	Sand (Reese, et al.)	22.0	34.0	0.0	-12.0	57.6	36	--	
	Stiff clay w/o free water	34.0	102.0	-12.0	-80.0	52.6	--	3.5	

Default values were used for E50 for clay layers and k for sand layers.
The scourable soils above Elev. 11 ft have not been included in the LPILE model.

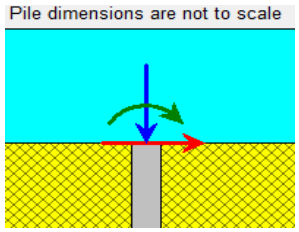
Layer Name	Model	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ_{rl}	τ_{rl}	SSL
ALLUVIUM	Soft Clay (Matlock)	13.0	16.0	9	6	37.6	3	0.125	
	Soft Clay (Matlock)	16.0	20.0	6	2	37.6	6	0.125	
	Soft Clay (Matlock)	20.0	24.0	2	-2	37.6	5	0.125	
	Soft Clay (Matlock)	24.0	32.0	-2	-10	37.6	7	0.3	
	Soft Clay (Matlock)	32.0	34.0	-10	-12	37.6	16	1.3	

Resistance from the scourable soils have been included in the EE1 loading condition. (Depth: 8 - 13 feet: Existing FILL modeled by Sand (Reese, et al.) model)

Input as one stratum into LPILE with undrained cohesion of 125 psf.

Loading Diagram

Pile dimensions are not to scale



Project Mgr:	HJC	Terracon Project No.	EN175299	Terracon	I-95 Bridge Replacement over Bagshaw Swamp
Prepared by:	AQF				Lateral Analysis of Piles
Checked by:	DJC	Scale:	NTS		Jasper County / South Carolina
Approved by:	TCS	Date:	10/8/2021	1450 FIFTH STREET WEST NORTH CHARLESTON, SC PH: (843) 884-1234 Fax. (843) 884-9234	SCDOT File No: P030260 / Client: ICE, PLLC

EXHIBIT C-7

INTERIOR BENT 4
SOIL PROFILE

Pavement Elev. :	28.0 ft	Subsurface Model :	See Exhibit C-3
Top of Pile/Load Elev. :	22.0 ft	Mudline Elev.	16.0 ft
Top of Bearing Layer Elev. :	-12.0 ft	100-yr Scour Elev. :	11.0 ft
Groundwater Elev.:	15.0 ft		

Layer Name	Model	Top Depth (ft)	Bott. Depth (ft)	Top Elev. (ft)	Bott. Elev. (ft)	γ' (pcf)	ϕ (°)	S_u (ksf)	Static
		LPILE INPUT							
Existing FILL	Sand (Reese, et al.)	The scourable soils above Elev. 11 ft have been excluded.							
ALLUVIUM	Mod. Stiff clay w/o free water	11.0	13.0	11.0	9.0	62.6	--	1.2	
	Sand (Reese, et al.)	13.0	22.0	9.0	0.0	37.6	28	--	
	Sand (Reese, et al.)	22.0	34.0	0.0	-12.0	57.6	36	--	
	Stiff clay w/o free water	34.0	102.0	-12.0	-80.0	52.6	--	3.5	

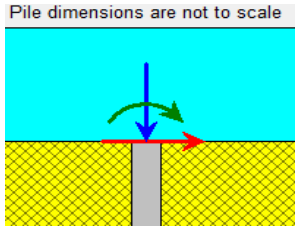
Default values were used for E50 for clay layers and k for sand layers.

							ϕ_{rl}	τ_{rl}	SSL
ALLUVIUM	Soft Clay (Matlock)	13.0	16.0	9	6	37.6	3	0.125	
	Soft Clay (Matlock)	16.0	20.0	6	2	37.6	6	0.125	
	Soft Clay (Matlock)	20.0	24.0	2	-2	37.6	5	0.125	
	Soft Clay (Matlock)	24.0	32.0	-2	-10	37.6	7	0.3	
	Soft Clay (Matlock)	32.0	34.0	-10	-12	37.6	16	1.3	

Resistance from the scourable soils have been included in the EE1 loading condition. (Depth: 8 - 13 feet: Existing FILL modeled by Sand (Reese, et al.) model)

Input as one stratum into LPILE with undrained cohesion of 125 psf.

Loading Diagram



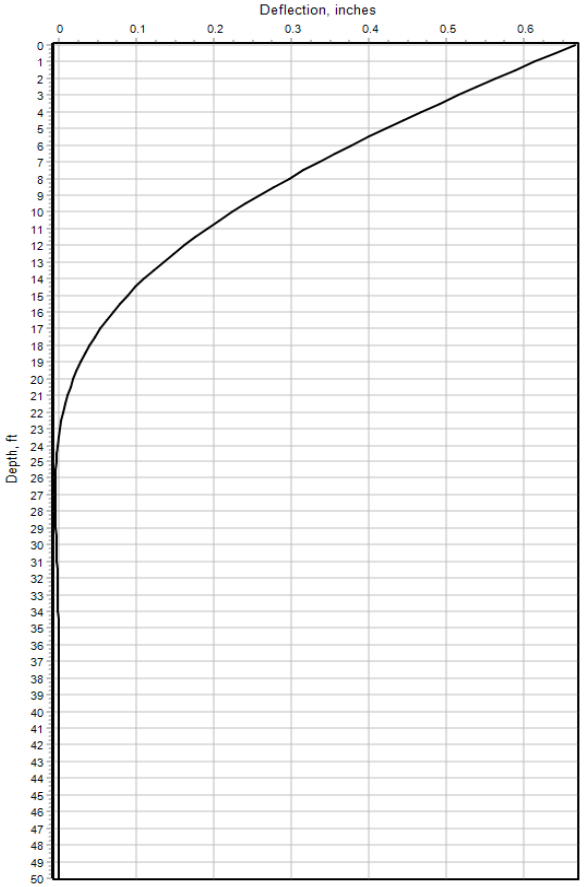
Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS
EN175299	EN175299
Scale:	NTS
Date:	10/8/2021

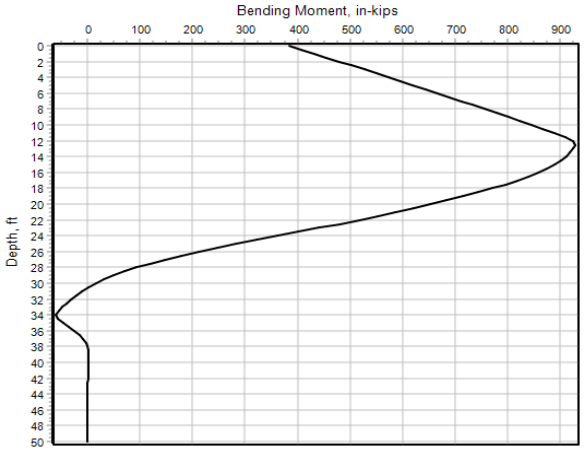
Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

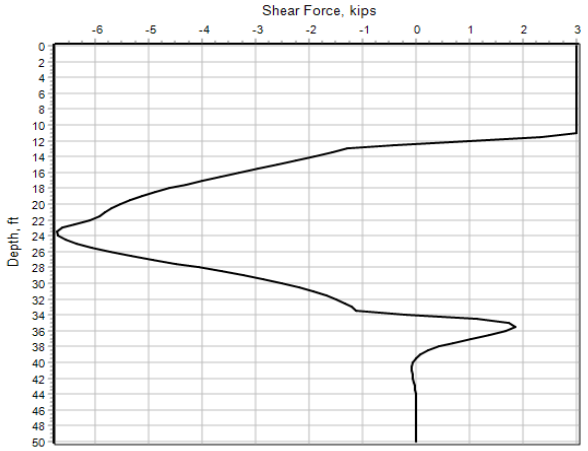
I-95 Bridge Replacement over Bagshaw Swamp
Lateral Analysis of Piles
Jasper County **South Carolina**
SCDOT File No: P030260 **Client: ICE, PLLC**

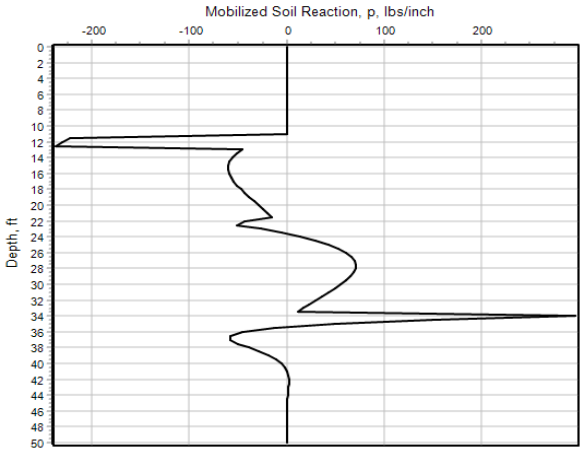
EXHIBIT
C-7

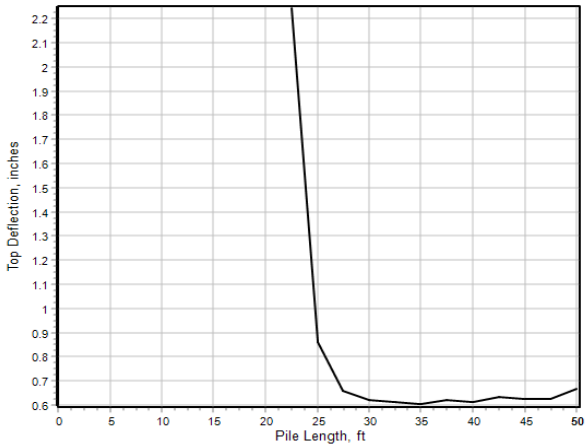
INTERIOR BENT 2
Loading: Strength, Longitudinal, Pm=1.0





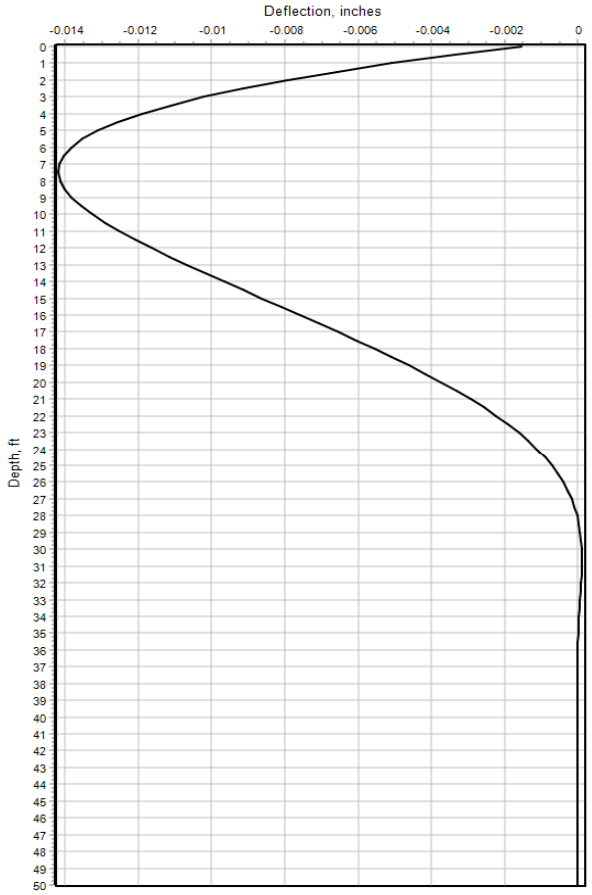


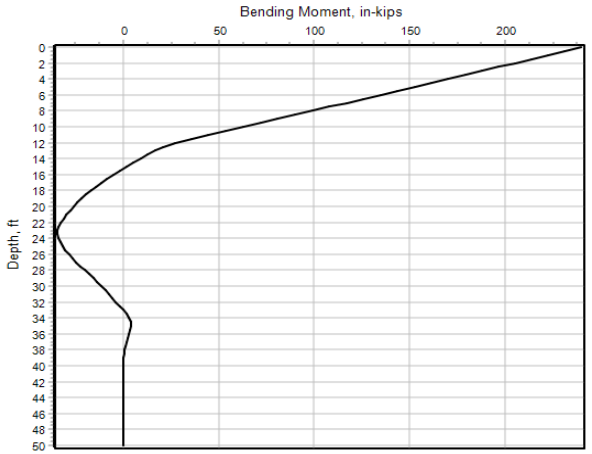


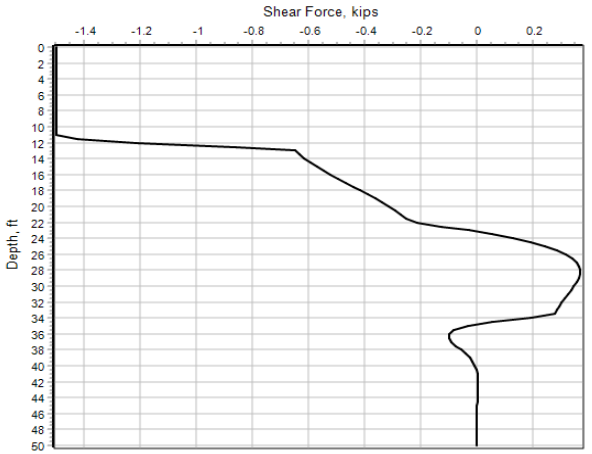


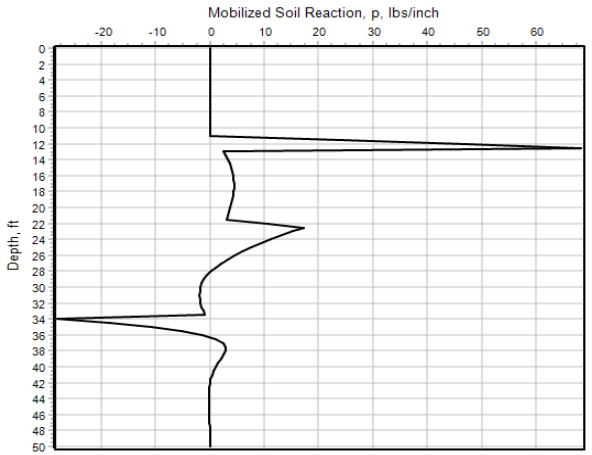
Project Mgr: HJC	Terracon Project No. EN175299	Terracon	I-95 Bridge Replacement over Bagshaw Swamp	EXHIBIT
Prepared by: AQF			Lateral Analyis of Piles	
Checked by: DJC	Scale: NTS	1450 FIFTH STREET WEST NORTH CHARLESTON, SC	Jasper County South Carolina	C-7
Approved by: TCS	Date: 10/8/2021	PH: (843) 884-1234 Fax. (843) 884-9234	SCDOT File No: P030260 Client: ICE, PLLC	

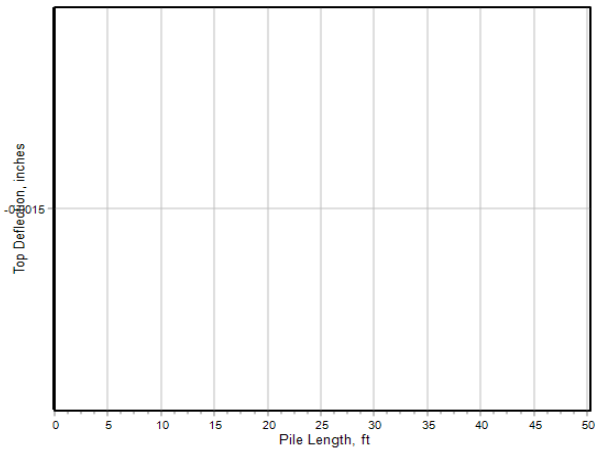
INTERIOR BENT 2
Loading: Strength, Transverse, Pm=0.68











Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

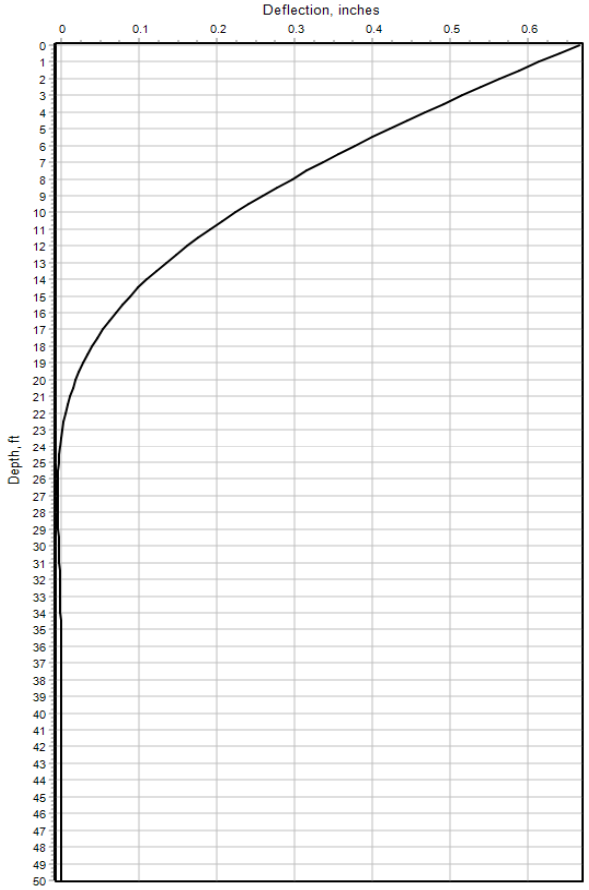
Jasper County **South Carolina**

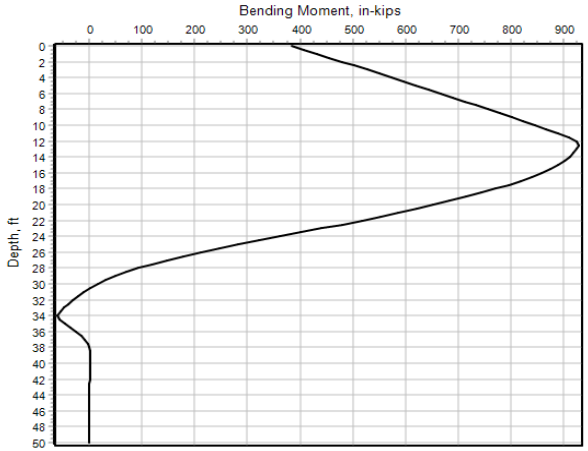
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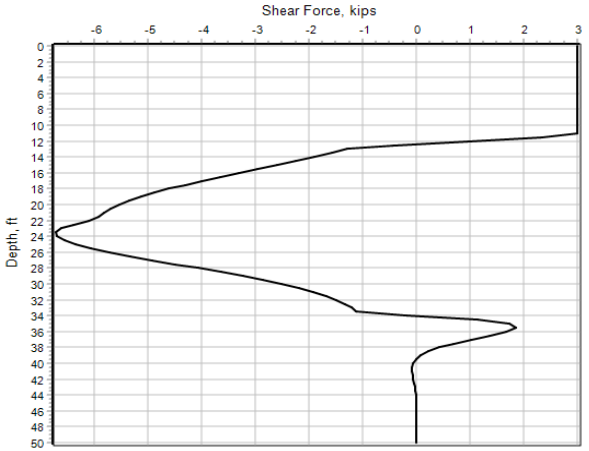
EXHIBIT

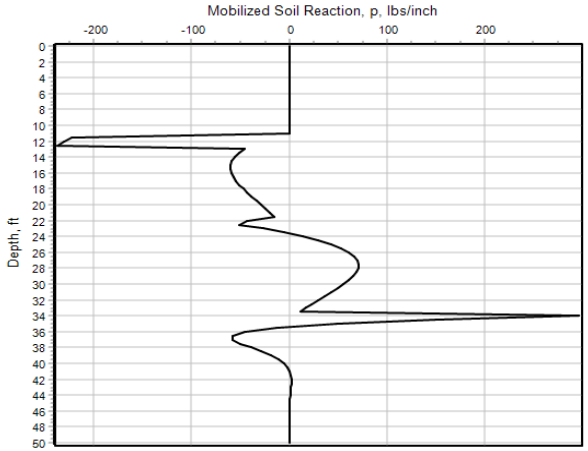
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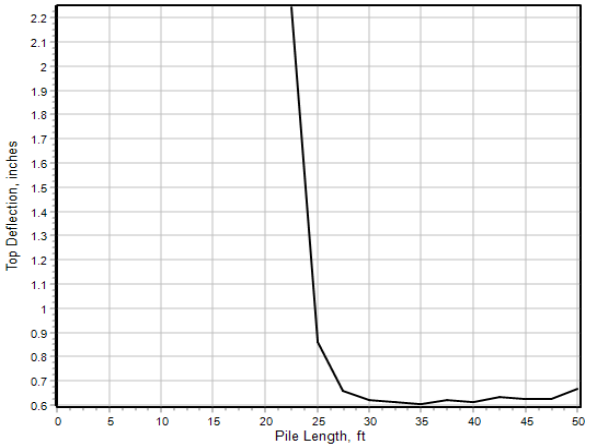
INTERIOR BENT 3
Loading: Strength, Longitudinal, Pm=1.0





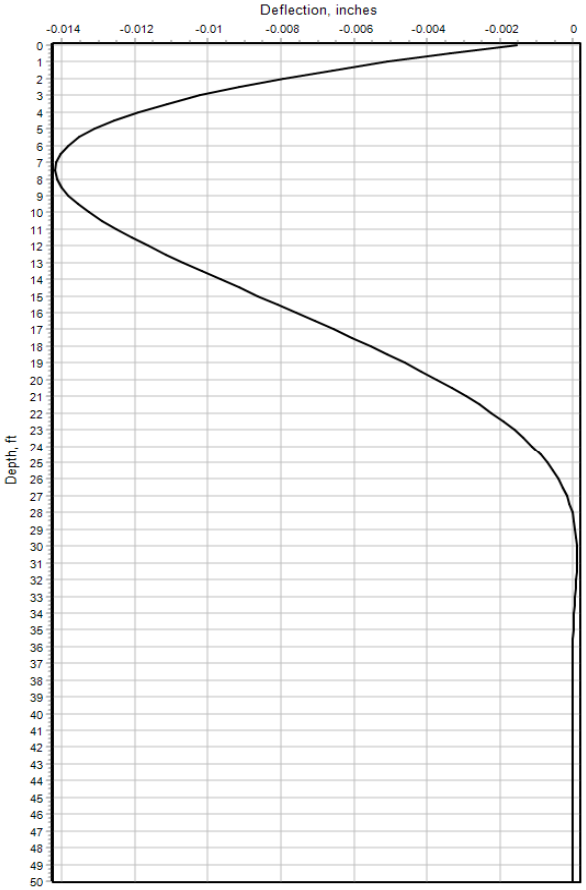


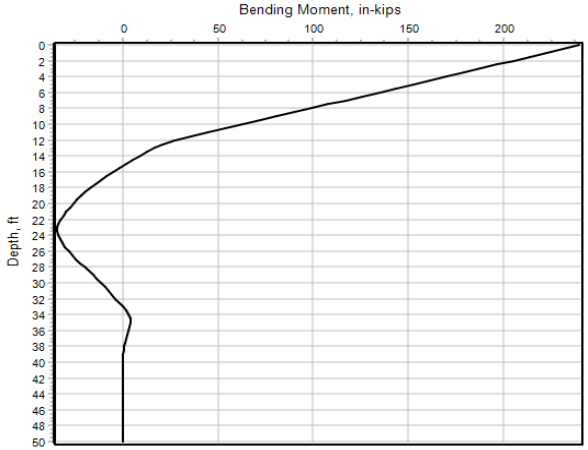


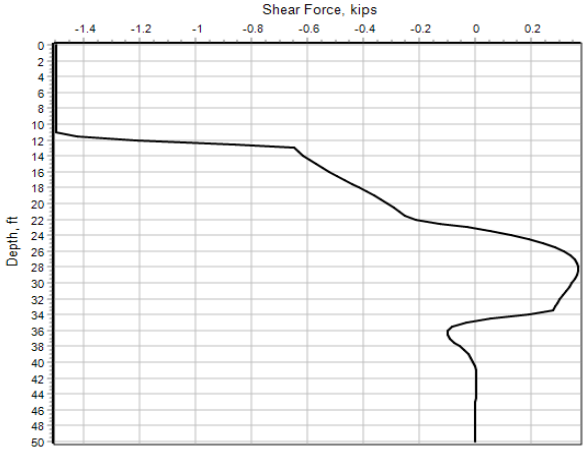


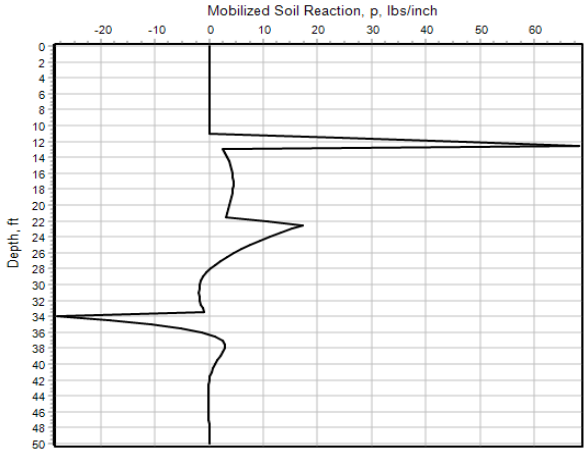
Project Mgr: HJC	Terracon Project No. EN175299	Terracon	I-95 Bridge Replacement over Bagshaw Swamp	EXHIBIT
Prepared by: AQF			Lateral Analyis of Piles	
Checked by: DJC	Scale: NTS	1450 FIFTH STREET WEST NORTH CHARLESTON, SC	Jasper County South Carolina	C-7
Approved by: TCS	Date: 10/8/2021	PH: (843) 884-1234 Fax. (843) 884-9234	SCDOT File No: P030260 Client: ICE, PLLC	

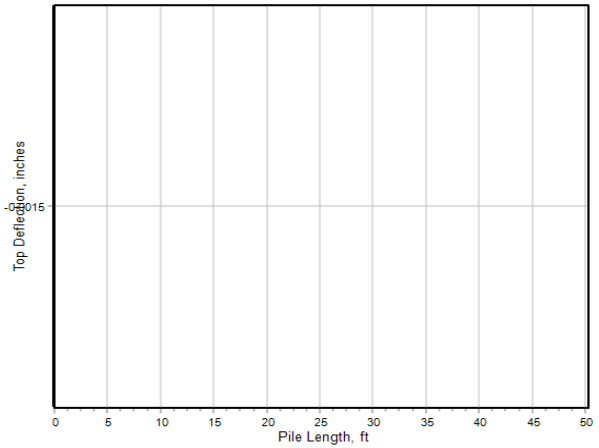
INTERIOR BENT 3
Loading: Strength, Transverse, Pm=0.68











Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

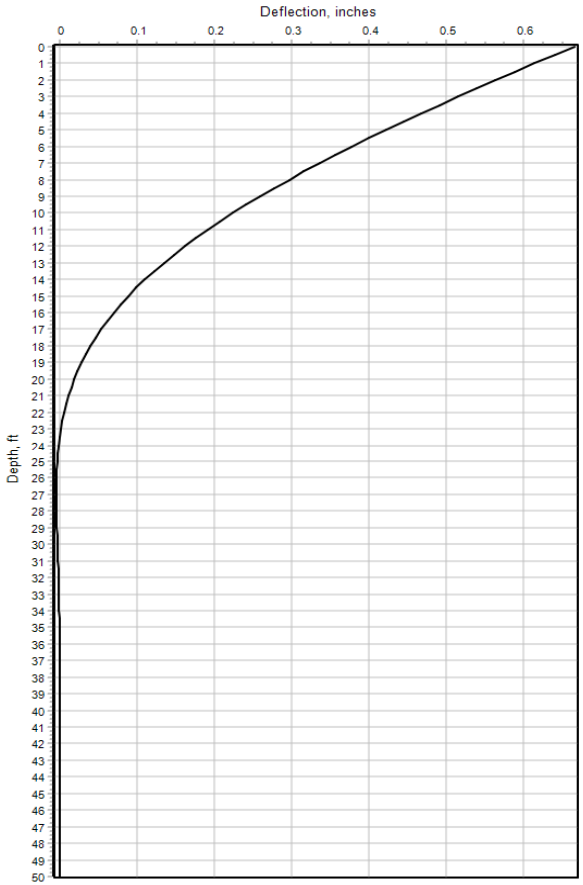
Jasper County **South Carolina**

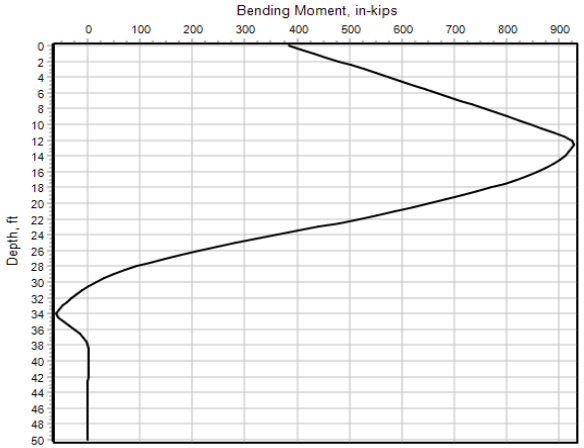
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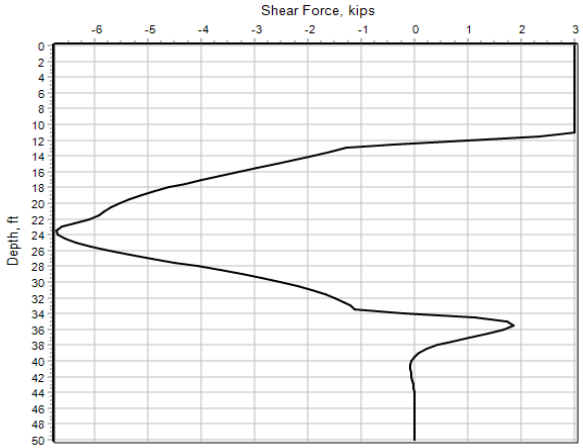
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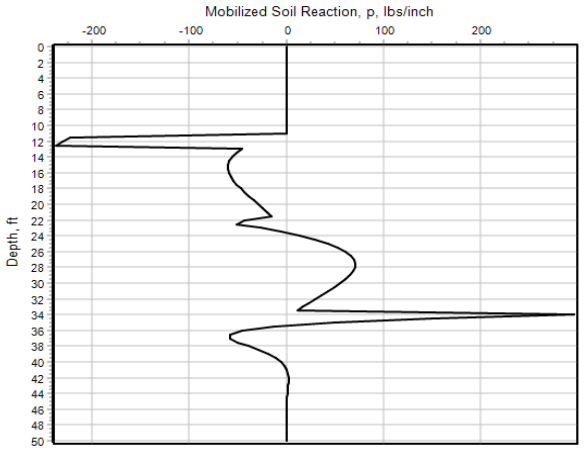
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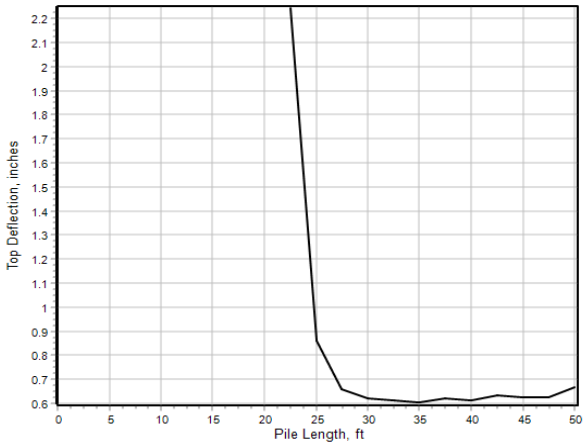
INTERIOR BENT 4
Loading: Strength, Longitudinal, Pm=1.0





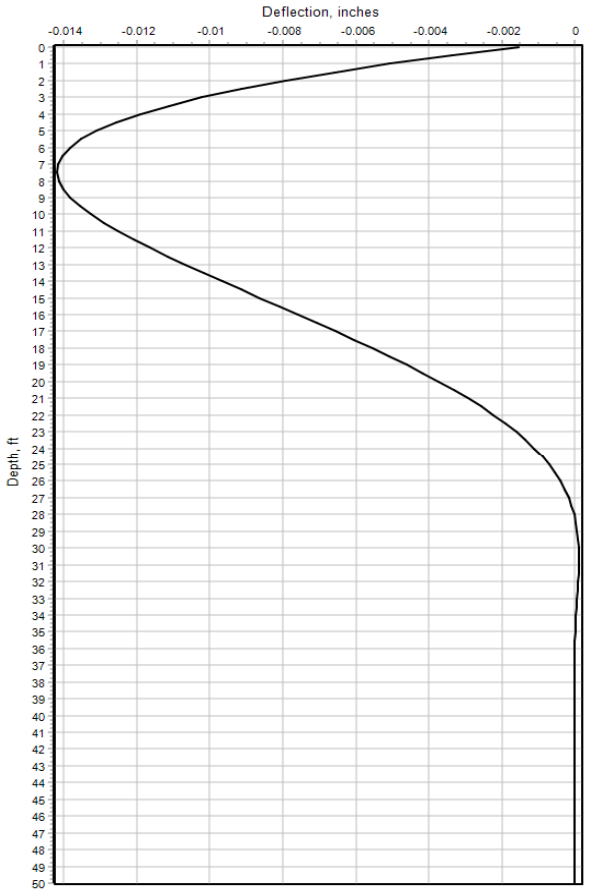


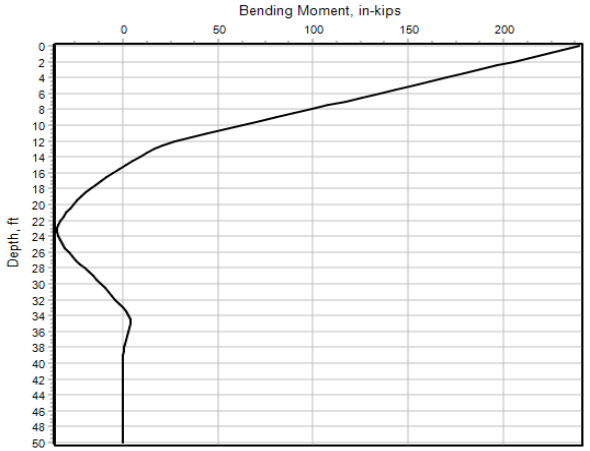


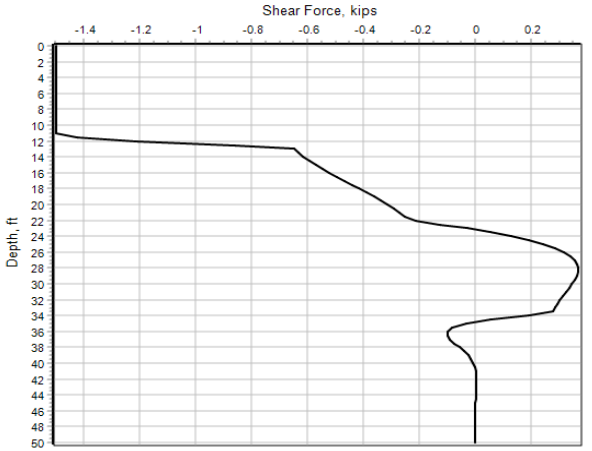


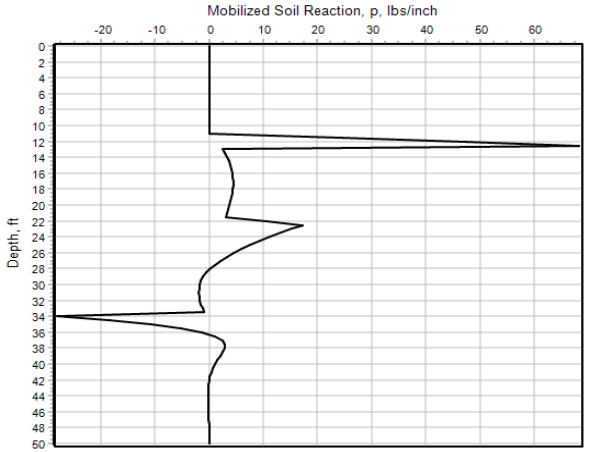
Project Mgr: HJC	Terracon Project No. EN175299	Terracon	I-95 Bridge Replacement over Bagshaw Swamp	EXHIBIT
Prepared by: AQF			Lateral Analyis of Piles	
Checked by: DJC	Scale: NTS	1450 FIFTH STREET WEST NORTH CHARLESTON, SC	Jasper County South Carolina	C-7
Approved by: TCS	Date: 10/8/2021	PH: (843) 884-1234 Fax. (843) 884-9234	SCDOT File No: P030260 Client: ICE, PLLC	

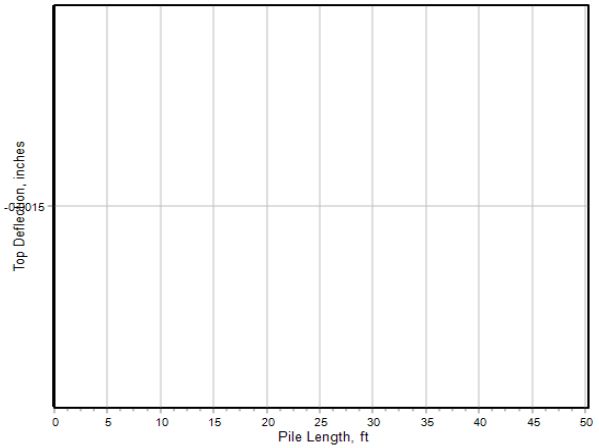
INTERIOR BENT 4
Loading: Strength, Longitudinal, Pm=0.68











Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

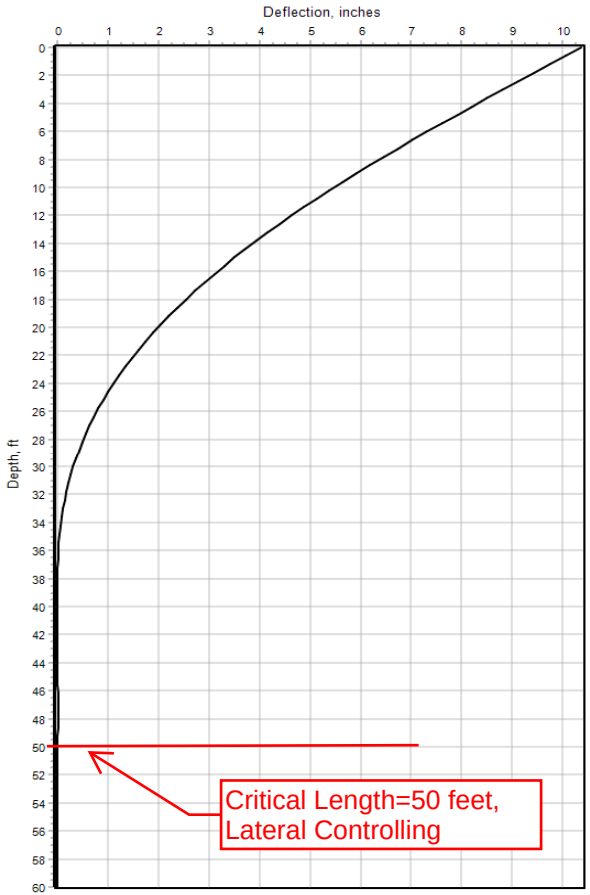
Jasper County **South Carolina**

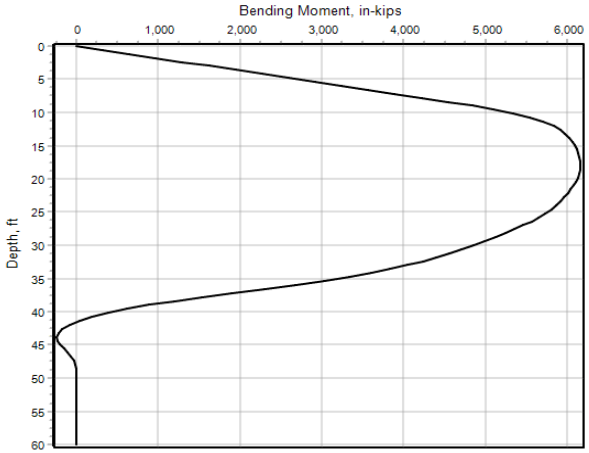
SCDOT File No: P030260 **Client: ICE, PLLC**

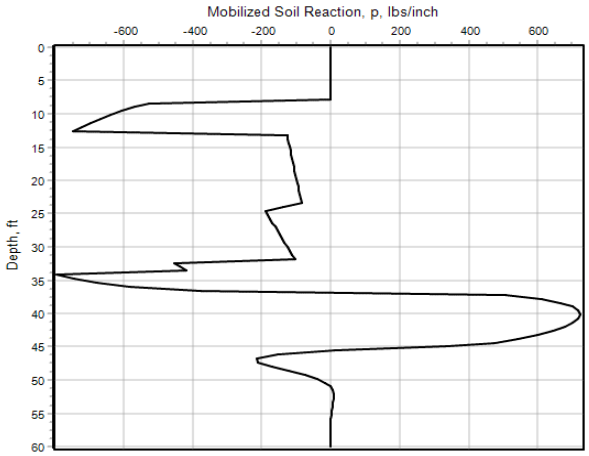
EXHIBIT

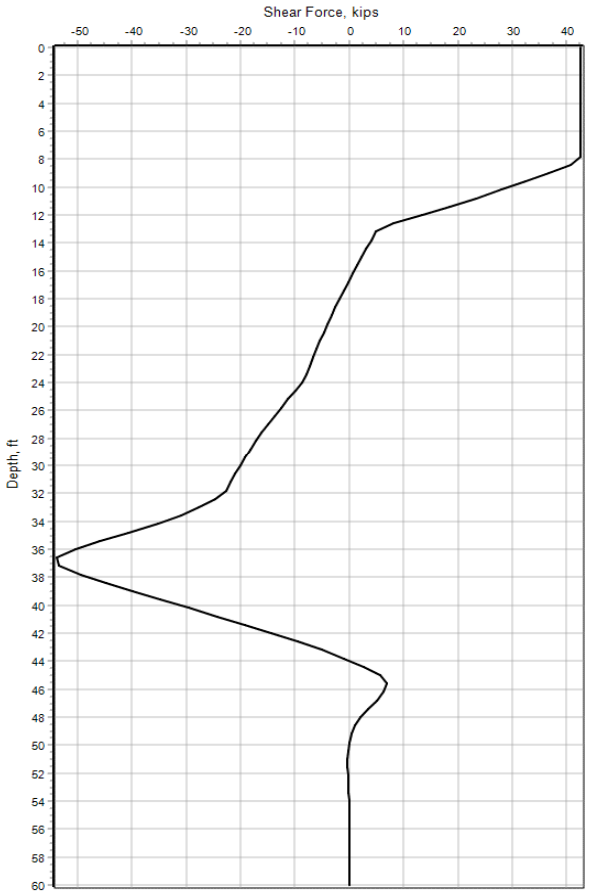
C-7

INTERIOR BENTS - Maximum Loading Combo (See Exhibit C-4)
Loading: EE I (SEE), Longitudinal, Pm=1.0









Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

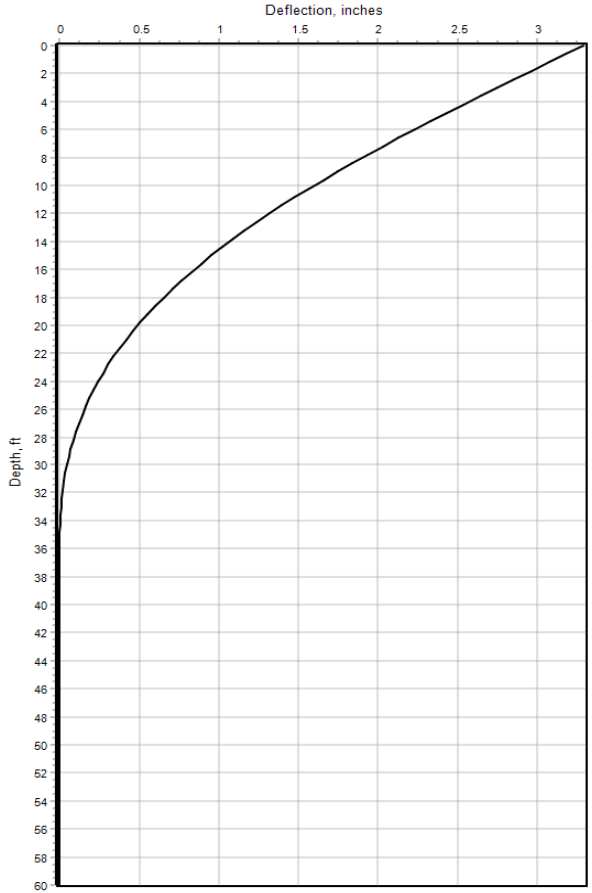
Jasper County **South Carolina**

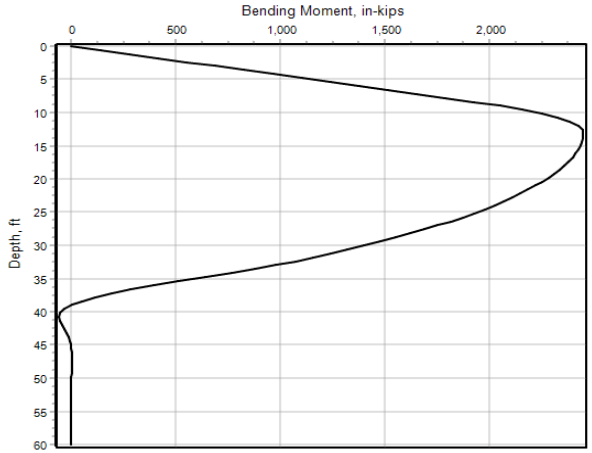
SCDOT File No: P030260 **Client: ICE, PLLC**

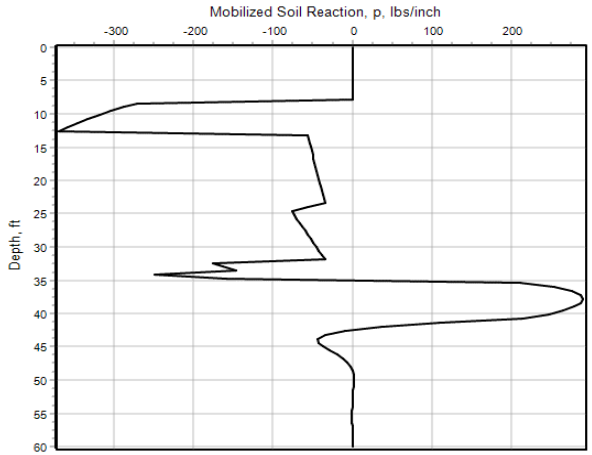
EXHIBIT

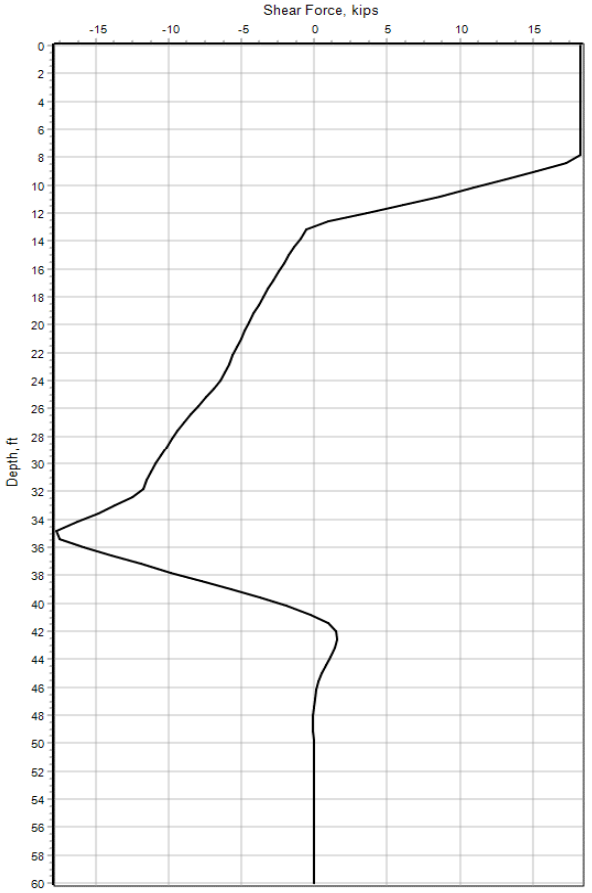
C-7

INTERIOR BENTS - Maximum Loading Combo (See Exhibit C-4)
Loading: EE I (SEE), Transverse, Pm=0.68









Project Mgr:	HJC
Prepared by:	AQF
Checked by:	DJC
Approved by:	TCS

Terracon Project No.	EN175299
Scale:	NTS
Date:	10/8/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

I-95 Bridge Replacement over Bagshaw Swamp

Lateral Analyis of Piles

Jasper County **South Carolina**

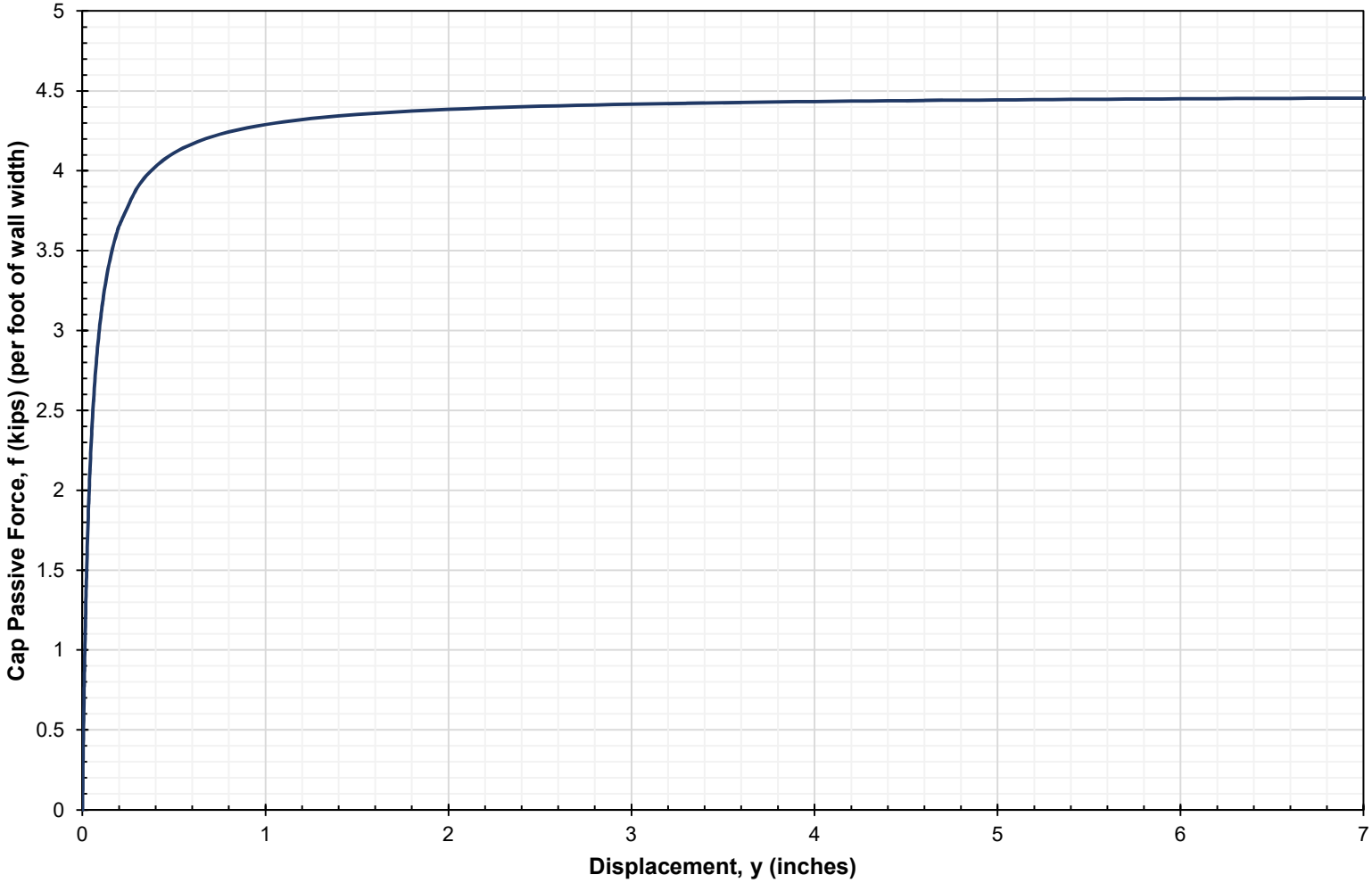
SCDOT File No: P030260 **Client: ICE, PLLC**

EXHIBIT

C-7

Passive Earth Pressure Against End Bent Walls

Hyperbolic Force Displacement Curve



Project Mgr:	HJC
Prepared by:	AF
Checked by:	HJC
Approved by:	DJC

Terracon Project No.	EN175299
Scale:	As Shown
Date:	10/14/2021

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

LATERAL FOUNDATION ANALYSIS

I-95 BRO Bagshaw Swamp

JASPER COUNTY **SOUTH CAROLINA**

SCDOT FILE NO.: P030260 **CLIENT: ICE**

EXHIBIT

C-7

EXHIBIT C-8: SLOPE STABILITY ANALYSIS

Project Name: I-95 Bridge Replacement over Bagshaw Swamp

Project Location: Jasper County, SC

SCDOT Project ID: P030260

Location of Analysis:

Approx. Station	Location	Bridge Operational Classification (OC)
515+00	Begin Bridge	OC I
518+00	End Bridge	OC I

Given Geometry: Bridge plans and profiles and roadway cross sections dated 6/3/2021.

Soil Profile and Parameters Used in Analysis: Based on soil test borings, cone penetrometer test soundings, and laboratory tests performed by Terracon

Analysis Methodology: Slope stability was checked against End of Construction, Long-term, Seismic (EE I), and Partial Submergence (EE II) loading conditions. Spencer method was employed for checking slope stability under static and seismic loads. End of construction was analyzed using total stress soil parameters (undrained condition), and long term was analyzed using effective stress soil parameters (drained condition). Circular and non-circular slip failure were checked. Results of one of the two failure modes have been shown here. Slope stability under Extreme Events I and II was checked using total stress soil parameters and following Spencer method.

Performance limit values for global instability have not been established in GDM 2019, but the performance objective is that the embankment does not adversely affect the bridge structure during the design seismic event. Newmark displacement analysis was conducted to estimate the horizontal and vertical displacements at top and bottom of embankment. The calculated displacements have been reported for the structural engineer to verify if the displacement will not adversely affect the bridge structure.

Summary of Analysis Results: See Slope Stability Resistance Factors sheet.

Comparison of Results to Performance Limits: See Slope Stability Resistance Factors sheet.

SLOPE STABILITY SUMMARY

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project No.:	EN175299
Structure:	Bridge Embankments
Computed By:	A. Fekrat
Checked By:	D.J. Corley
Date:	7/31/2021

Slope Stability Resistance Factors

Station	Average Slope Height (ft.)	Slope Inclination	Loading Conditions	Analysis Serial Number	φ	Method	D/C Remarks
						Spencer	
Begin Bridge: Longitudinal Slope (514+50 to 516+80)	13	2H:1V	Service (LT)	**1**	0.75	0.59	OK
			Service (EoC)	**2**	0.75	0.58	OK
			EEII (PS)	**3**	1.00	0.63	OK
			EEI (EQ: SEE)	**4a, 4b, 4c**	1.00	2.08	NDA
End Bridge: Longitudinal Slope (516+60 to 518+50)	14	2H:1V	Service (LT)	**5**	0.75	0.33	OK
			Service (EoC)	**6**	0.75	0.47	OK
			EEII (PS)	**7**	1.00	0.35	OK
			EEI (EQ: SEE)	**8a, 8b, 8c**	1.00	1.79	NDA
Begin Bridge: Transverse (Side) Slope (515+00)	13	2H:1V	Service (LT)	**9**	0.75	0.50	OK
			Service (EoC)	**10**	0.75	0.57	OK
			EEII (PS)	**11**	1.00	0.49	OK
			EEI (EQ: SEE)	**12a, 12b, 12c**	1.00	2.00	NDA
End Bridge: Transverse (Side) Slope (518+00)	14	2H:1V	Service (LT)	**13**	0.75	0.51	OK
			Service (EoC)	**14**	0.75	0.51	OK
			EEII (PS)	**15**	1.00	0.50	OK
			EEI (EQ: SEE)	**16a, 16b, 16c**	1.00	3.13	NDA

φ = Resistance Factor
EoC: End of Construction aka Short-term
LT: Long-term
EEI (EQ: SEE): Extreme Event I (Earthquake: Safety Evaluation Earthquake)
EEII (PS): Extremem Event II (Partial Submergence)

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Terracon Project No.:	EN175299
Structure:	Bridge Embankments
Computed By:	A. Fekrat
Checked By:	D.J. Corley
Date:	7/31/2021

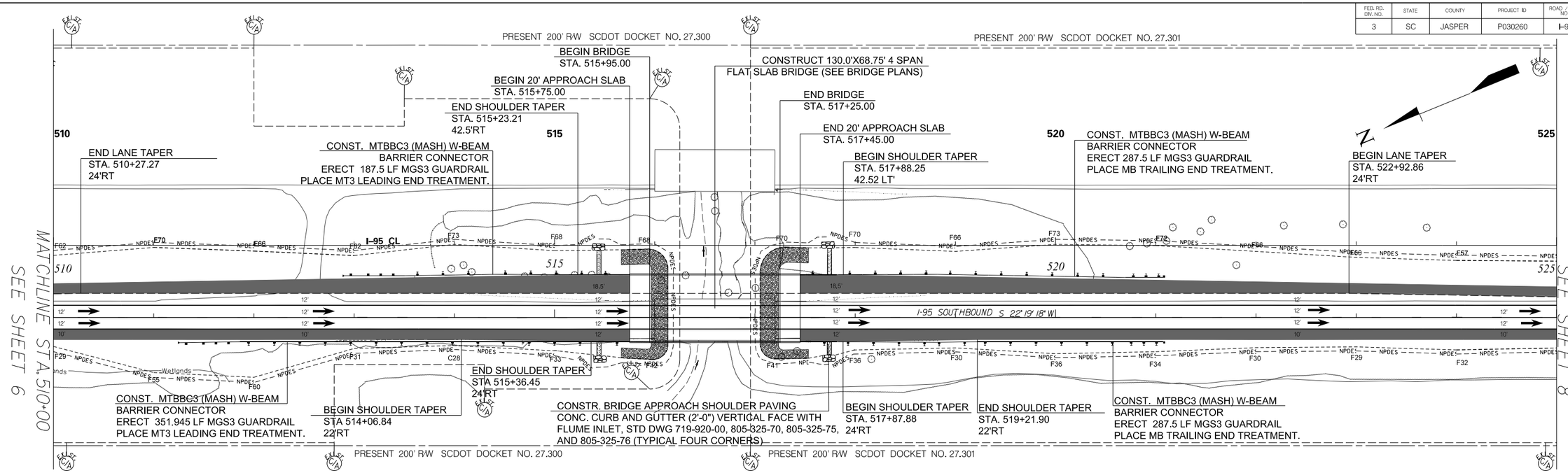
Slope Stability Resistance Factors

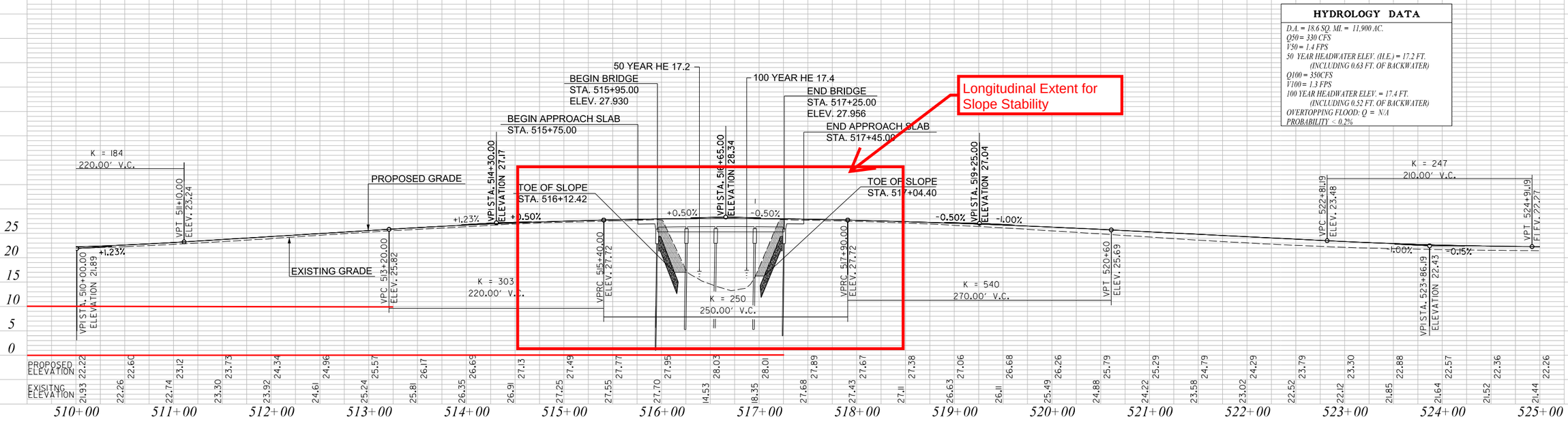
Station	Average Slope Height (ft.)	Slope Inclination	Loading Conditions	Analysis Serial Number	GI-01 (Top)	GI-02 (Top)	GI-02 (Bottom)
Begin Bridge: Longitudinal Slope (514+50 to 516+80)	13	2H:1V	EEI (EQ: SEE)	**4a, 4b, 4c**	6.57	11.65	12.50
End Bridge: Longitudinal Slope (516+60 to 518+50	14	2H:1V	EEI (EQ: SEE)	**8a, 8b, 8c**	8.36	10.47	11.90
Begin Bridge: Transverse (Side) Slope (515+00)	13	2H:1V	EEI (EQ: SEE)	**12a, 12b, 12c**	1.84	2.47	2.60
End Bridge: Transverse (Side) Slope (518+00)	14	2H:1V	EEI (EQ: SEE)	**16a, 16b, 16c**	2.42	3.21	3.41

GI-01: Maximum Vertical Displacement at top of the failure surface (circular)
GI-02: Maximum Lateral Displacement at either top of bottom of the failure surface (sliding block)
EEI (EQ: SEE): Extreme Event I (Earthquake: Safety Evaluation Earthquake)

LONGITUDINAL SECTION VIEW OF THE BRIDGE

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROUTE NO.	SHEET NO.
3	SC	JASPER	P030260	I-95	7





SCALE: 1" = 50'

ALIGNMENT CONTROL CAN BE FOUND ON REFERENCE DATA SHEET 5A

INFRASTRUCTURE CONSULTING & ENGINEERING

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE: 1" = 50'

REV.NO.	BY	DATE	DESCRIPTION OF REVISION
7			
6			
5			
4			
3			
2			
1			

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

PLAN PROFILE SHEET

INTERSTATE 95
BRIDGE REPLACEMENT
JASPER COUNTY

R:\Projects\18-42 I-95 Bridge Replacements Jasper Co\Roadway\PLAN SHEETS\SHT_07.dgn
6/3/2021

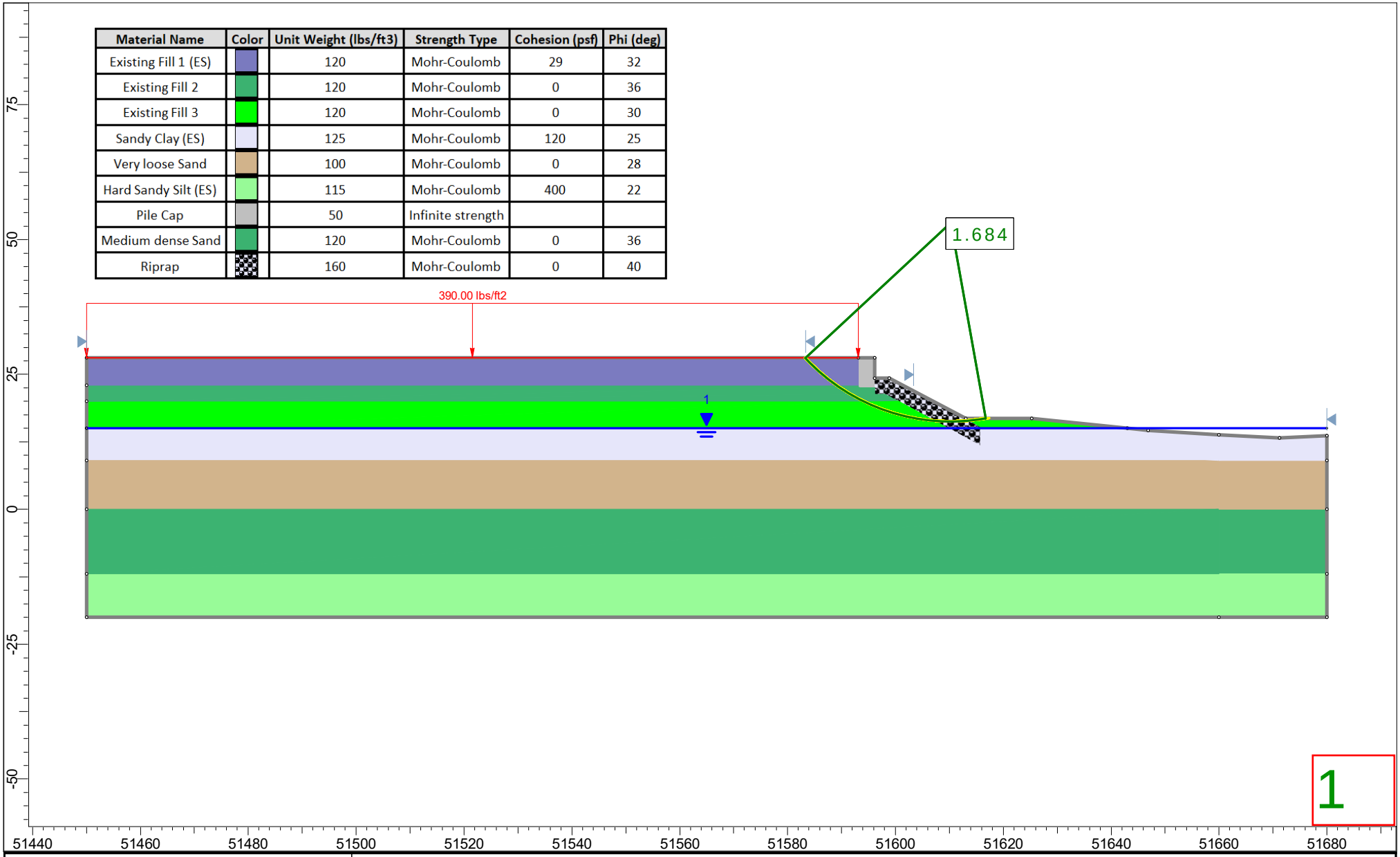
SLOPE STABILITY ANALYSIS CALCULATIONS

Slope Stability Analysis Methodology

Analysis Methodology	
Analysis Type	Slope Stability Analysis
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	Bridge Approach (Longitudinal Slope)
Geometry	Bridge plans and profiles dated 6/3/2021.
Soil Boring Model	See Exhibit C-3 for soil profile
Analysis Method	Slope stability was performed using the commercial program Slide2 version 9.012 distributed by Rocscience. The following loading conditions were considered when performing slope stability analyses. End of construction (short-term), long-term, partial submergence and earthquake. Service Limit State was checked using soil parameters based on total stress (undrained condition - end of construction) and effective stress (drained condition – long term). For end of construction, total stress parameters were used for cohesive soils. For long-term analysis, effective stress parameters were used. Spencer method was employed for checking slope stability under static and seismic loads. Extreme Events I loading conditions (seismic event) was checked using Spencer methodology and total stress soil parameters. Newmark displacement analysis was performed to estimate global instability displacements and have been reported here for the structural engineer to verify if the bridge structure can handle the displacements. Extreme Events II loading conditions (partial submergence) was checked using Spencer methodology and total stress soil parameters.
Surcharge Load	• Service Long Term and Extreme Event II (Flooding) Construction: Surcharge=390psf (250psf live load + 12 inches of asphalt pavement) per Table 8-7 and Section 17.4.1 SCDOT GDM 2019 • Service End of Construction and Extreme Event II (Partial Submergence): Surcharge=320psf (250psf live load + 6 inches of asphalt pavement, refer to pavement calculations) • Extreme Event I (Seismic) Loading Condition: Surcharge = 70psf

See next page for soil profile and parameters.

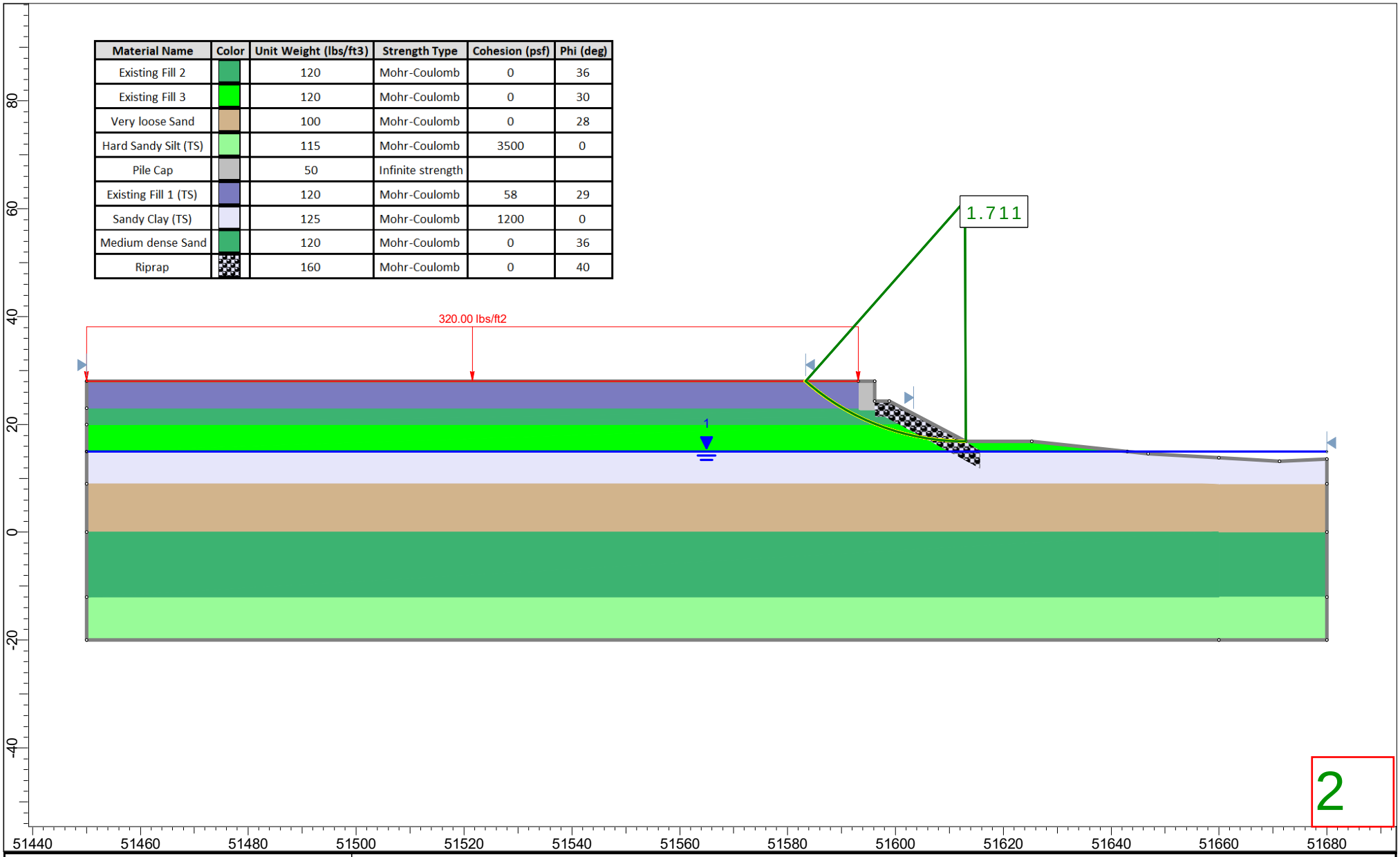
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 1 (ES)		120	Mohr-Coulomb	29	32
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Sandy Clay (ES)		125	Mohr-Coulomb	120	25
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (ES)		115	Mohr-Coulomb	400	22
Pile Cap		50	Infinite strength		
Medium dense Sand		120	Mohr-Coulomb	0	36
Riprap		160	Mohr-Coulomb	0	40



Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: Begin Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

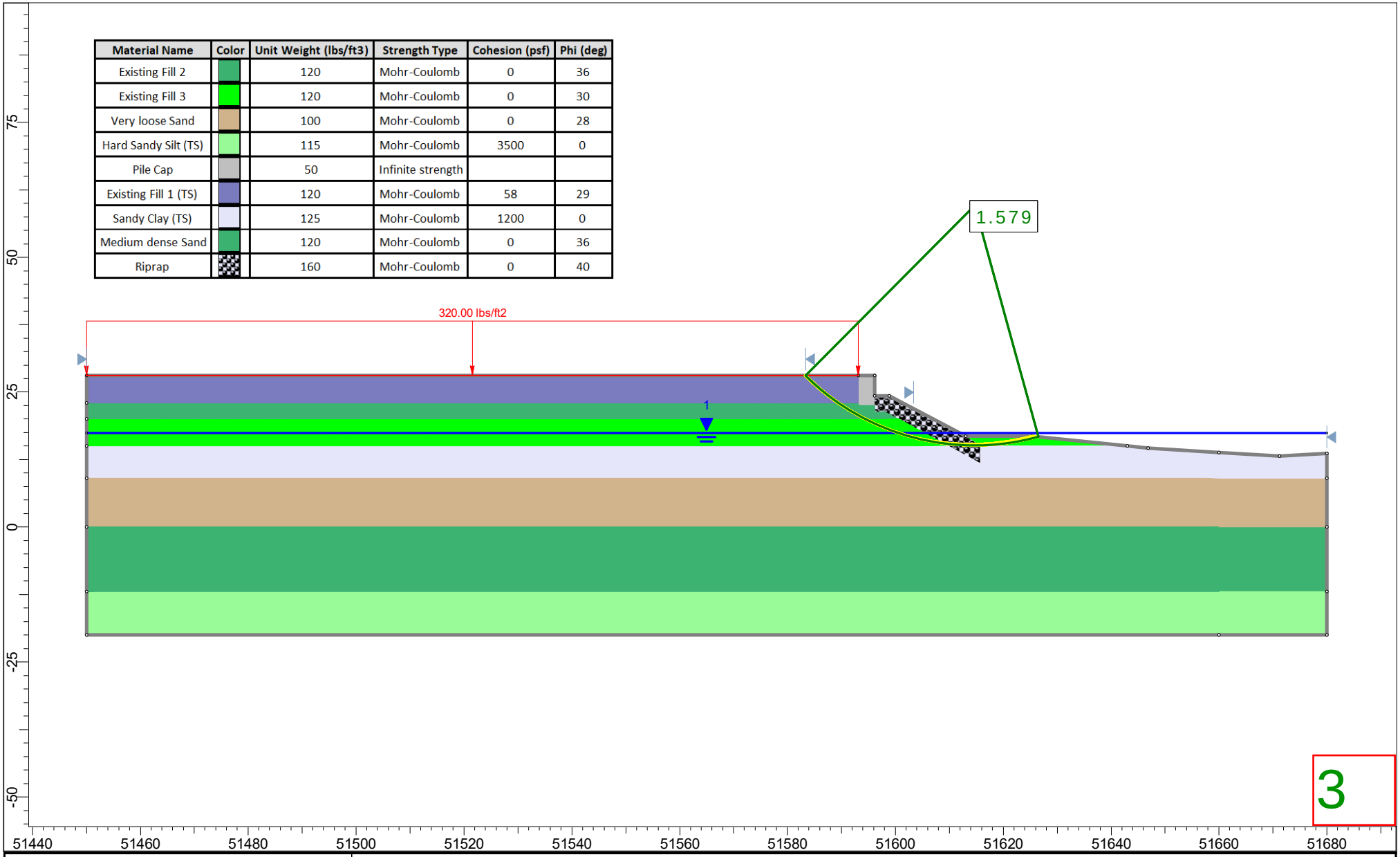
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Medium dense Sand		120	Mohr-Coulomb	0	36
Riprap		160	Mohr-Coulomb	0	40



Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By A. Fekrat	*Company*	Terracon
	Date 7/28/2021, 10:51:28 AM	*File Name*	Begin Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Medium dense Sand		120	Mohr-Coulomb	0	36
Riprap		160	Mohr-Coulomb	0	40

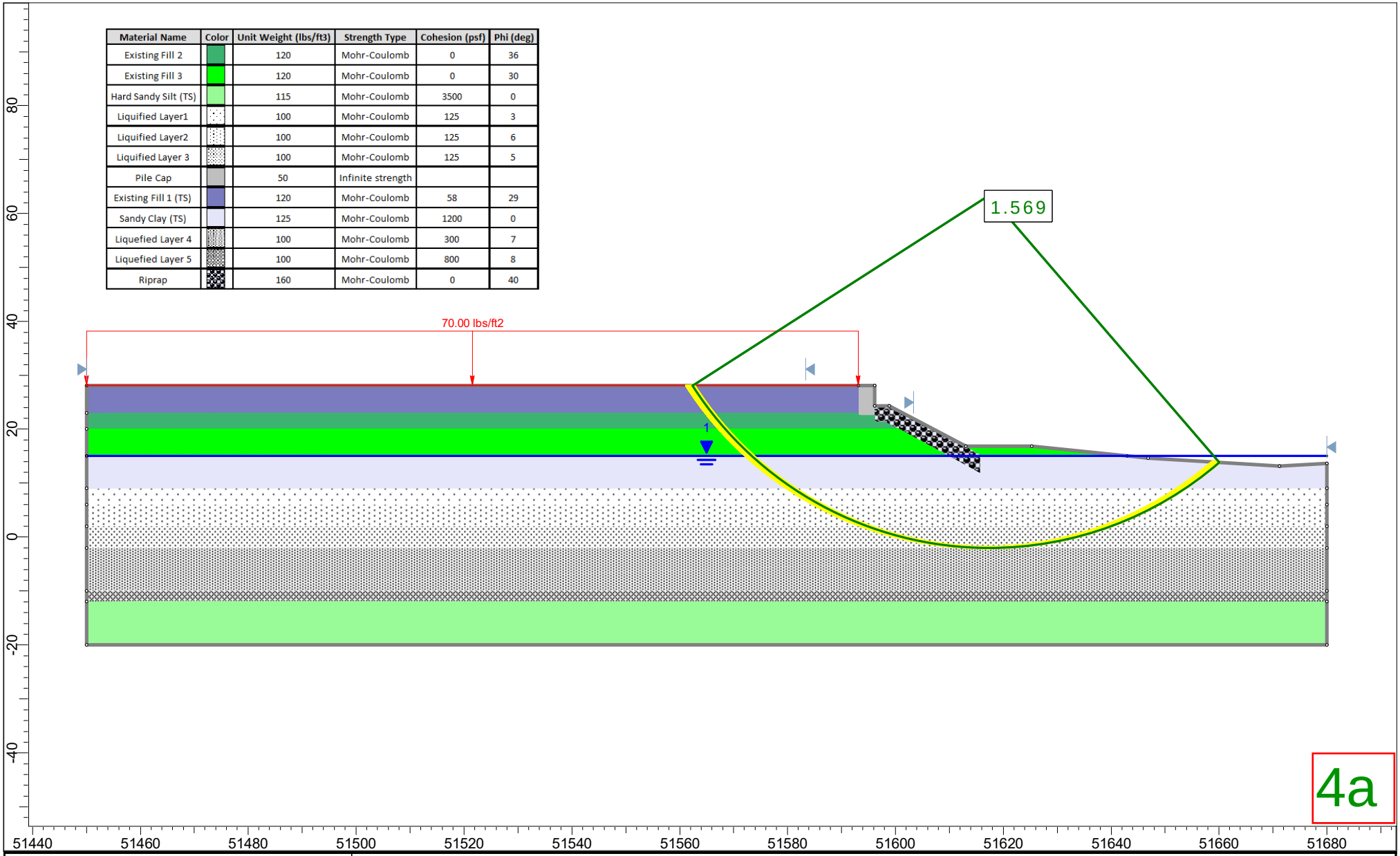


3

Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	*Company* Terracon
	Date	7/28/2021, 10:51:28 AM	*File Name* Begin Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8
Riprap		160	Mohr-Coulomb	0	40

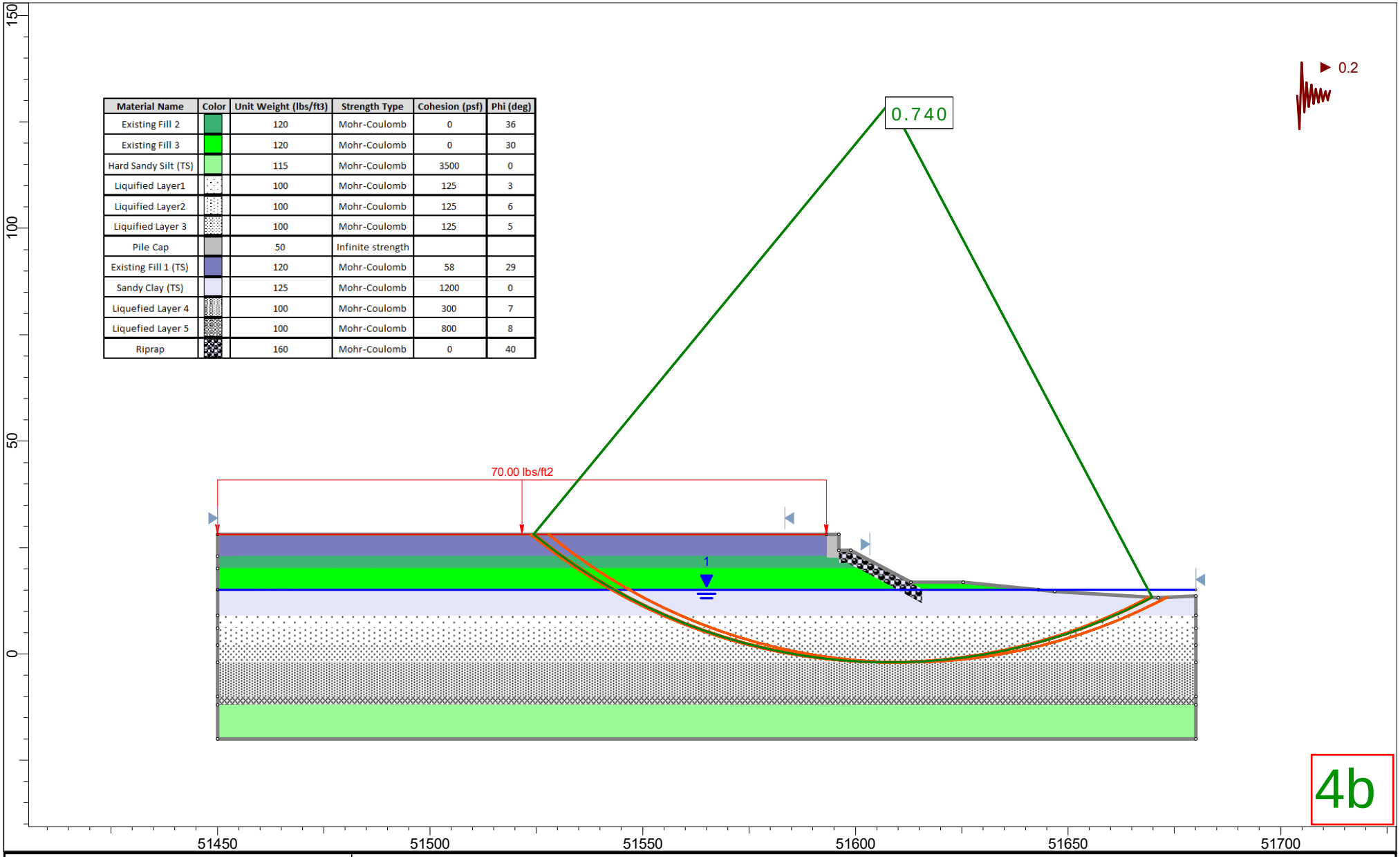


4a

Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	*Company* Terracon
	Date	7/28/2021, 10:51:28 AM	*File Name* Begin Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

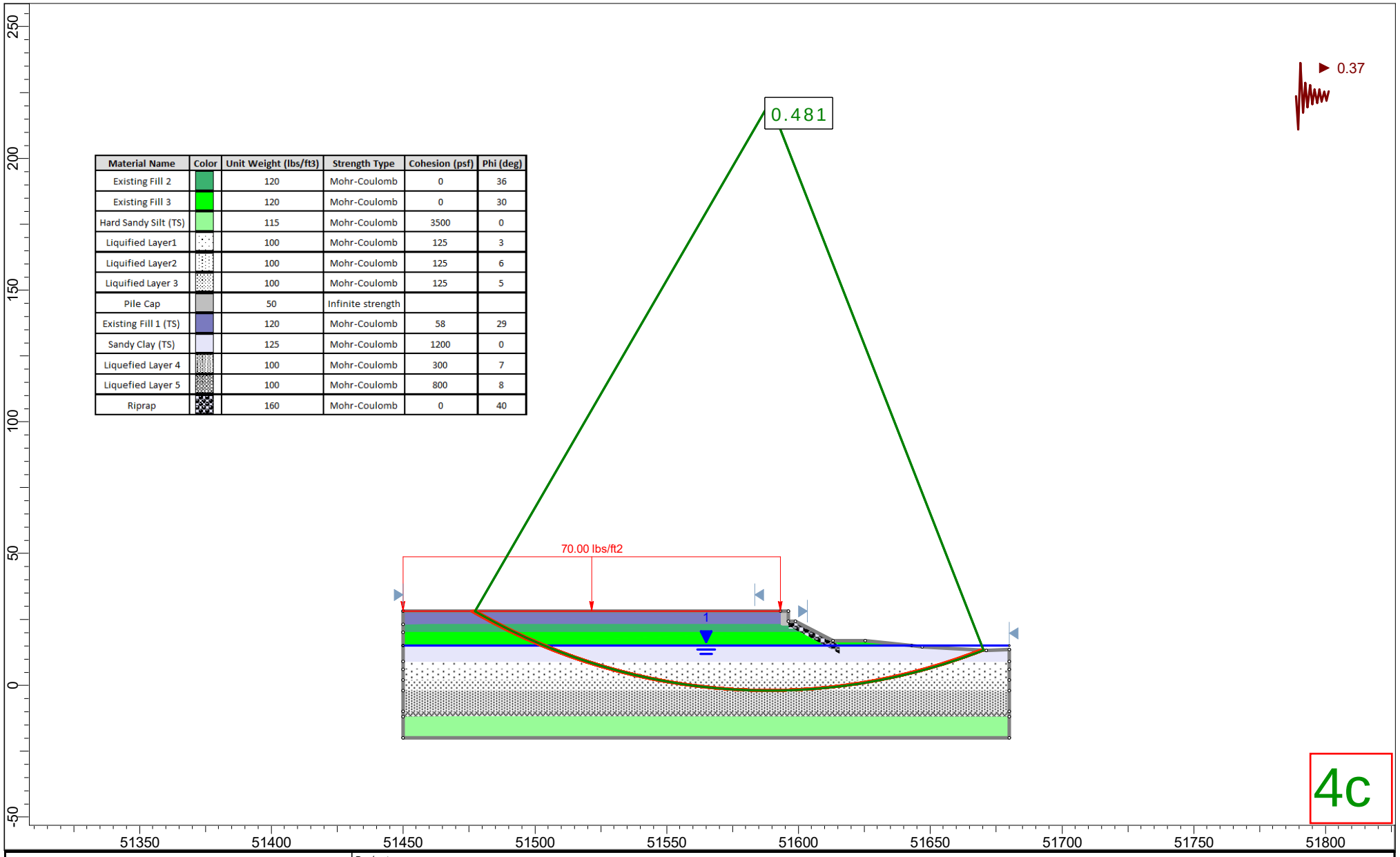
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8
Riprap		160	Mohr-Coulomb	0	40



Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: Begin Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8
Riprap		160	Mohr-Coulomb	0	40



4c

Terracon

SLIDEINTERPRET 9.012

Project	I-95 Bridge Replacement over Bagshaw Swamp		
Analysis Description	Longitudinal Slope		
Drawn By	A. Fekrat	Company	Terracon
Date	7/28/2021, 10:51:28 AM	File Name	Begin Bridge Longitudinal.slmd

NEWMARK DISPLACEMENT ANALYSIS

Ref: SCDOT Geotechnical Design Manual (2019), Section 13.14.2

Project:	**I-95 BRO Bagshaw Swamp**
County	Jasper
Terracon Project No:	EN175299
Location:	Begin Bridge Longitudinal Slope
Design Earthquake:	SEE
Computed By:	A. Fekrat
Checked By:	D. Corley
Date:	7/30/2021

Stability Analysis Serial No: 4a, 4b, 4c

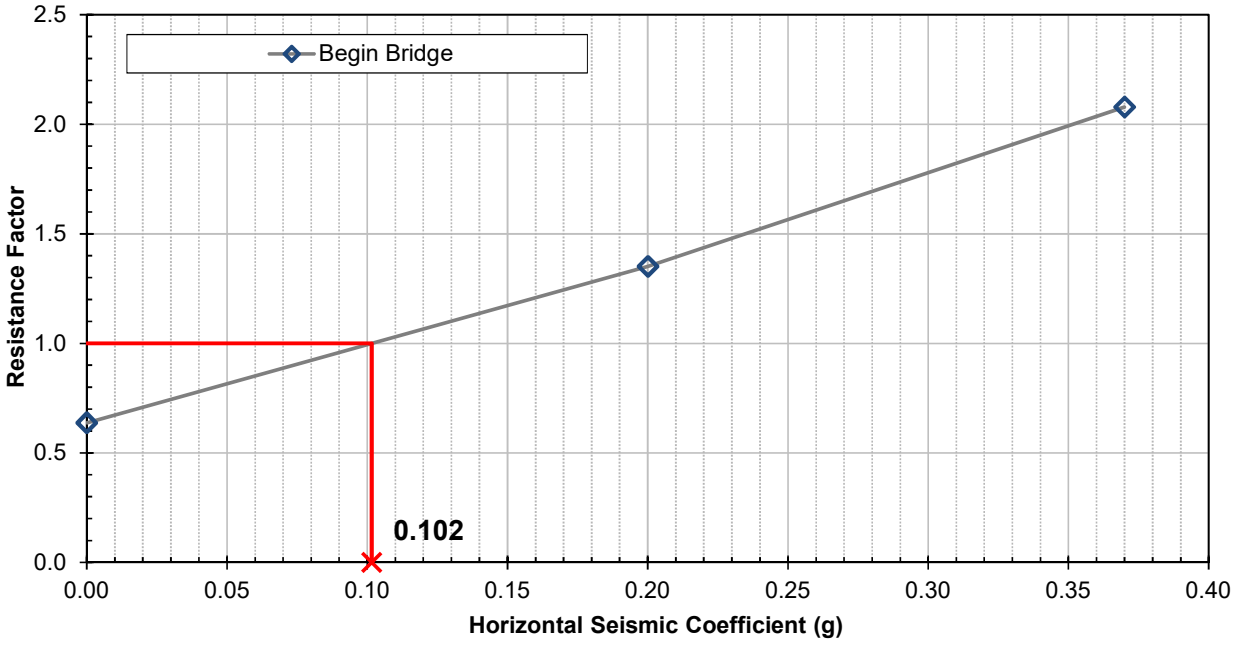
Slope Stability Analyses

Begin Bridge		
2H:1V Slope		
k_h	**Resistance Factor**	**FOS**
0.0000	0.64	1.569
0.2000	1.35	0.740
0.3700	2.08	0.481

Deformation ID (Table 10-1 GDM)
GI-01
GI-02

Lateral Deformation Analyses

R (ft)	NA
k_{max} =	0.370
k_y =	0.102
k_y/k_{max} =	0.275
S_1 =	0.480
F_v =	1.000
PGV =	18.3 in/sec
H =	13.00 ft.
β (0.5 ≤ β ≤ 1.5)	1.30
α_W (α_W=1 if H≤20)	1.00
$k_{max} = k_h = k_{av}$ =	0.370
$k_y/k_{max} = k_y/k_{av}$ =	0.275
log (d) =	0.825
Displacement	**13.37 in.**
Slice Angle of Entry	29°
Slice Angle of Exit	21°
GI-01 (V at Top)	**6.57 in.**
GI-02 (H at Top)	**11.65 in.**
(H at Bottom)	**12.50 in.**
RS-04 (Wall Rot.)	NA



Project Summary

File Name:	Begin Bridge Longitudinal.slmd
Slide Modeler Version:	9.012
Project Title:	I-95 Bridge Replacement over Bagshaw Swamp
Analysis:	Longitudinal Slope
Author:	A. Fekrat
Company:	Terracon
Date Created:	7/28/2021, 10:51:28 AM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Effective Stress	Master Scenario	Spencer: 1.684130	00h:00m:02.423s
Total Stress	Master Scenario	Spencer: 1.711150	00h:00m:02.607s
Partial Submergence	Master Scenario	Spencer: 1.579360	00h:00m:02.359s
Seismic	Master Scenario	Spencer: 1.568510	00h:00m:03.323s
	Kh=0.2	Spencer: 0.740379	00h:00m:02.116s
	Kh=0.37	Spencer: 0.480570	00h:00m:01.977s

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Seismic Loading

Effective Stress

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Total Stress

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Partial Submergence

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - Master Scenario

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - Kh=0.2

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.2

Seismic - Kh=0.37

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.37

Loading

Effective Stress

Distribution:	Constant
Magnitude [psf]:	390
Orientation:	Vertical

Total Stress

Distribution:	Constant
Magnitude [psf]:	320
Orientation:	Vertical

Partial Submergence

Distribution:	Constant
Magnitude [psf]:	320
Orientation:	Vertical

Seismic

Distribution:	Constant
Magnitude [psf]:	70
Orientation:	Vertical

Materials

Existing Fill 1 (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	29
Friction Angle [deg]	32
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	30
Water Surface	Assigned per scenario
Hu Value	1
Sandy Clay (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	120
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Hu Value	1
Very loose Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	28
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	400

Friction Angle [deg]	22
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	3500
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer1	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	3
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	6
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	5
Water Surface	Assigned per scenario
Hu Value	1
Pile Cap	
Color	
Strength Type	Infinite strength
Unit Weight [lbs/ft3]	50
Allow Sliding Along Boundary	No
Water Surface	Assigned per scenario
Hu Value	0
Existing Fill 1 (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	58
Friction Angle [deg]	29
Water Surface	Assigned per scenario
Hu Value	1

Sandy Clay (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	1200
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Medium dense Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 4	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	300
Friction Angle [deg]	7
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 5	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	800
Friction Angle [deg]	8
Water Surface	Assigned per scenario
Hu Value	1
Riprap	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	160
Cohesion [psf]	0
Friction Angle [deg]	40
Water Surface	Assigned per scenario
Hu Value	1

Materials In Use

Material	Effective Stress	Total Stress	Partial Submergence	Seismic	Kh=0.2	Kh=0.37
Existing Fill 1 (ES)	✓	✗	✗	✗	✗	✗
Existing Fill 2	✓	✓	✓	✓	✓	✓
Existing Fill 3	✓	✓	✓	✓	✓	✓
Sandy Clay (ES)	✓	✗	✗	✗	✗	✗
Very loose Sand	✓	✓	✓	✗	✗	✗
Hard Sandy Silt (ES)	✓	✗	✗	✗	✗	✗
Hard Sandy Silt (TS)	✗	✓	✓	✓	✓	✓
Liquified Layer1	✗	✗	✗	✓	✓	✓
Liquified Layer2	✗	✗	✗	✓	✓	✓
Liquified Layer 3	✗	✗	✗	✓	✓	✓
Pile Cap	✓	✓	✓	✓	✓	✓
Existing Fill 1 (TS)	✗	✓	✓	✓	✓	✓
Sandy Clay (TS)	✗	✓	✓	✓	✓	✓
Medium dense Sand	✓	✓	✓	✗	✗	✗
Liquefied Layer 4	✗	✗	✗	✓	✓	✓
Liquefied Layer 5	✗	✗	✗	✓	✓	✓
Riprap	✓	✓	✓	✓	✓	✓

Slice Data

Effective Stress

Global Minimum Query (spencer) - Safety Factor: 1.68413

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.641931	25.9569	-46.393	Existing Fill 1 (ES)	29	32	111.836	188.347	255.009	0	255.009	372.42	372.42
2	0.641931	76.6054	-44.9618	Existing Fill 1 (ES)	29	32	132.471	223.098	310.621	0	310.621	442.916	442.916
3	0.641931	124.814	-43.5656	Existing Fill 1 (ES)	29	32	152.95	257.587	365.815	0	365.815	511.292	511.292
4	0.641931	170.75	-42.2011	Existing Fill 1 (ES)	29	32	173.263	291.797	420.562	0	420.562	577.673	577.673
5	0.641931	214.56	-40.8654	Existing Fill 1 (ES)	29	32	193.401	325.712	474.839	0	474.839	642.163	642.163
6	0.641931	256.373	-39.5562	Existing Fill 1 (ES)	29	32	213.358	359.323	528.627	0	528.627	704.858	704.858
7	0.641931	296.302	-38.2712	Existing Fill 1 (ES)	29	32	233.128	392.618	581.912	0	581.912	765.835	765.835
8	0.641931	334.445	-37.0086	Existing Fill 1 (ES)	29	32	252.707	425.591	634.679	0	634.679	825.167	825.167
9	0.641931	370.892	-35.7667	Existing Fill 1 (ES)	29	32	272.09	458.235	686.92	0	686.92	882.917	882.917
10	0.635349	401.394	-34.55	Existing Fill 2	0	36	315.857	531.944	732.158	0	732.158	949.647	949.647
11	0.635349	434.015	-33.3571	Existing Fill 2	0	36	337.669	568.678	782.718	0	782.718	1005.01	1005.01
12	0.635349	465.2	-32.1803	Existing Fill 2	0	36	359.298	605.105	832.856	0	832.856	1058.95	1058.95
13	0.635349	495.004	-31.0186	Existing Fill 2	0	36	380.741	641.218	882.562	0	882.562	1111.5	1111.5
14	0.635349	523.479	-29.8708	Existing Fill 2	0	36	401.996	677.014	931.83	0	931.83	1162.72	1162.72
15	0.635349	550.67	-28.7362	Existing Fill 2	0	36	423.059	712.487	980.655	0	980.655	1212.62	1212.62
16	0.635349	420.351	-27.6137	Existing Fill 2	0	36	272.785	459.406	632.318	0	632.318	775.01	775.01
17	0.635349	361.693	-26.5026	Existing Fill 2	0	36	197.896	333.283	458.725	0	458.725	557.403	557.403
18	0.680883	413.743	-25.3631	Existing Fill 3	0	30	171.763	289.271	501.031	0	501.031	582.454	582.454
19	0.680883	439.427	-24.1951	Existing Fill 3	0	30	185.164	311.841	540.124	0	540.124	623.321	623.321
20	0.680883	468.793	-23.0378	Existing Fill 3	0	30	200.47	337.617	584.77	0	584.77	670.02	670.02
21	0.680883	517.882	-21.8903	Existing Fill 3	0	30	224.713	378.446	655.488	0	655.488	745.778	745.778
22	0.680883	539.599	-20.752	Existing Fill 3	0	30	237.542	400.051	692.908	0	692.908	782.914	782.914
23	0.680883	560.266	-19.6223	Existing Fill 3	0	30	250.199	421.367	729.829	0	729.829	819.03	819.03
24	0.680883	586.02	-18.5004	Existing Fill 3	0	30	265.45	447.053	774.318	0	774.318	863.138	863.138
25	0.680883	589.588	-17.3858	Existing Fill 3	0	30	270.872	456.184	790.133	0	790.133	874.946	874.946
26	0.680883	577.587	-16.2779	Existing Fill 3	0	30	269.124	453.239	785.033	0	785.033	863.618	863.618
27	0.680883	564.422	-15.1763	Existing Fill 3	0	30	266.708	449.171	777.988	0	777.988	850.332	850.332
28	0.680883	550.111	-14.0804	Existing Fill 3	0	30	263.614	443.96	768.961	0	768.961	835.08	835.08
29	0.680883	534.672	-12.9898	Existing Fill 3	0	30	259.826	437.581	757.911	0	757.911	817.848	817.848

30	0.680883	518.12	-11.9039	Existing Fill 3	0	30	255.33	430.009	744.798	0	744.798	798.622	798.622
31	0.680883	500.468	-10.8223	Existing Fill 3	0	30	250.11	421.218	729.572	0	729.572	777.384	777.384
32	0.680883	481.73	-9.74461	Existing Fill 3	0	30	244.149	411.178	712.18	0	712.18	754.109	754.109
33	0.680883	461.916	-8.6704	Existing Fill 3	0	30	237.425	399.855	692.568	0	692.568	728.774	728.774
34	0.680883	441.036	-7.59926	Existing Fill 3	0	30	229.919	387.214	670.675	0	670.675	701.349	701.349
35	0.680883	419.099	-6.53078	Existing Fill 3	0	30	221.609	373.218	646.433	0	646.433	671.803	671.803
36	0.680883	396.112	-5.46458	Existing Fill 3	0	30	212.469	357.825	619.771	0	619.771	640.097	640.097
37	0.658806	356.342	-4.4175	Riprap	0	40	306.244	515.754	614.652	0	614.652	638.311	638.311
38	0.658806	324.611	-3.38914	Riprap	0	40	283.958	478.223	569.924	0	569.924	586.74	586.74
39	0.658806	291.63	-2.36187	Riprap	0	40	259.72	437.402	521.275	0	521.275	531.988	531.988
40	0.658806	257.402	-1.33535	Riprap	0	40	233.435	393.135	468.521	0	468.521	473.962	473.962
41	0.658806	221.93	-0.30927	Riprap	0	40	205.003	345.251	411.454	0	411.454	412.56	412.56
42	0.658806	185.213	0.716715	Riprap	0	40	174.311	293.563	349.854	0	349.854	347.674	347.674
43	0.658806	147.253	1.74293	Riprap	0	40	141.24	237.866	283.478	0	283.478	279.18	279.18
44	0.658806	108.047	2.7697	Riprap	0	40	105.654	177.935	212.054	0	212.054	206.943	206.943
45	0.658806	67.6178	3.79737	Riprap	0	40	67.4324	113.565	135.341	0	135.341	130.865	130.865
46	0.658806	40.1369	4.82626	Riprap	0	40	40.8366	68.7741	81.9618	0	81.9618	78.5138	78.5138
47	0.750343	33.0306	5.92844	Existing Fill 3	0	30	18.9237	31.8699	55.2004	0	55.2004	53.2353	53.2353
48	0.750343	25.3123	7.10459	Existing Fill 3	0	30	14.7692	24.8733	43.0819	0	43.0819	41.2411	41.2411
49	0.750343	16.1836	8.28376	Existing Fill 3	0	30	9.62081	16.2027	28.064	0	28.064	26.6632	26.6632
50	0.750343	5.63266	9.46648	Existing Fill 3	0	30	3.72933	6.28068	10.8785	0	10.8785	10.2566	10.2566

Total Stress

Global Minimum Query (spencer) - Safety Factor: 1.71115

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.58043	17.545	-40.9568	Existing Fill 1 (TS)	58	29	107.161	183.369	226.171	0	226.171	319.183	319.183
2	0.58043	52.0379	-39.9775	Existing Fill 1 (TS)	58	29	121.65	208.161	270.897	0	270.897	372.891	372.891
3	0.58043	85.3618	-39.012	Existing Fill 1 (TS)	58	29	136.01	232.734	315.229	0	315.229	425.415	425.415
4	0.58043	117.564	-38.0595	Existing Fill 1 (TS)	58	29	150.24	257.083	359.156	0	359.156	476.788	476.788
5	0.58043	148.69	-37.1193	Existing Fill 1 (TS)	58	29	164.336	281.204	402.67	0	402.67	527.044	527.044
6	0.58043	178.777	-36.1907	Existing Fill 1 (TS)	58	29	178.296	305.091	445.763	0	445.763	576.211	576.211
7	0.58043	207.864	-35.2729	Existing Fill 1 (TS)	58	29	192.117	328.741	488.43	0	488.43	624.32	624.32
8	0.58043	235.985	-34.3654	Existing Fill 1 (TS)	58	29	205.798	352.151	530.663	0	530.663	671.393	671.393
9	0.58043	263.171	-33.4676	Existing Fill 1 (TS)	58	29	219.337	375.318	572.457	0	572.457	717.454	717.454
10	0.58043	289.451	-32.5791	Existing Fill 1 (TS)	58	29	232.732	398.239	613.807	0	613.807	762.526	762.526
11	0.58043	314.852	-31.6992	Existing Fill 1 (TS)	58	29	245.981	420.911	654.708	0	654.708	806.625	806.625
12	0.58043	339.399	-30.8276	Existing Fill 1 (TS)	58	29	259.084	443.332	695.158	0	695.158	849.772	849.772
13	0.615161	385.569	-29.9383	Existing Fill 2	0	36	309.639	529.839	729.261	0	729.261	907.587	907.587
14	0.615161	411.247	-29.0312	Existing Fill 2	0	36	327.384	560.203	771.053	0	771.053	952.759	952.759
15	0.615161	435.989	-28.1321	Existing Fill 2	0	36	344.96	590.279	812.449	0	812.449	996.889	996.889
16	0.615161	459.818	-27.2404	Existing Fill 2	0	36	362.366	620.062	853.443	0	853.443	1040	1040
17	0.615161	395.341	-26.3558	Existing Fill 2	0	36	289.353	495.126	681.483	0	681.483	824.841	824.841
18	0.615161	272.768	-25.4779	Existing Fill 2	0	36	154.194	263.849	363.157	0	363.157	436.631	436.631
19	0.615161	293.985	-24.6064	Existing Fill 2	0	36	168.174	287.771	396.083	0	396.083	473.102	473.102
20	0.615161	314.37	-23.741	Existing Fill 2	0	36	181.965	311.369	428.563	0	428.563	508.595	508.595
21	0.615161	333.939	-22.8812	Existing Fill 2	0	36	195.562	334.636	460.587	0	460.587	543.12	543.12
22	0.615161	367.587	-22.0269	Existing Fill 2	0	36	217.778	372.65	512.908	0	512.908	601.015	601.015
23	0.574013	371.594	-21.2059	Existing Fill 3	0	30	190.1	325.29	563.419	0	563.419	637.176	637.176
24	0.574013	386.624	-20.4177	Existing Fill 3	0	30	199.678	341.679	591.806	0	591.806	666.136	666.136
25	0.574013	401.048	-19.6335	Existing Fill 3	0	30	209.094	357.792	619.715	0	619.715	694.308	694.308
26	0.574013	418.857	-18.8532	Existing Fill 3	0	30	220.442	377.21	653.346	0	653.346	728.619	728.619
27	0.574013	430.456	-18.0764	Existing Fill 3	0	30	228.678	391.302	677.754	0	677.754	752.394	752.394
28	0.574013	423.145	-17.3031	Existing Fill 3	0	30	226.899	388.258	672.483	0	672.483	743.168	743.168
29	0.574013	414.68	-16.533	Existing Fill 3	0	30	224.436	384.043	665.182	0	665.182	731.804	731.804
30	0.574013	405.638	-15.766	Existing Fill 3	0	30	221.585	379.165	656.732	0	656.732	719.293	719.293
31	0.574013	396.026	-15.0019	Existing Fill 3	0	30	218.343	373.617	647.124	0	647.124	705.636	705.636
32	0.574013	385.849	-14.2405	Existing Fill 3	0	30	214.704	367.39	636.337	0	636.337	690.826	690.826

33	0.574013	375.114	-13.4816	Existing Fill 3	0	30	210.662	360.474	624.359	0	624.359	674.863	674.863
34	0.574013	363.826	-12.7252	Existing Fill 3	0	30	206.212	352.86	611.171	0	611.171	657.739	657.739
35	0.574013	351.99	-11.971	Existing Fill 3	0	30	201.348	344.537	596.755	0	596.755	639.447	639.447
36	0.574013	339.611	-11.2189	Existing Fill 3	0	30	196.064	335.495	581.093	0	581.093	619.982	619.982
37	0.574013	326.694	-10.4687	Existing Fill 3	0	30	190.352	325.72	564.164	0	564.164	599.336	599.336
38	0.6117	330.511	-9.6959	Riprap	0	40	272.499	466.286	555.698	0	555.698	602.257	602.257
39	0.6117	308.873	-8.90032	Riprap	0	40	257.806	441.144	525.734	0	525.734	566.107	566.107
40	0.6117	286.383	-8.10647	Riprap	0	40	242.002	414.101	493.506	0	493.506	527.975	527.975
41	0.6117	263.049	-7.31419	Riprap	0	40	225.056	385.105	458.951	0	458.951	487.838	487.838
42	0.6117	238.873	-6.5233	Riprap	0	40	206.937	354.1	421.999	0	421.999	445.662	445.662
43	0.6117	213.861	-5.73367	Riprap	0	40	187.608	321.025	382.582	0	382.582	401.419	401.419
44	0.6117	188.016	-4.94513	Riprap	0	40	167.032	285.817	340.624	0	340.624	355.076	355.076
45	0.6117	161.341	-4.15752	Riprap	0	40	145.17	248.408	296.041	0	296.041	306.594	306.594
46	0.6117	133.84	-3.3707	Riprap	0	40	121.98	208.726	248.75	0	248.75	255.934	255.934
47	0.6117	105.513	-2.58452	Riprap	0	40	97.4164	166.694	198.658	0	198.658	203.056	203.056
48	0.6117	76.3639	-1.79882	Riprap	0	40	71.4303	122.228	145.666	0	145.666	147.909	147.909
49	0.6117	46.3929	-1.01346	Riprap	0	40	43.9719	75.2425	89.6705	0	89.6705	90.4484	90.4484
50	0.6117	15.601	-0.228293	Riprap	0	40	18.3221	31.3519	37.3638	0	37.3638	37.4368	37.4368

Partial Submergence

Global Minimum Query (spencer) - Safety Factor: 1.57936

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.867592	43.676	-44.0411	Existing Fill 1 (TS)	58	29	115.147	181.859	223.448	0	223.448	334.804	334.804
2	0.867592	128.742	-42.5043	Existing Fill 1 (TS)	58	29	140.029	221.156	294.341	0	294.341	422.673	422.673
3	0.867592	209.399	-41.0045	Existing Fill 1 (TS)	58	29	164.639	260.024	364.46	0	364.46	507.601	507.601
4	0.867592	285.944	-39.538	Existing Fill 1 (TS)	58	29	188.962	298.439	433.764	0	433.764	589.743	589.743
5	0.867592	358.639	-38.102	Existing Fill 1 (TS)	58	29	212.988	336.384	502.219	0	502.219	669.235	669.235
6	0.867592	427.709	-36.6936	Existing Fill 1 (TS)	58	29	236.706	373.844	569.799	0	569.799	746.193	746.193
7	0.867592	493.354	-35.3107	Existing Fill 1 (TS)	58	29	260.109	410.806	636.479	0	636.479	820.72	820.72
8	0.83706	535.186	-33.9745	Existing Fill 2	0	36	318.226	502.593	691.759	0	691.759	906.2	906.2
9	0.83706	590.486	-32.6826	Existing Fill 2	0	36	346.724	547.602	753.71	0	753.71	976.155	976.155
10	0.83706	643.128	-31.4092	Existing Fill 2	0	36	374.947	592.176	815.061	0	815.061	1044.01	1044.01
11	0.83706	693.221	-30.1528	Existing Fill 2	0	36	402.885	636.301	875.794	0	875.794	1109.83	1109.83
12	0.83706	571.104	-28.9122	Existing Fill 2	0	36	296.616	468.463	644.783	0	644.783	808.607	808.607
13	0.83706	470.375	-27.6864	Existing Fill 2	0	36	204.342	322.729	444.198	0	444.198	551.418	551.418
14	0.88637	544.882	-26.4388	Existing Fill 3	0	30	182.834	288.76	500.147	0	500.147	591.061	591.061
15	0.88637	594.03	-25.1692	Existing Fill 3	0	30	202.577	319.942	554.155	0	554.155	649.348	649.348
16	0.88637	674.042	-23.9127	Existing Fill 3	0	30	233.559	368.873	638.907	0	638.907	742.468	742.468
17	0.88637	714.632	-22.6684	Existing Fill 3	0	30	251.554	397.295	688.135	0	688.135	793.199	793.199
18	0.88637	758.532	-21.4352	Existing Fill 3	0	30	271.198	428.32	741.873	0	741.873	848.347	848.347
19	0.88637	778.329	-20.2124	Existing Fill 3	0	30	282.602	446.331	773.067	0	773.067	877.114	877.114
20	0.88637	763.054	-18.9991	Existing Fill 3	0	30	281.327	444.317	769.579	0	769.579	866.443	866.443
21	0.815953	687.039	-17.8422	Existing Fill 3	0	30	276.359	436.47	763.699	7.71054	755.988	852.652	844.942
22	0.815953	670.506	-16.7403	Existing Fill 3	0	30	267.541	422.543	755.428	23.562	731.866	835.899	812.337
23	0.815953	652.301	-15.6447	Existing Fill 3	0	30	258.187	407.77	744.627	38.3485	706.279	816.931	778.583
24	0.815953	632.454	-14.5549	Existing Fill 3	0	30	248.283	392.128	731.273	52.0877	679.186	795.738	743.65
25	0.815953	610.988	-13.4706	Existing Fill 3	0	30	237.812	375.591	715.338	64.7956	650.543	772.303	707.507
26	0.815953	587.926	-12.3911	Existing Fill 3	0	30	226.757	358.131	696.788	76.4867	620.301	746.607	670.12
27	0.815953	563.29	-11.316	Existing Fill 3	0	30	215.099	339.718	675.583	87.1742	588.409	718.627	631.453
28	0.815953	537.097	-10.245	Existing Fill 3	0	30	202.817	320.321	651.682	96.8698	554.812	688.339	591.469
29	0.815953	509.364	-9.17762	Existing Fill 3	0	30	189.89	299.905	625.034	105.584	519.45	655.714	550.13
30	0.815953	480.106	-8.11342	Existing Fill 3	0	30	176.295	278.433	595.587	113.326	482.261	620.719	507.393
31	0.872726	472.958	-7.0152	Riprap	0	40	239.884	378.863	571.818	120.306	451.512	601.337	481.031
32	0.872726	422.735	-5.88271	Riprap	0	40	207.467	327.665	516.958	126.462	390.496	538.334	411.872
33	0.872726	370.08	-4.75253	Riprap	0	40	172.797	272.909	456.772	131.532	325.24	471.138	339.606
34	0.872726	315.007	-3.6242	Riprap	0	40	135.753	214.403	391.036	135.52	255.516	399.634	264.114
35	0.872726	258.018	-2.49727	Riprap	0	40	96.5543	152.494	320.167	138.432	181.735	324.378	185.946

36	0.872726	227.389	-1.37131	Riprap	0	40	75.6414	119.465	282.646	140.272	142.374	284.456	144.184
37	0.872726	211.124	-0.245883	Riprap	0	40	65.2353	103.03	263.826	141.04	122.786	264.106	123.066
38	0.872726	192.466	0.879451	Riprap	0	40	53.2806	84.1492	241.024	140.739	100.285	240.206	99.4674
39	0.891558	181.534	2.01728	Existing Fill 3	0	30	28.4758	44.9736	217.238	139.342	77.8956	216.235	76.8926
40	0.891558	177.215	3.16806	Existing Fill 3	0	30	28.3422	44.7626	214.353	136.822	77.5315	212.785	75.9627
41	0.891558	170.972	4.32012	Existing Fill 3	0	30	27.7126	43.7681	208.989	133.181	75.8084	206.896	73.7149
42	0.891558	162.799	5.47394	Existing Fill 3	0	30	26.549	41.9305	201.04	128.414	72.6261	198.496	70.0819
43	0.891558	152.685	6.62998	Existing Fill 3	0	30	24.8103	39.1844	190.385	122.515	67.87	187.501	64.9862
44	0.891558	140.618	7.78875	Existing Fill 3	0	30	22.4509	35.458	176.892	115.477	61.4151	173.821	58.3442
45	0.891558	126.583	8.95073	Existing Fill 3	0	30	19.4206	30.6721	160.417	107.291	53.1259	157.358	50.0671
46	0.891558	110.562	10.1164	Existing Fill 3	0	30	15.6641	24.7393	140.797	97.9467	42.8502	138.002	40.0554
47	0.891558	92.5339	11.2864	Existing Fill 3	0	30	11.1198	17.5622	117.851	87.4322	30.4188	115.632	28.1996
48	0.891558	72.4766	12.4611	Existing Fill 3	0	30	5.71887	9.03216	91.3779	75.7337	15.6442	90.1142	14.3805
49	0.891558	49.7346	13.6412	Existing Fill 3	0	30	0	0	60.9928	62.836	-1.84316	60.9928	-1.84316
50	0.891558	17.6223	14.8273	Existing Fill 3	0	30	0	0	29.6196	48.7216	-19.102	29.6196	-19.102

Seismic - Master Scenario

Global Minimum Query (spencer) - Safety Factor: 1.56851

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.79303	285.035	-55.9117	Existing Fill 1 (TS)	58	29	76.7622	120.402	112.577	0	112.577	226.004	226.004
2	1.79303	827.894	-53.1969	Existing Fill 1 (TS)	58	29	150.54	236.124	321.343	0	321.343	522.553	522.553
3	2.50199	1965.36	-50.172	Existing Fill 2	0	36	250.872	393.495	541.598	0	541.598	842.405	842.405
4	1.64481	1764.58	-47.394	Existing Fill 3	0	30	295.443	463.405	802.643	0	802.643	1123.87	1123.87
5	1.64481	2105.13	-45.3036	Existing Fill 3	0	30	356.66	559.424	968.953	0	968.953	1329.41	1329.41
6	1.64481	2422.08	-43.2878	Existing Fill 3	0	30	415.795	652.178	1129.61	0	1129.61	1521.26	1521.26
7	1.91832	3204.37	-41.1798	Sandy Clay (TS)	1200	0	765.057	1200	1065.42	51.875	1013.55	1734.7	1682.83
8	1.91832	3591.69	-38.9805	Sandy Clay (TS)	1200	0	765.057	1200	1313.27	152.667	1160.6	1932.37	1779.7
9	1.91832	3950.16	-36.8477	Sandy Clay (TS)	1200	0	765.057	1200	1542.88	245.952	1296.92	2116.2	1870.25
10	1.91832	4282.21	-34.7729	Sandy Clay (TS)	1200	0	765.057	1200	1756.06	332.36	1423.7	2287.26	1954.9
11	1.65053	3909.92	-32.8874	Liquified Layer1	125	3	143.018	224.325	2302.45	407.215	1895.23	2394.93	1987.71
12	1.65053	4080.42	-31.1799	Liquified Layer1	125	3	144.517	226.677	2411.78	471.676	1940.11	2499.24	2027.56
13	1.65053	4239.93	-29.5028	Liquified Layer1	125	3	145.936	228.902	2514.54	531.978	1982.56	2597.11	2065.14
14	2.20171	5885.24	-27.5824	Liquified Layer2	125	6.00001	213.522	334.912	2594.18	597.001	1997.18	2705.72	2108.72
15	2.20171	6127.07	-25.4246	Liquified Layer2	125	6.00001	217.001	340.368	2714.63	665.541	2049.09	2817.79	2152.25
16	2.20171	6346.69	-23.3048	Liquified Layer2	125	6.00001	220.237	345.444	2825.17	727.786	2097.39	2920.05	2192.26
17	2.20171	5904.33	-21.2184	Liquified Layer2	125	6.00001	200.932	315.164	2593.34	784.046	1809.29	2671.35	1887.3
18	1.93241	5193.26	-19.2855	Liquified Layer 3	125	5	178.383	279.795	2601.13	831.813	1769.31	2663.55	1831.73
19	1.93241	5379.63	-17.4997	Liquified Layer 3	125	5	181.919	285.341	2704.62	871.918	1832.7	2761.98	1890.06
20	1.93241	5419.75	-15.7313	Liquified Layer 3	125	5	181.565	284.787	2734.29	907.91	1826.38	2785.43	1877.52
21	1.93241	5287.61	-13.9781	Liquified Layer 3	125	5	176.548	276.918	2676.33	939.901	1736.43	2720.28	1780.38
22	1.93241	5142.34	-12.2382	Liquified Layer 3	125	5	171.34	268.748	2611.04	967.986	1643.05	2648.2	1680.22
23	1.93241	4985.24	-10.5098	Liquified Layer 3	125	5	165.972	260.328	2539.05	992.248	1546.8	2569.84	1577.59
24	1.93241	4816.51	-8.79091	Liquified Layer 3	125	5	160.445	251.66	2460.49	1012.76	1447.73	2485.3	1472.54
25	1.93241	4635.91	-7.08	Liquified Layer 3	125	5	154.752	242.73	2375.23	1029.57	1345.66	2394.45	1364.88
26	1.93241	4436.82	-5.37543	Liquified Layer 3	125	5	148.698	233.235	2279.86	1042.73	1237.13	2293.85	1251.12
27	1.93241	4262.93	-3.67562	Liquified Layer 3	125	5	143.537	225.14	2196.88	1052.28	1144.6	2206.1	1153.82
28	1.93241	4205.43	-1.97905	Liquified Layer 3	125	5	141.903	222.577	2173.54	1058.23	1115.31	2178.45	1120.22
29	2.58065	5348.97	0	Liquified Layer 3	125	5	136.412	213.964	2077.17	1060.32	1016.85	2077.17	1016.85
30	1.93241	3998.88	1.97905	Liquified Layer 3	125	5	136.737	214.474	2080.92	1058.23	1022.69	2076.19	1017.96
31	1.93241	3980.44	3.67562	Liquified Layer 3	125	5	136.876	214.692	2077.46	1052.28	1025.18	2068.67	1016.39
32	1.93241	3950.87	5.37543	Liquified Layer 3	125	5	136.895	214.721	2068.25	1042.73	1025.52	2055.37	1012.64

33	1.93241	3901.92	7.08	Liquified Layer 3	125	5	136.552	214.183	2048.94	1029.57	1019.37	2031.98	1002.41
34	1.93241	3806.84	8.79091	Liquified Layer 3	125	5	135.063	211.848	2005.43	1012.76	992.67	1984.54	971.784
35	1.93241	3696.38	10.5098	Liquified Layer 3	125	5	133.325	209.122	1953.77	992.248	961.52	1929.03	936.786
36	1.93241	3574.29	12.2382	Liquified Layer 3	125	5	131.451	206.182	1895.9	967.986	927.914	1867.39	899.401
37	1.93241	3440.36	13.9781	Liquified Layer 3	125	5	129.436	203.022	1831.7	939.901	891.794	1799.48	859.575
38	1.93241	3294.34	15.7313	Liquified Layer 3	125	5	127.277	199.636	1761	907.91	853.091	1725.15	817.24
39	1.93241	3135.93	17.4997	Liquified Layer 3	125	5	124.97	196.016	1683.64	871.918	811.724	1644.24	772.322
40	1.93241	2964.78	19.2855	Liquified Layer 3	125	5	122.508	192.155	1599.4	831.813	767.585	1556.53	724.718
41	2.20171	3152.2	21.2184	Liquified Layer2	125	6.00001	127.981	200.74	1504.66	784.046	720.612	1454.97	670.925
42	2.20171	2892.26	23.3048	Liquified Layer2	125	6.00001	124.117	194.679	1390.74	727.786	662.95	1337.27	609.484
43	2.20171	2609.33	25.4246	Liquified Layer2	125	6.00001	119.91	188.081	1265.71	665.541	600.173	1208.71	543.172
44	2.20171	2314.05	27.5824	Liquified Layer2	125	6.00001	115.719	181.506	1134.62	597.001	537.619	1074.17	477.168
45	1.65053	1539.35	29.5028	Liquified Layer1	125	3	95.6155	149.974	1008.51	531.978	476.533	954.408	422.43
46	1.65053	1360.02	31.1799	Liquified Layer1	125	3	94.0653	147.542	901.812	471.676	430.136	844.889	373.213
47	1.65053	1169.68	32.8874	Liquified Layer1	125	3	92.4196	144.961	788.093	407.215	380.878	728.333	321.118
48	2.11527	1162.21	34.8795	Sandy Clay (TS)	1200	0	765.057	1200	1133.7	327.912	805.786	600.394	272.482
49	2.11527	722.632	37.1737	Sandy Clay (TS)	1200	0	765.057	1200	970.998	231.861	739.137	390.841	158.98
50	2.11527	247.141	39.5401	Sandy Clay (TS)	1200	0	765.057	1200	795.078	127.334	667.744	163.514	36.1796

Seismic - Kh=0.2

Global Minimum Query (spencer) - Safety Factor: 0.740379

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.26565	510.359	-38.5759	Existing Fill 1 (TS)	58	29	157.679	116.742	105.973	0	105.973	231.738	231.738
2	3.26565	1499.07	-36.7808	Existing Fill 1 (TS)	58	29	303.033	224.359	300.119	0	300.119	526.659	526.659
3	2.16227	1508.06	-35.3179	Existing Fill 2	0	36	442.492	327.612	450.919	0	450.919	764.429	764.429
4	2.16227	1897.26	-34.1733	Existing Fill 2	0	36	557.155	412.506	567.767	0	567.767	946.03	946.03
5	2.71708	2909.97	-32.9013	Existing Fill 3	0	30	582.7	431.419	747.239	0	747.239	1124.22	1124.22
6	2.71708	3468.03	-31.5045	Existing Fill 3	0	30	702.197	519.892	900.481	0	900.481	1330.86	1330.86
7	2.71708	3996.58	-30.1284	Existing Fill 3	0	30	820.383	607.394	1052.04	0	1052.04	1528.14	1528.14
8	3.00563	5014.49	-28.7001	Sandy Clay (TS)	1200	0	1620.79	1200	952.781	50.8571	901.924	1840.14	1789.28
9	3.00563	5614.02	-27.2199	Sandy Clay (TS)	1200	0	1620.79	1200	1188.44	150.433	1038.01	2022.13	1871.7
10	3.00563	6176.89	-25.7592	Sandy Clay (TS)	1200	0	1620.79	1200	1412.75	243.919	1168.83	2194.85	1950.93
11	3.00563	6704.46	-24.3163	Sandy Clay (TS)	1200	0	1620.79	1200	1626.13	331.543	1294.59	2358.5	2026.96
12	2.49442	5908	-23.0097	Liquified Layer1	125	3	293.093	217	2162.43	406.967	1755.47	2286.9	1879.94
13	2.49442	6164.78	-21.836	Liquified Layer1	125	3	296.156	219.268	2269.94	471.203	1798.74	2388.61	1917.41
14	2.49442	6406.82	-20.6719	Liquified Layer1	125	3	299.128	221.468	2372.48	531.752	1840.73	2485.34	1953.59
15	3.24265	8665.78	-19.3448	Liquified Layer2	125	6.00001	432.947	320.545	2457.12	596.635	1860.49	2609.12	2012.49
16	3.24265	9019.72	-17.8566	Liquified Layer2	125	6.00001	440.549	326.173	2578.78	664.745	1914.04	2720.71	2055.96
17	3.24265	9343.63	-16.3808	Liquified Layer2	125	6.00001	447.863	331.588	2692.63	727.077	1965.55	2824.28	2097.2
18	3.24265	9638.21	-14.9161	Liquified Layer2	125	6.00001	454.882	336.785	2798.77	783.766	2015	2919.94	2136.17
19	3.01313	9195.25	-13.5125	Liquified Layer 3	125	5	412.922	305.719	2898.93	833.308	2065.62	2998.16	2164.85
20	3.01313	9402.22	-12.1683	Liquified Layer 3	125	5	417.782	309.317	2982.92	876.17	2106.75	3073.01	2196.84
21	3.01313	9586.95	-10.8309	Liquified Layer 3	125	5	422.419	312.75	3060.42	914.427	2146	3141.24	2226.81
22	3.01313	9749.76	-9.49941	Liquified Layer 3	125	5	426.83	316.016	3131.47	948.144	2183.33	3202.9	2254.75
23	3.01313	9890.92	-8.17311	Liquified Layer 3	125	5	431.014	319.114	3196.11	977.377	2218.73	3258.01	2280.63
24	3.01313	9728.84	-6.8512	Liquified Layer 3	125	5	422.35	312.699	3147.59	1002.17	2145.42	3198.33	2196.16
25	3.01313	9008.1	-5.53295	Liquified Layer 3	125	5	388.845	287.893	2884.46	1022.58	1861.88	2922.12	1899.54
26	3.01313	9175.58	-4.21764	Liquified Layer 3	125	5	395.454	292.786	2956.42	1038.62	1917.8	2985.58	1946.96
27	3.01313	8812.14	-2.90455	Liquified Layer 3	125	5	382.345	283.08	2857.18	1050.32	1806.86	2876.58	1826.26
28	3.01313	8283.15	-1.59299	Liquified Layer 3	125	5	363.226	268.925	2702.78	1057.7	1645.08	2712.88	1655.18
29	4.31105	10887	0	Liquified Layer 3	125	5	339.251	251.174	2502.48	1060.32	1442.16	2502.48	1442.16
30	2.73921	6293.11	1.53338	Liquified Layer 3	125	5	314.931	233.168	2294.39	1058.03	1236.36	2285.96	1227.93
31	2.73921	5998.63	2.72559	Liquified Layer 3	125	5	304.585	225.508	2200.48	1051.67	1148.81	2185.98	1134.31
32	2.73921	5601.59	3.919	Liquified Layer 3	125	5	290.104	214.787	2068.01	1041.75	1026.26	2048.14	1006.39

33	2.73921	5536.83	5.1141	Liquified Layer 3	125	5	290.403	215.008	2057.04	1028.25	1028.79	2031.05	1002.8
34	2.73921	5461.76	6.31145	Liquified Layer 3	125	5	290.689	215.22	2042.36	1011.14	1031.22	2010.21	999.072
35	2.73921	5358.09	7.51156	Liquified Layer 3	125	5	290.156	214.825	2017.13	990.423	1026.71	1978.87	988.447
36	2.73921	5167.68	8.71501	Liquified Layer 3	125	5	286.207	211.902	1959.34	966.053	993.288	1915.47	949.416
37	2.73921	4950.2	9.92234	Liquified Layer 3	125	5	281.451	208.38	1891.04	938.002	953.04	1841.81	903.806
38	2.73921	4716.4	11.1341	Liquified Layer 3	125	5	276.357	204.609	1816.16	906.232	909.932	1761.77	855.542
39	2.73921	4466.07	12.351	Liquified Layer 3	125	5	270.912	200.577	1734.55	870.698	863.855	1675.23	804.534
40	2.73921	4199	13.5736	Liquified Layer 3	125	5	265.102	196.276	1646.04	831.35	814.692	1582.04	750.686
41	3.24265	4601.4	14.9161	Liquified Layer2	125	6.00001	277.459	205.425	1548.96	783.766	765.192	1475.05	691.283
42	3.24265	4170.86	16.3808	Liquified Layer2	125	6.00001	267.785	198.263	1424.12	727.077	697.048	1345.41	618.332
43	3.24265	3739.56	17.8566	Liquified Layer2	125	6.00001	258.742	191.567	1298.09	664.745	633.342	1214.73	549.987
44	3.24265	3309.06	19.3448	Liquified Layer2	125	6.00001	250.429	185.412	1171.42	596.635	574.786	1083.5	486.867
45	2.49442	2234.05	20.6719	Liquified Layer1	125	3	204.073	151.091	1029.6	531.752	497.846	952.6	420.848
46	2.49442	1946.7	21.836	Liquified Layer1	125	3	200.424	148.39	917.501	471.203	446.298	837.191	365.988
47	2.49442	1644.62	23.0097	Liquified Layer1	125	3	196.541	145.514	798.407	406.967	391.44	714.941	307.974
48	2.9481	1483.89	24.3025	Sandy Clay (TS)	1200	0	1620.79	1200	1541.49	332.381	1209.11	809.594	477.213
49	2.9481	913.682	25.7175	Sandy Clay (TS)	1200	0	1620.79	1200	1399.06	246.543	1152.52	618.419	371.876
50	2.9481	310.205	27.1495	Sandy Clay (TS)	1200	0	1620.79	1200	1258.01	155.072	1102.94	426.845	271.773

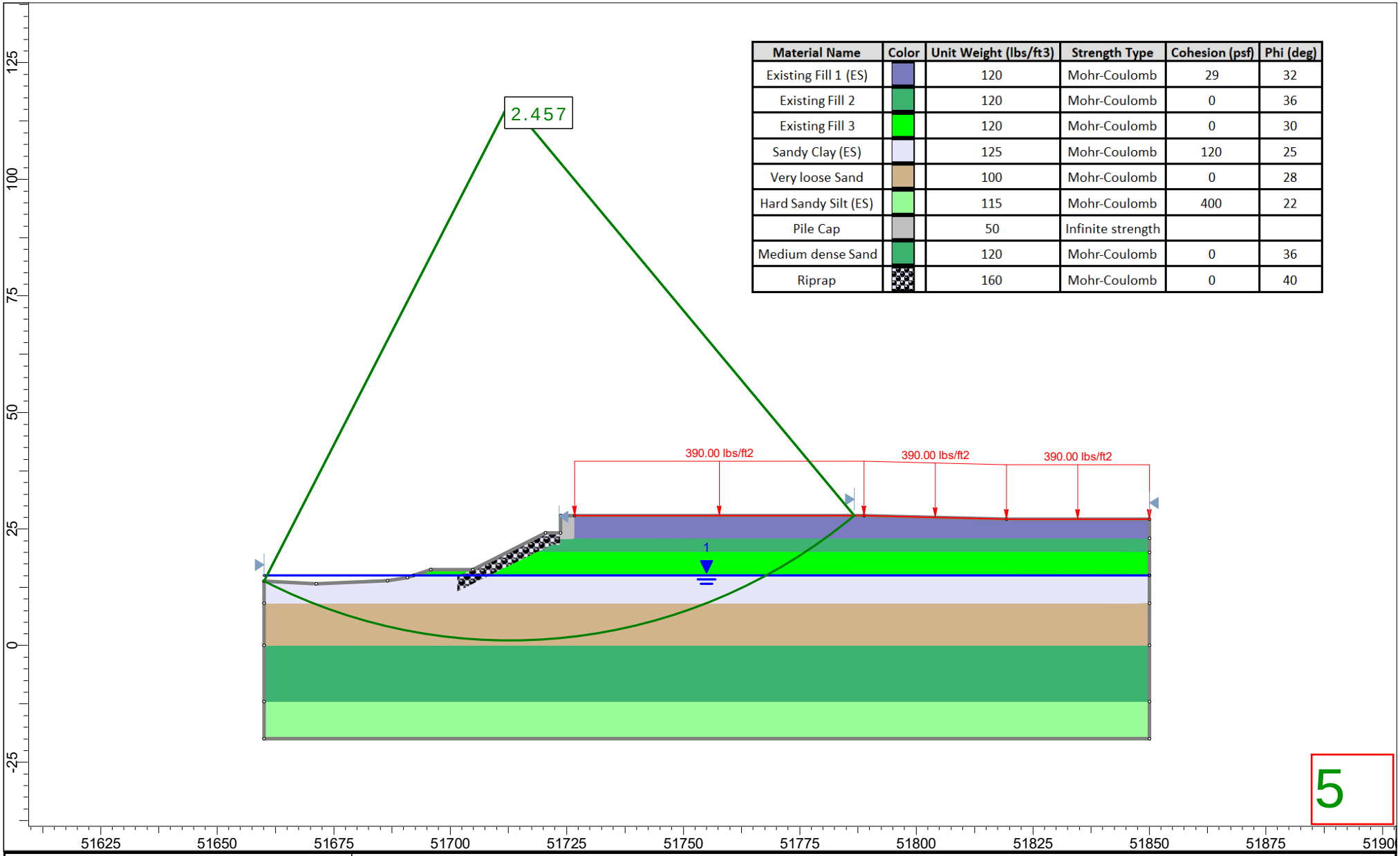
Seismic - Kh=0.37

Global Minimum Query (spencer) - Safety Factor: 0.48057

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	4.60347	716.308	-29.3947	Existing Fill 1 (TS)	58	29	258.403	124.181	119.393	0	119.393	264.964	264.964
2	4.60347	2110.06	-28.0478	Existing Fill 1 (TS)	58	29	482.8	232.019	313.937	0	313.937	571.163	571.163
3	3.00633	2096.06	-26.9461	Existing Fill 2	0	36	708.513	340.49	468.644	0	468.644	828.81	828.81
4	3.00633	2637.2	-26.0841	Existing Fill 2	0	36	893.395	429.339	590.935	0	590.935	1028.3	1028.3
5	3.72888	3991.58	-25.1265	Existing Fill 3	0	30	912.186	438.369	759.277	0	759.277	1187.09	1187.09
6	3.72888	4755.59	-24.0742	Existing Fill 3	0	30	1102.04	529.605	917.302	0	917.302	1409.67	1409.67
7	3.72888	5482.98	-23.0306	Existing Fill 3	0	30	1292.69	621.227	1076	0	1076	1625.53	1625.53
8	4.05699	6765.88	-21.9498	Sandy Clay (TS)	1200	0	2497.03	1200	1146.5	50.5282	1095.97	2152.82	2102.29
9	4.05699	7571.87	-20.8319	Sandy Clay (TS)	1200	0	2497.03	1200	1363.98	149.703	1214.28	2314.11	2164.4
10	4.05699	8332.07	-19.7222	Sandy Clay (TS)	1200	0	2497.03	1200	1573.48	243.243	1330.24	2468.64	2225.4
11	4.05699	9047.45	-18.6202	Sandy Clay (TS)	1200	0	2497.03	1200	1775.13	331.268	1443.86	2616.45	2285.18
12	3.3259	7876.89	-17.6234	Liquified Layer1	125	3	431.676	207.451	1980.13	406.88	1573.25	2117.26	1710.38
13	3.3259	8218.84	-16.7303	Liquified Layer1	125	3	435.563	209.318	2079.93	471.036	1608.89	2210.85	1739.82
14	3.3259	8542.02	-15.8414	Liquified Layer1	125	3	439.419	211.172	2175.93	531.672	1644.26	2300.61	1768.94
15	4.28359	11446.7	-14.8295	Liquified Layer2	125	6.00001	629.663	302.597	2286.23	596.501	1689.73	2452.94	1856.44
16	4.28359	11913.2	-13.6955	Liquified Layer2	125	6.00001	640.313	307.715	2402.87	664.455	1738.41	2558.9	1894.45
17	4.28359	12341.3	-12.567	Liquified Layer2	125	6.00001	650.863	312.785	2513.48	726.816	1786.67	2658.57	1931.76
18	4.28359	12731.5	-11.4434	Liquified Layer2	125	6.00001	661.294	317.798	2618.03	783.663	1834.36	2751.89	1968.23
19	3.94466	12037.5	-10.3684	Liquified Layer 3	125	5	600.859	288.755	2704.97	833.234	1871.73	2814.9	1981.67
20	3.94466	12307.9	-9.34116	Liquified Layer 3	125	5	608.361	292.36	2788.92	875.997	1912.93	2889	2013
21	3.94466	12549.6	-8.31698	Liquified Layer 3	125	5	615.727	295.9	2867.64	914.234	1953.41	2957.65	2043.42
22	3.94466	12762.9	-7.29547	Liquified Layer 3	125	5	622.95	299.371	2941.07	947.981	1993.09	3020.82	2072.84
23	3.94466	12948.1	-6.27629	Liquified Layer 3	125	5	630.016	302.767	3009.16	977.273	2031.89	3078.45	2101.18
24	3.94466	13105.3	-5.25909	Liquified Layer 3	125	5	636.914	306.082	3071.92	1002.14	2069.78	3130.55	2128.41
25	3.94466	13234.6	-4.24356	Liquified Layer 3	125	5	643.629	309.309	3129.26	1022.6	2106.66	3177.02	2154.42
26	3.94466	13336.3	-3.22936	Liquified Layer 3	125	5	650.149	312.442	3181.15	1038.67	2142.48	3217.83	2179.16
27	3.94466	13410.3	-2.21618	Liquified Layer 3	125	5	656.458	315.474	3227.52	1050.38	2177.14	3252.93	2202.55
28	3.94466	13456.7	-1.20369	Liquified Layer 3	125	5	662.547	318.4	3268.31	1057.73	2210.58	3282.23	2224.5
29	5.43805	18573.8	3.89758e-12	Liquified Layer 3	125	5	669.434	321.71	3308.73	1060.32	2248.41	3308.73	2248.41
30	3.58605	11369.3	1.15767	Liquified Layer 3	125	5	625.297	300.499	3064.02	1058.06	2005.96	3051.39	1993.33
31	3.58605	10986.2	2.07806	Liquified Layer 3	125	5	607.82	292.1	2961.7	1051.73	1909.97	2939.64	1887.91
32	3.58605	10573.8	2.999	Liquified Layer 3	125	5	594.298	285.602	2877.49	1041.81	1835.68	2846.36	1804.55

33	3.58605	9696.29	3.92071	Liquified Layer 3	125	5	558.212	268.26	2665.76	1028.28	1637.48	2627.5	1599.22
34	3.58605	8797.96	4.84343	Liquified Layer 3	125	5	521.158	250.453	2445.07	1011.13	1433.94	2400.91	1389.78
35	3.58605	7864.28	5.76742	Liquified Layer 3	125	5	482.373	231.814	2211.24	990.353	1220.88	2162.52	1172.16
36	3.58605	7203.56	6.69292	Liquified Layer 3	125	5	457.462	219.842	2049.98	965.923	1084.05	1996.29	1030.37
37	3.58605	6728.94	7.62017	Liquified Layer 3	125	5	442.339	212.575	1938.81	937.825	1000.98	1879.63	941.805
38	3.58605	6546.26	8.54944	Liquified Layer 3	125	5	442.739	212.767	1909.22	906.036	1003.18	1842.66	936.623
39	3.58605	6304.6	9.48098	Liquified Layer 3	125	5	440.764	211.818	1862.87	870.531	992.334	1789.26	918.726
40	3.58605	5925.52	10.4151	Liquified Layer 3	125	5	432.209	207.707	1776.62	831.281	945.344	1697.18	865.901
41	4.28359	6539.29	11.4434	Liquified Layer2	125	6.00001	458.381	220.284	1690.23	783.663	906.569	1597.44	813.782
42	4.28359	5918.34	12.567	Liquified Layer2	125	6.00001	443.326	213.049	1564.55	726.816	837.735	1465.72	738.908
43	4.28359	5259.18	13.6955	Liquified Layer2	125	6.00001	426.978	205.193	1427.44	664.455	762.985	1323.39	658.934
44	4.28359	4561.89	14.8295	Liquified Layer2	125	6.00001	409.278	196.687	1278.56	596.501	682.055	1170.19	573.693
45	3.3259	3087.44	15.8414	Liquified Layer1	125	3	322.95	155.2	1107.93	531.672	576.256	1016.29	484.618
46	3.3259	2683.71	16.7303	Liquified Layer1	125	3	317.539	152.6	997.665	471.036	526.629	902.216	431.18
47	3.3259	2261.23	17.6234	Liquified Layer1	125	3	311.737	149.811	880.309	406.88	473.429	781.28	374.4
48	3.94242	2040.8	18.6047	Sandy Clay (TS)	1200	0	2497.03	1200	2279.73	332.51	1947.22	1439.16	1106.65
49	3.94242	1253.29	19.6753	Sandy Clay (TS)	1200	0	2497.03	1200	2154.35	247.122	1907.23	1261.5	1014.38
50	3.94242	424.68	20.7532	Sandy Clay (TS)	1200	0	2497.03	1200	2025.61	156.53	1869.08	1079.41	922.88

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 1 (ES)		120	Mohr-Coulomb	29	32
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Sandy Clay (ES)		125	Mohr-Coulomb	120	25
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (ES)		115	Mohr-Coulomb	400	22
Pile Cap		50	Infinite strength		
Medium dense Sand		120	Mohr-Coulomb	0	36
Riprap		160	Mohr-Coulomb	0	40



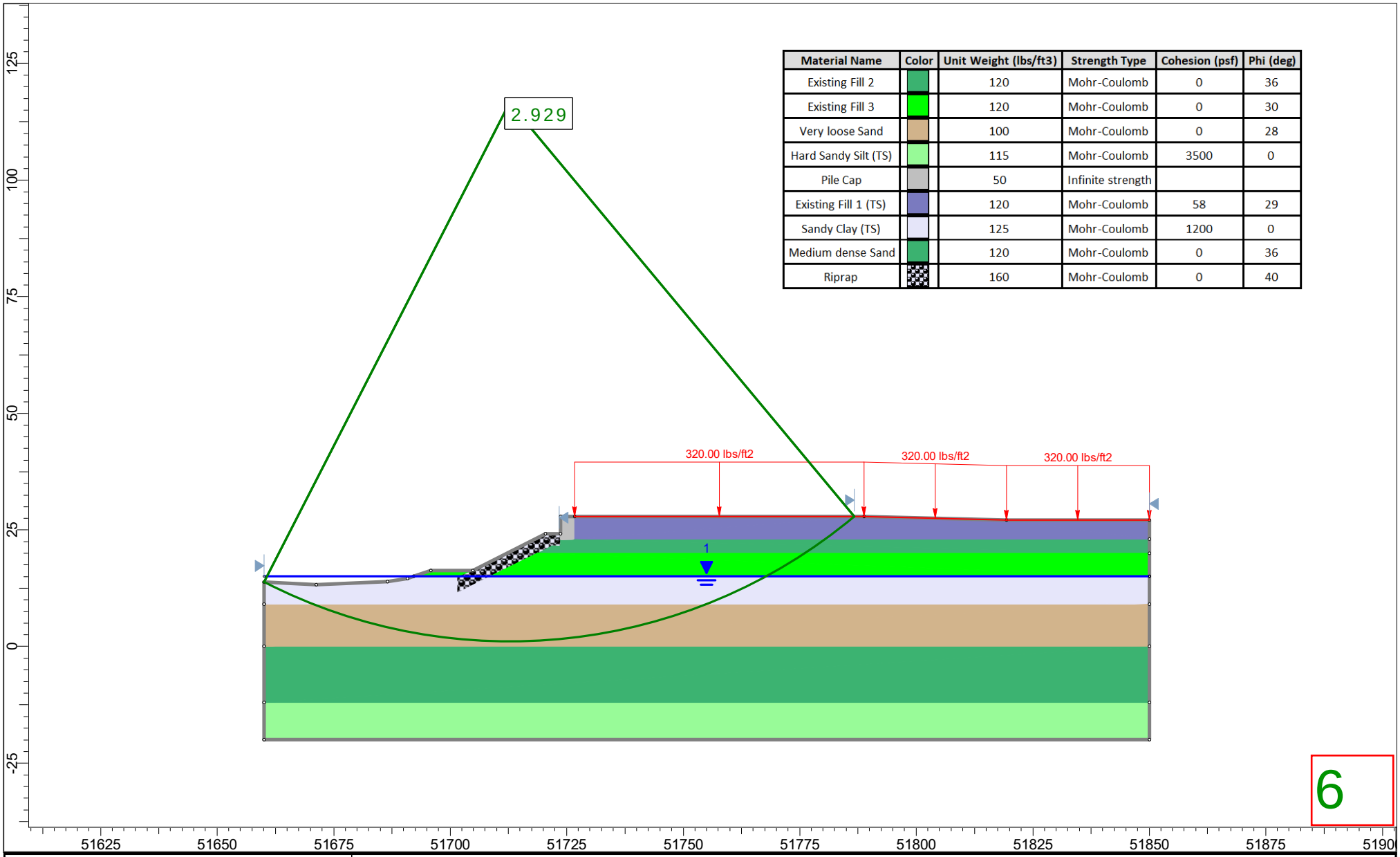
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Terracon

SLIDEINTERPRET 9.012

Project	I-95 Bridge Replacement over Bagshaw Swamp		
Analysis Description	Longitudinal Slope		
Drawn By	A. Fekrat	Company	Terracon
Date	7/28/2021, 10:51:28 AM	File Name	End Bridge Longitudinal.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Medium dense Sand		120	Mohr-Coulomb	0	36
Riprap		160	Mohr-Coulomb	0	40



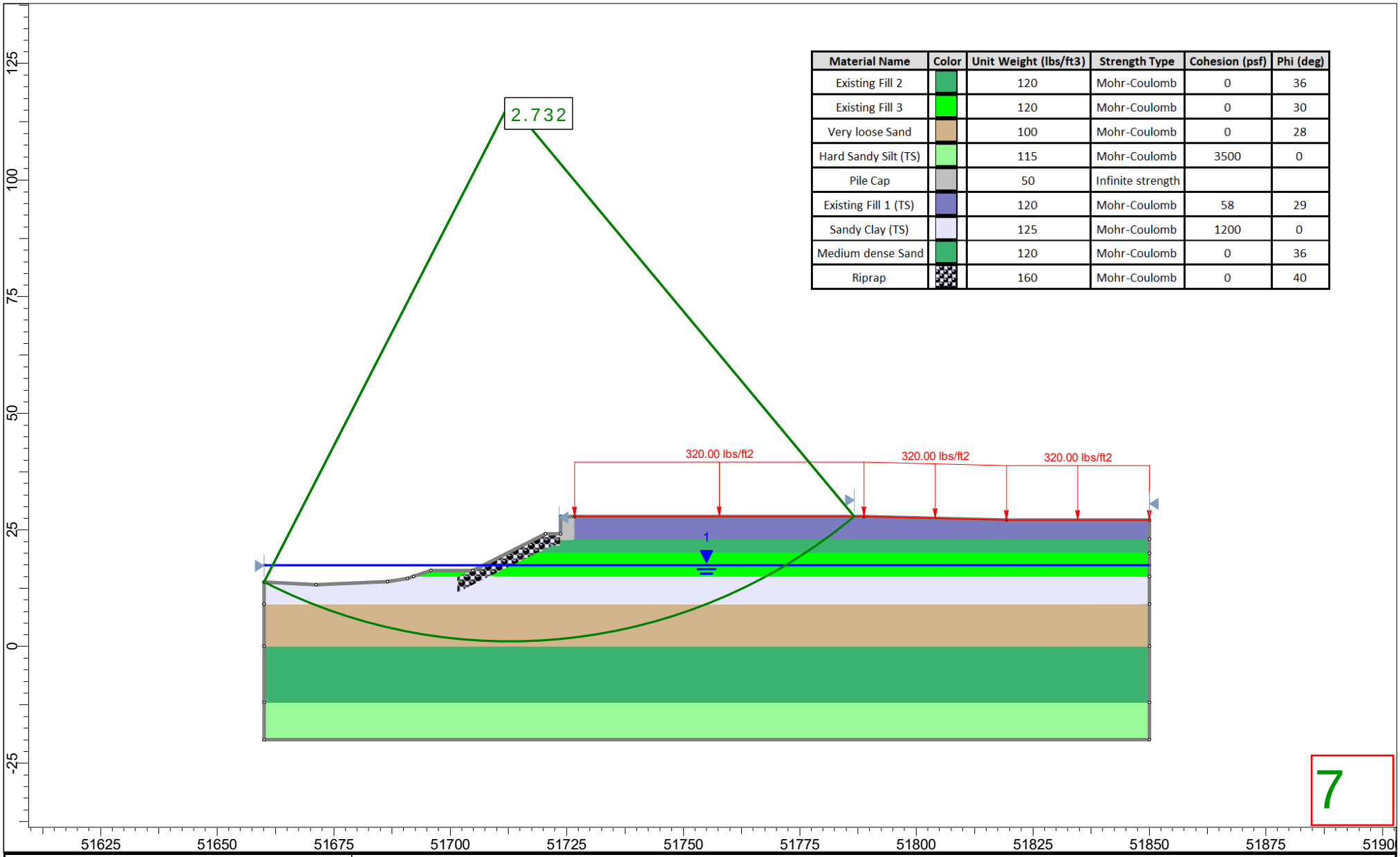
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Terracon

SLIDEINTERPRET 9.012

Project	I-95 Bridge Replacement over Bagshaw Swamp		
Analysis Description	Longitudinal Slope		
Drawn By	A. Fekrat	Company	Terracon
Date	7/28/2021, 10:51:28 AM	File Name	End Bridge Longitudinal.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Medium dense Sand		120	Mohr-Coulomb	0	36
Riprap		160	Mohr-Coulomb	0	40

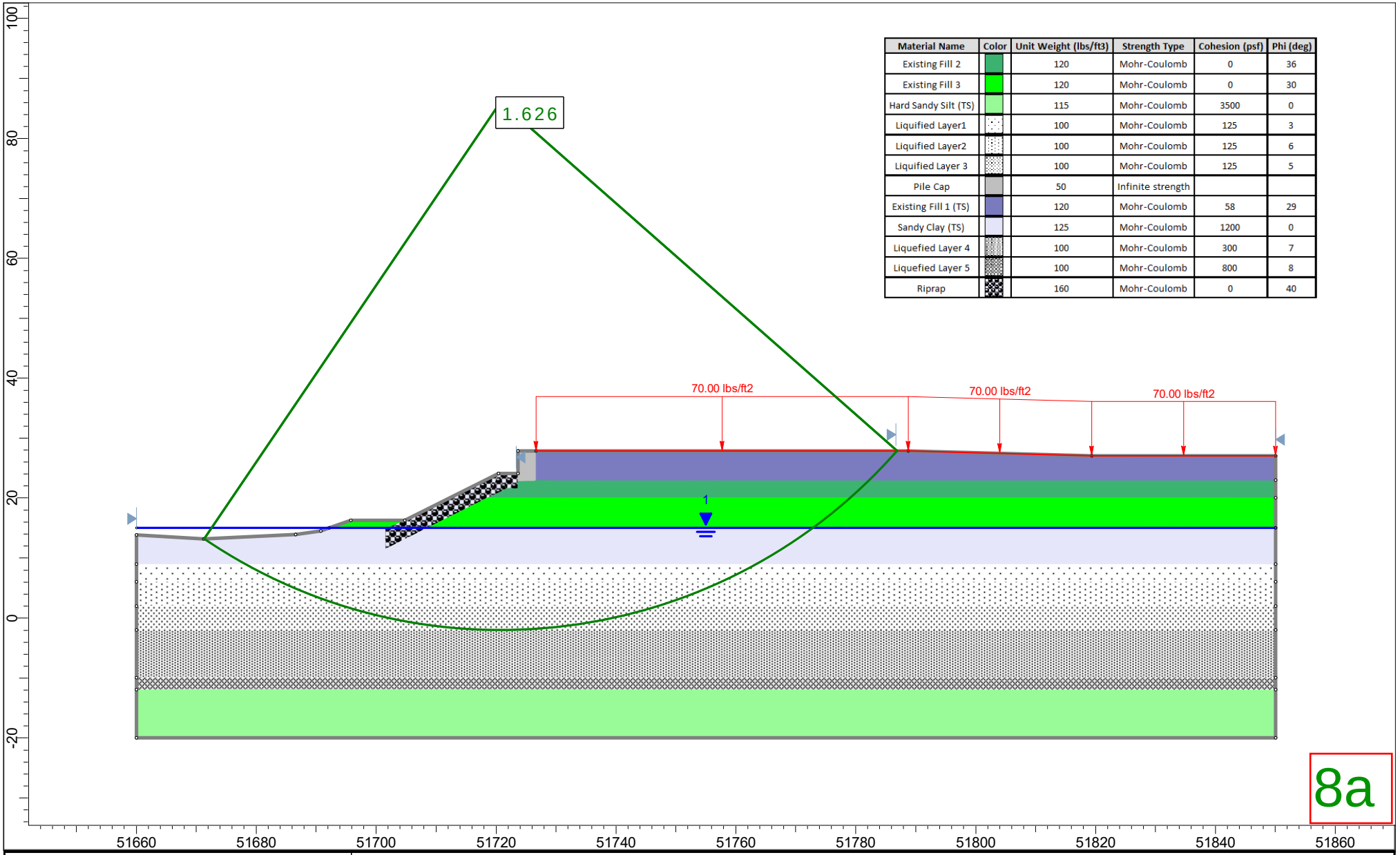


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Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	*Company* Terracon
	Date	7/28/2021, 10:51:28 AM	*File Name* End Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

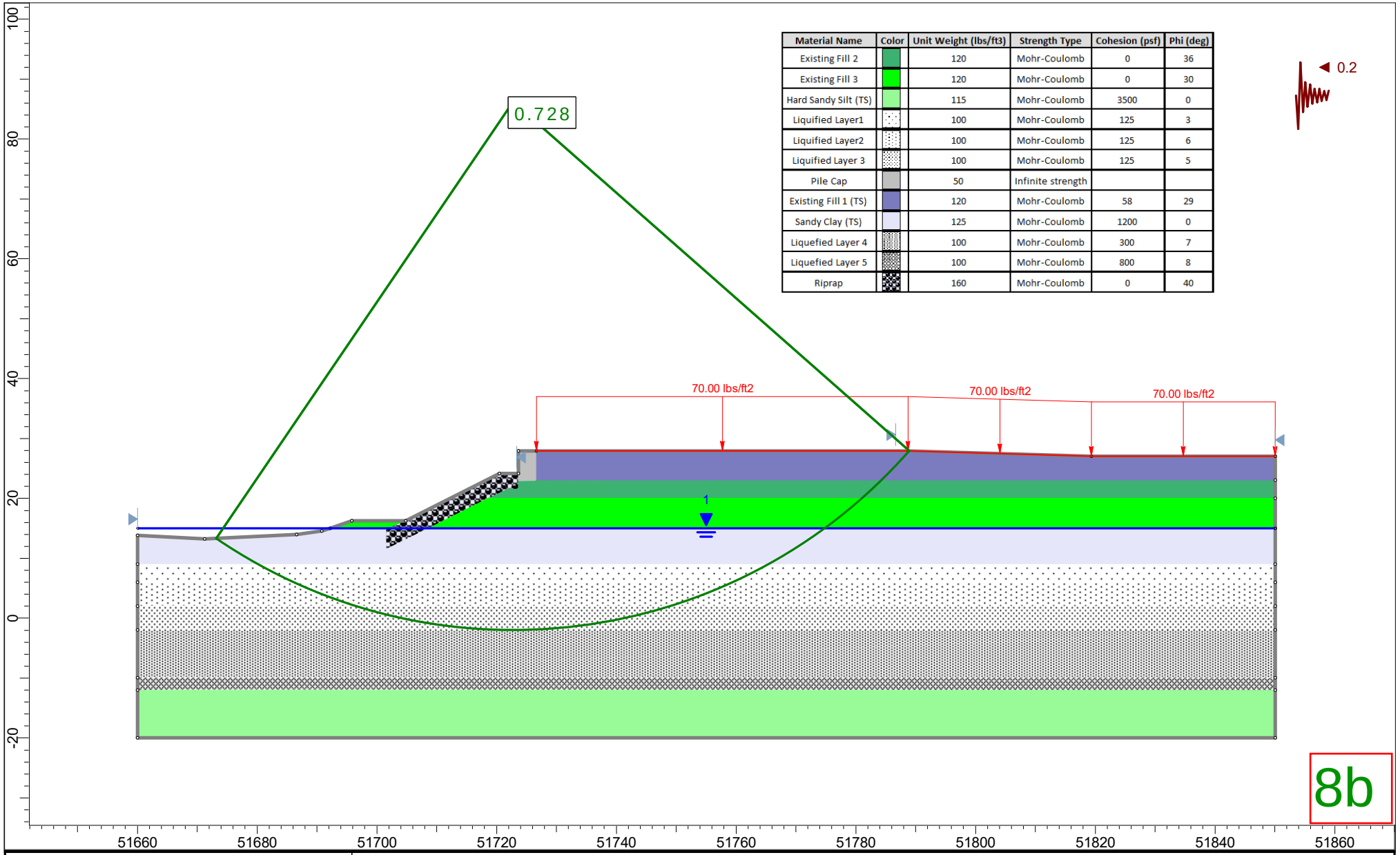
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8
Riprap		160	Mohr-Coulomb	0	40



8a

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

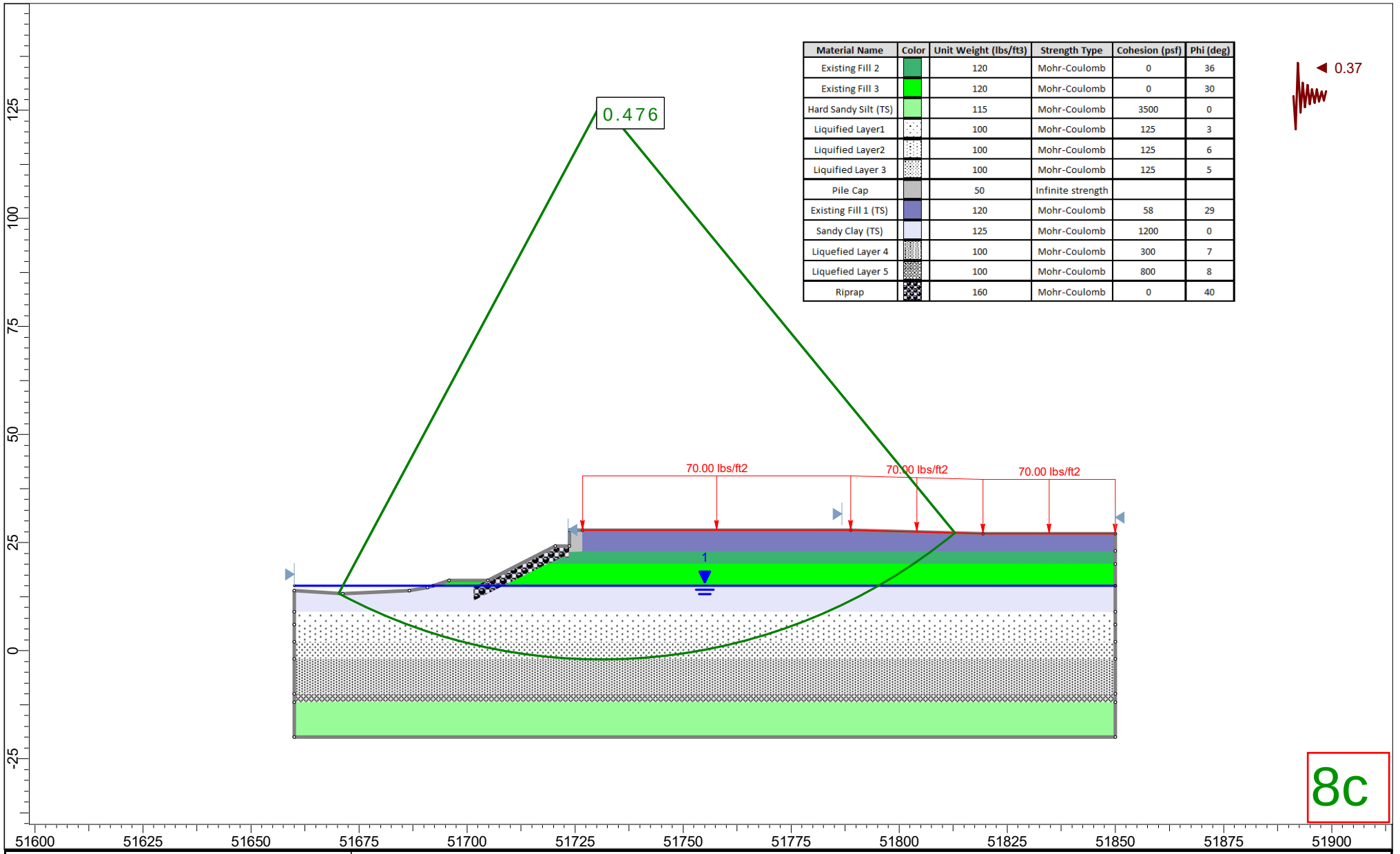


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8
Riprap		160	Mohr-Coulomb	0	40

8b

Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	*Company* Terracon
	Date	7/28/2021, 10:51:28 AM	*File Name* End Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Pile Cap		50	Infinite strength		
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8
Riprap		160	Mohr-Coulomb	0	40

◄ 0.37

8c

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Longitudinal Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Longitudinal.slmd

SLIDEINTERPRET 9.012

NEWMARK DISPLACEMENT ANALYSIS

Ref: SCDOT Geotechnical Design Manual (2019), Section 13.14.2

Project:	**I-95 BRO Bagshaw Swamp**
County	Jasper
Terracon Project No:	EN175299
Location:	End Bridge Longitudinal Slope
Design Earthquake:	SEE
Computed By:	A. Fekrat
Checked By:	D. Corley
Date:	7/30/2021

Stability Analysis Serial No: 8a, 8b, 8c

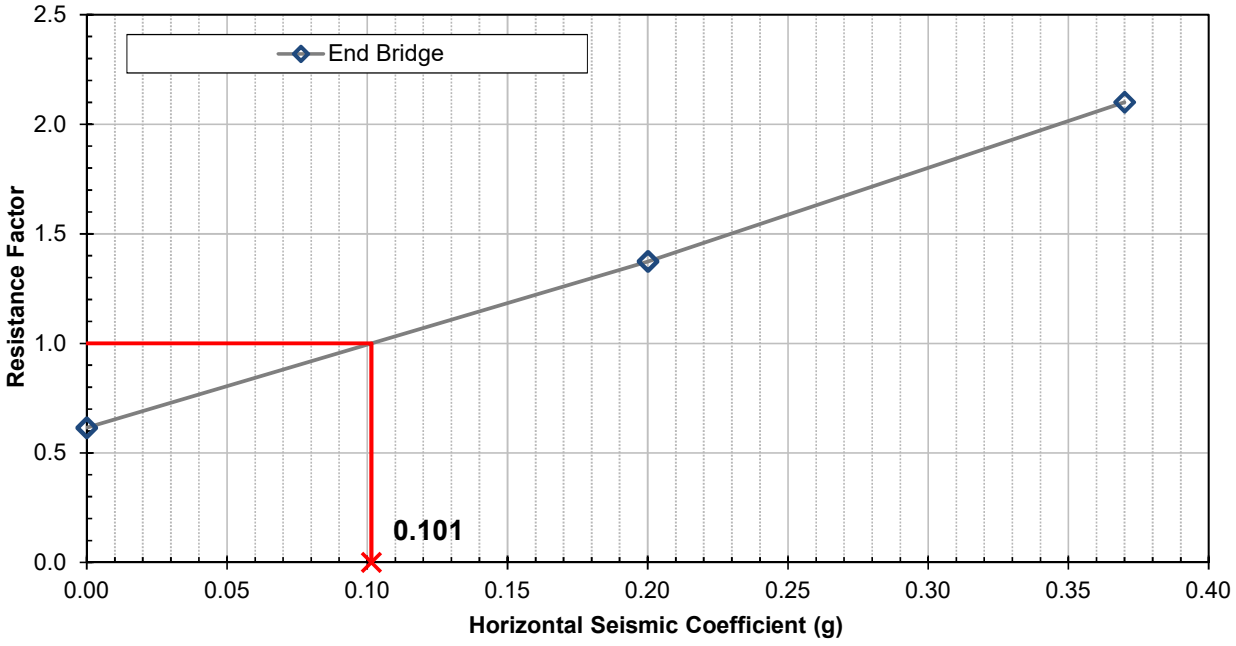
Slope Stability Analyses

End Bridge		
2H:1V Slope		
k_h	**Resistance Factor**	**FOS**
0.0000	0.62	1.626
0.2000	1.37	0.728
0.3700	2.10	0.476

Deformation ID (Table 10-1 GDM)
GI-01
GI-02

Lateral Deformation Analyses

R (ft)	NA
k_{max} =	0.370
k_y =	0.101
k_y/k_{max} =	0.274
S_1 =	0.480
F_v =	1.000
PGV =	18.3 in/sec
H =	14.00 ft.
β (0.5 ≤ β ≤ 1.5)	1.30
α_W (α_W=1 if H≤20)	1.00
$k_{max} = k_h = k_{av}$ =	0.370
$k_y/k_{max} = k_y/k_{av}$ =	0.274
log (d) =	0.826
Displacement	**13.40 in.**
Slice Angle of Entry	39°
Slice Angle of Exit	27°
GI-01 (V at Top)	**8.36 in.**
GI-02 (H at Top)	**10.47 in.**
(H at Bottom)	**11.90 in.**
RS-04 (Wall Rot.)	NA



Project Summary

File Name:	End Bridge Longitudinal.slmd
Slide Modeler Version:	9.012
Project Title:	I-95 Bridge Replacement over Bagshaw Swamp
Analysis:	Longitudinal Slope
Author:	A. Fekrat
Company:	Terracon
Date Created:	7/28/2021, 10:51:28 AM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Effective Stress	Master Scenario	Spencer: 2.457030	00h:00m:02.630s
Seismic	Kh=0.2	Spencer: 0.727865	00h:00m:03.25s

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Seismic Loading

Effective Stress

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.2

Loading

Effective Stress

Distribution:	Constant
Magnitude [psf]:	390
Orientation:	Vertical

Seismic

Distribution:	Constant
Magnitude [psf]:	70
Orientation:	Vertical

Materials

Existing Fill 1 (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	29
Friction Angle [deg]	32
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	30
Water Surface	Assigned per scenario
Hu Value	1
Sandy Clay (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	120
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Hu Value	1
Very loose Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0
Friction Angle [deg]	28
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	400

Friction Angle [deg]	22
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	3500
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer1	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	3
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	6
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	5
Water Surface	Assigned per scenario
Hu Value	1
Pile Cap	
Color	
Strength Type	Infinite strength
Unit Weight [lbs/ft3]	50
Allow Sliding Along Boundary	No
Water Surface	Assigned per scenario
Hu Value	0
Existing Fill 1 (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	58
Friction Angle [deg]	29
Water Surface	Assigned per scenario
Hu Value	1

Sandy Clay (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	1200
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Medium dense Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 4	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	300
Friction Angle [deg]	7
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 5	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	800
Friction Angle [deg]	8
Water Surface	Assigned per scenario
Hu Value	1
Riprap	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	160
Cohesion [psf]	0
Friction Angle [deg]	40
Water Surface	Assigned per scenario
Hu Value	1

Materials In Use

Material	Effective Stress	Kh=0.2
Existing Fill 1 (ES)	✓	✗
Existing Fill 2	✓	✓
Existing Fill 3	✓	✓
Sandy Clay (ES)	✓	✗
Very loose Sand	✓	✗
Hard Sandy Silt (ES)	✓	✗
Hard Sandy Silt (TS)	✗	✓
Liquified Layer1	✗	✓
Liquified Layer2	✗	✓
Liquified Layer 3	✗	✓
Pile Cap	✓	✓
Existing Fill 1 (TS)	✗	✓
Sandy Clay (TS)	✗	✓
Medium dense Sand	✓	✗
Liquefied Layer 4	✗	✓
Liquefied Layer 5	✗	✓
Riprap	✓	✓

Slice Data

Effective Stress

Global Minimum Query (spencer) - Safety Factor: 2.45703

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.68151	196.92	-26.4009	Sandy Clay (ES)	120	25	48.0796	118.133	110.286	114.289	-4.00334	86.4178	-27.8712
2	2.68151	576.513	-24.9254	Sandy Clay (ES)	120	25	62.7008	154.058	267.739	194.702	73.0367	238.6	43.8982
3	2.68151	928.114	-23.4674	Sandy Clay (ES)	120	25	75.6168	185.793	410.997	269.903	141.094	378.169	108.266
4	2.68151	1252.67	-22.0253	Sandy Clay (ES)	120	25	86.9586	213.66	540.925	340.07	200.855	505.747	165.677
5	2.46976	1415.91	-20.6537	Very loose Sand	0	28	48.6071	119.429	627.572	402.961	224.611	609.25	206.289
6	2.46976	1673.04	-19.3502	Very loose Sand	0	28	60.5955	148.885	739.078	459.067	280.011	717.798	258.731
7	2.46976	1916.23	-18.0571	Very loose Sand	0	28	71.8017	176.419	843.046	511.25	331.796	819.637	308.387
8	2.46976	2144.24	-16.7734	Very loose Sand	0	28	82.1195	201.77	939.071	559.598	379.473	914.319	354.721
9	2.46976	2357.39	-15.4983	Very loose Sand	0	28	91.6012	225.067	1027.48	604.191	423.289	1002.08	397.888
10	2.46976	2555.97	-14.2311	Very loose Sand	0	28	100.295	246.428	1108.56	645.1	463.462	1083.13	438.026
11	2.46976	2753.25	-12.9709	Very loose Sand	0	28	109.52	269.093	1188.48	682.392	506.09	1163.26	480.864
12	2.46976	2992.73	-11.7171	Very loose Sand	0	28	123.486	303.408	1286.75	716.122	570.627	1261.14	545.016
13	2.46976	3281.4	-10.4689	Very loose Sand	0	28	142.743	350.725	1405.96	746.342	659.617	1379.58	633.241
14	2.46976	3638.62	-9.22579	Very loose Sand	0	28	169.009	415.26	1554.09	773.096	780.991	1526.64	753.539
15	2.46976	3889.48	-7.98702	Very loose Sand	0	28	185.532	455.857	1653.77	796.424	857.342	1627.73	831.31
16	2.46976	3970.99	-6.75199	Very loose Sand	0	28	186.628	458.551	1678.77	816.359	862.41	1656.67	840.314
17	2.46976	4203.02	-5.52011	Very loose Sand	0	28	202.503	497.555	1768.69	832.929	935.766	1749.12	916.195
18	2.46976	4385.33	-4.29079	Very loose Sand	0	28	214.274	526.477	1836.32	846.157	990.162	1820.24	974.085
19	2.46976	4686.51	-3.06345	Very loose Sand	0	28	237.521	583.596	1953.65	856.063	1097.58	1940.94	1084.87
20	2.46976	5094.97	-1.83751	Very loose Sand	0	28	270.924	665.669	2114.6	862.659	1251.94	2105.91	1243.25
21	2.46976	5479.36	-0.612409	Very loose Sand	0	28	302.378	742.953	2263.25	865.954	1397.29	2260.01	1394.06
22	2.46976	5849.88	0.612409	Very loose Sand	0	28	332.843	817.805	2404.02	865.954	1538.07	2407.58	1541.62
23	2.46976	6207.36	1.83751	Very loose Sand	0	28	362.416	890.467	2537.38	862.659	1674.73	2549.01	1686.35
24	2.46976	6551.77	3.06345	Very loose Sand	0	28	391.118	960.989	2663.42	856.063	1807.36	2684.35	1828.29
25	2.46976	6699.25	4.29079	Very loose Sand	0	28	402.83	989.766	2707.64	846.157	1861.48	2737.86	1891.7
26	2.46976	6628.15	5.52011	Very loose Sand	0	28	396.046	973.097	2663.06	832.929	1830.13	2701.33	1868.4
27	2.46976	6864.79	6.75199	Very loose Sand	0	28	446.043	1095.94	2877.52	816.359	2061.16	2930.33	2113.97
28	2.46976	7338.59	7.98702	Very loose Sand	0	28	540.799	1328.76	3295.45	796.424	2499.03	3371.33	2574.91
29	2.46976	7246.26	9.22579	Very loose Sand	0	28	533.477	1310.77	3238.29	773.096	2465.2	3324.94	2551.85

30	2.46976	7140.36	10.4689	Very loose Sand	0	28	525.83	1291.98	3176.2	746.342	2429.85	3273.36	2527.02
31	2.46976	7020.75	11.7171	Very loose Sand	0	28	517.861	1272.4	3109.15	716.122	2393.03	3216.56	2500.44
32	2.46976	6887.25	12.9709	Very loose Sand	0	28	509.575	1252.04	3037.13	682.392	2354.74	3154.5	2472.11
33	2.46976	6739.65	14.2311	Very loose Sand	0	28	500.971	1230.9	2960.09	645.1	2314.99	3087.15	2442.05
34	2.46976	6577.74	15.4983	Very loose Sand	0	28	492.062	1209.01	2878	604.191	2273.81	3014.44	2410.25
35	2.46976	6401.24	16.7734	Very loose Sand	0	28	482.839	1186.35	2790.8	559.598	2231.2	2936.33	2376.74
36	2.46976	6209.88	18.0571	Very loose Sand	0	28	473.315	1162.95	2698.43	511.25	2187.18	2852.74	2341.49
37	2.46976	6003.35	19.3502	Very loose Sand	0	28	463.486	1138.8	2600.83	459.067	2141.77	2763.6	2304.53
38	2.46976	5781.28	20.6537	Very loose Sand	0	28	453.356	1113.91	2497.93	402.961	2094.97	2668.82	2265.86
39	2.59106	5775.08	22.001	Sandy Clay (ES)	120	25	435.075	1068.99	2376.37	341.251	2035.12	2552.16	2210.91
40	2.59106	5424.01	23.3939	Sandy Clay (ES)	120	25	420.55	1033.3	2232.2	273.615	1958.59	2414.14	2140.52
41	2.59106	5048.59	24.8017	Sandy Clay (ES)	120	25	405.487	996.293	2080.5	201.285	1879.22	2267.88	2066.59
42	2.59106	4648	26.2256	Sandy Clay (ES)	120	25	389.889	957.968	1921.13	124.105	1797.03	2113.2	1989.09
43	2.59106	4221.31	27.6671	Sandy Clay (ES)	120	25	373.757	918.332	1753.93	41.8981	1712.03	1949.88	1907.98
44	2.79437	4053.6	29.1862	Existing Fill 3	0	30	368.921	906.451	1570.02	0	1570.02	1776.09	1776.09
45	2.79437	3512.77	30.7863	Existing Fill 3	0	30	326.381	801.929	1388.98	0	1388.98	1583.44	1583.44
46	2.79437	2936.15	32.4136	Existing Fill 3	0	30	282.124	693.188	1200.64	0	1200.64	1379.77	1379.77
47	2.17875	1866.07	33.8851	Existing Fill 2	0	36	295.72	726.594	1000.07	0	1000.07	1198.68	1198.68
48	2.17875	1473.89	35.1969	Existing Fill 2	0	36	250.156	614.641	845.981	0	845.981	1022.43	1022.43
49	3.1355	1390.25	36.8293	Existing Fill 1 (ES)	29	32	179.432	440.869	659.128	0	659.128	793.504	793.504
50	3.1355	474.246	38.7982	Existing Fill 1 (ES)	29	32	118.247	290.536	418.544	0	418.544	513.611	513.611

Seismic

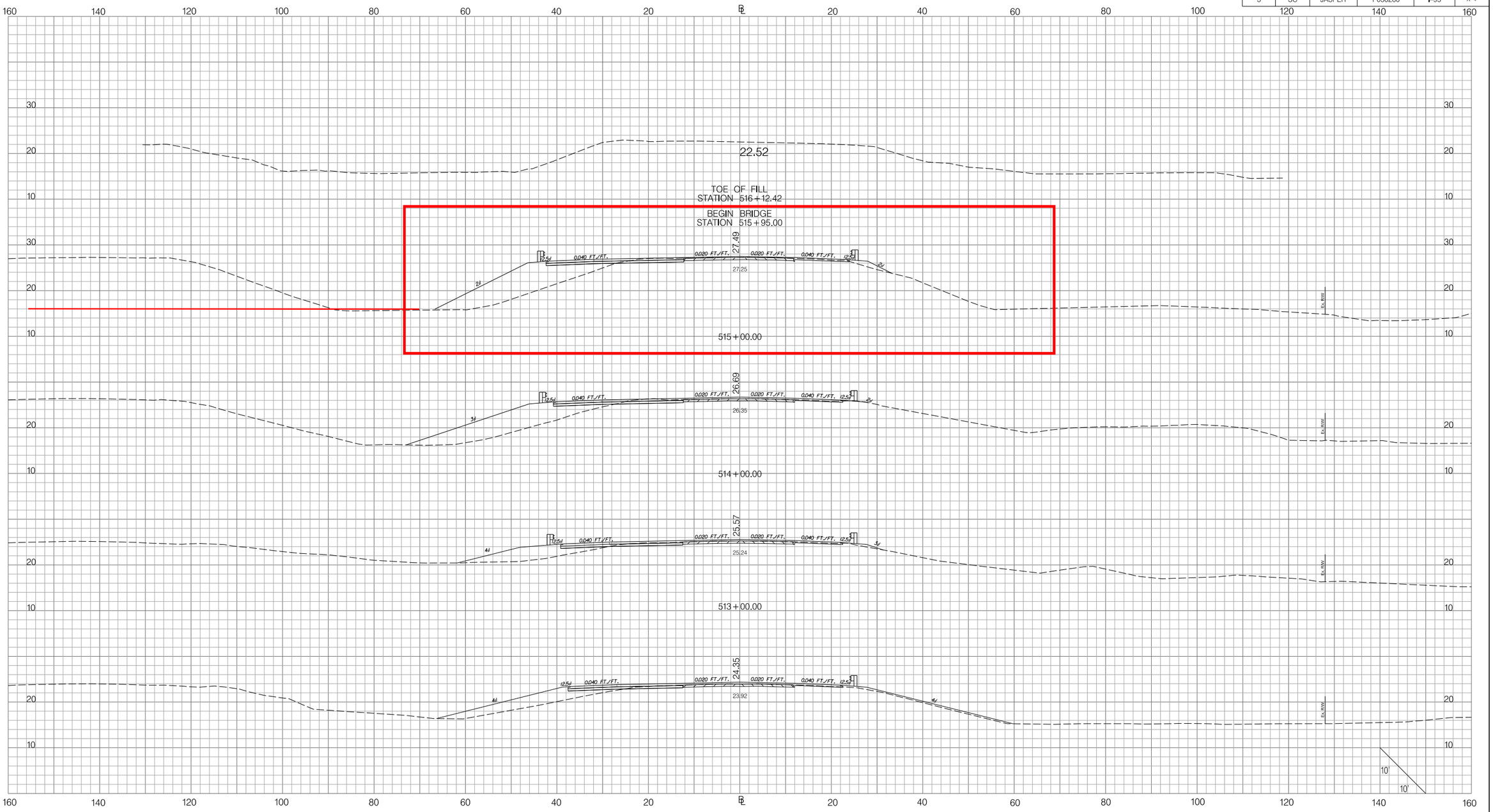
Global Minimum Query (spencer) - Safety Factor: 0.727865

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.31199	235.711	-33.3238	Sandy Clay (TS)	1200	0	1648.66	1200	1649.06	155.305	1493.75	565.112	409.807
2	2.31199	692.568	-31.5448	Sandy Clay (TS)	1200	0	1648.66	1200	1768.48	247.013	1521.47	756.412	509.399
3	2.31199	1121.1	-29.7991	Sandy Clay (TS)	1200	0	1648.66	1200	1878.06	332.605	1545.45	933.895	601.29
4	1.98212	1256.09	-28.2039	Liquified Layer1	125	3	202.214	147.185	830.39	407.08	423.31	721.946	314.866
5	1.98212	1484.07	-26.7531	Liquified Layer1	125	3	205.647	149.683	942.406	471.42	470.986	838.738	367.318
6	1.98212	1699.65	-25.3206	Liquified Layer1	125	3	208.798	151.976	1046.59	531.855	514.737	947.802	415.947
7	2.6079	2569.01	-23.6842	Liquified Layer2	125	6.00001	258.543	188.185	1197.97	596.805	601.163	1084.56	487.756
8	2.6079	2979.8	-21.8475	Liquified Layer2	125	6.00001	270.645	196.993	1350.09	665.118	684.971	1241.58	576.46
9	2.6079	3469.64	-20.0341	Liquified Layer2	125	6.00001	288.254	209.81	1534.33	727.411	806.915	1429.22	701.805
10	2.6079	3977.18	-18.2414	Liquified Layer2	125	6.00001	307.391	223.739	1723.34	783.898	939.441	1622.03	838.129
11	2.4685	4036.97	-16.5141	Liquified Layer 3	125	5	288.567	210.038	1805.54	833.549	971.989	1719.98	886.434
12	2.4685	4208.07	-14.8491	Liquified Layer 3	125	5	289.508	210.722	1856.62	876.802	979.815	1779.86	903.058
13	2.4685	4642.05	-13.1969	Liquified Layer 3	125	5	304.596	221.705	2020.62	915.282	1105.34	1949.2	1033.91
14	2.4685	4850.7	-11.5558	Liquified Layer 3	125	5	308.464	224.52	2086.61	949.089	1137.52	2023.54	1074.45
15	2.4685	5320.72	-9.92422	Liquified Layer 3	125	5	326.074	237.338	2262.34	978.312	1284.03	2205.29	1226.98
16	2.4685	5795.27	-8.30077	Liquified Layer 3	125	5	344.157	250.5	2437.5	1003.02	1434.48	2387.28	1384.26
17	2.4685	6245.56	-6.684	Liquified Layer 3	125	5	361.27	262.956	2600.13	1023.29	1576.84	2557.8	1534.51
18	2.4685	6678.46	-5.07256	Liquified Layer 3	125	5	377.777	274.971	2753.32	1039.15	1714.17	2719.79	1680.64
19	2.4685	7094.09	-3.46515	Liquified Layer 3	125	5	393.699	286.56	2897.28	1050.65	1846.63	2873.44	1822.79
20	2.4685	7473.63	-1.86046	Liquified Layer 3	125	5	408.137	297.069	3024.57	1057.81	1966.76	3011.31	1953.5
21	3.26077	9940.88	4.74435e-12	Liquified Layer 3	125	5	406.644	295.982	3014.65	1060.31	1954.34	3014.65	1954.34
22	2.24409	6833.83	1.78753	Liquified Layer 3	125	5	403.024	293.347	2982.35	1058.13	1924.22	2994.93	1936.8
23	2.24409	7566.01	3.24614	Liquified Layer 3	125	5	447.23	325.523	3343.96	1051.97	2291.99	3369.33	2317.36
24	2.24409	7552.06	4.70685	Liquified Layer 3	125	5	444.8	323.754	3314.01	1042.24	2271.77	3350.64	2308.4
25	2.24409	7504.1	6.17065	Liquified Layer 3	125	5	440.866	320.891	3267.95	1028.9	2239.05	3315.61	2286.71
26	2.24409	7443.11	7.6385	Liquified Layer 3	125	5	436.754	317.898	3216.78	1011.94	2204.84	3275.36	2263.42
27	2.24409	7368.96	9.11141	Liquified Layer 3	125	5	432.468	314.778	3160.5	991.324	2169.17	3229.85	2238.53
28	2.24409	7281.5	10.5904	Liquified Layer 3	125	5	428.007	311.531	3099.06	967.004	2132.06	3179.09	2212.08
29	2.24409	7180.55	12.0766	Liquified Layer 3	125	5	423.374	308.159	3032.45	938.933	2093.52	3123.03	2184.1
30	2.24409	7065.89	13.5711	Liquified Layer 3	125	5	418.572	304.664	2960.62	907.052	2053.56	3061.66	2154.6
31	2.24409	6937.29	15.0751	Liquified Layer 3	125	5	413.6	301.045	2883.5	871.292	2012.21	2994.91	2123.61
32	2.24409	6794.45	16.5898	Liquified Layer 3	125	5	408.463	297.306	2801.04	831.574	1969.46	2922.73	2091.15

33	2.08632	6176.05	18.0624	Liquified Layer2	125	6.00001	448.997	326.809	2709.57	789.486	1920.08	2856	2066.51
34	2.08632	6028.03	19.4933	Liquified Layer2	125	6.00001	442.759	322.269	2622.1	745.216	1876.89	2778.83	2033.62
35	2.08632	5867.72	20.937	Liquified Layer2	125	6.00001	436.357	317.609	2529.82	697.269	1832.55	2696.77	1999.5
36	2.08632	5694.77	22.3948	Liquified Layer2	125	6.00001	429.793	312.831	2432.64	645.541	1787.09	2609.74	1964.2
37	2.08632	5508.79	23.8681	Liquified Layer2	125	6.00001	423.066	307.935	2330.43	589.917	1740.51	2517.62	1927.71
38	1.98212	5049.23	25.3206	Liquified Layer1	125	3	296.186	215.583	2260.29	531.855	1728.43	2400.42	1868.57
39	1.98212	4857.26	26.7531	Liquified Layer1	125	3	293.012	213.273	2155.78	471.42	1684.36	2303.49	1832.07
40	1.98212	4652.89	28.2039	Liquified Layer1	125	3	289.758	210.905	2046.24	407.08	1639.16	2201.63	1794.55
41	2.34944	5192.59	29.8132	Sandy Clay (TS)	1200	0	1648.66	1200	1398.28	331.911	1066.37	2342.98	2011.07
42	2.34944	4782.77	31.5877	Sandy Clay (TS)	1200	0	1648.66	1200	1173.29	244.834	928.461	2187.07	1942.23
43	2.34944	4343.18	33.3968	Sandy Clay (TS)	1200	0	1648.66	1200	935.93	151.431	784.499	2022.89	1871.46
44	2.34944	3871.96	35.2443	Sandy Clay (TS)	1200	0	1648.66	1200	685.328	51.3089	634.019	1850.24	1798.93
45	2.07505	3009.62	37.022	Existing Fill 3	0	30	732.111	532.878	922.973	0	922.973	1475.1	1475.1
46	2.07505	2607.59	38.7294	Existing Fill 3	0	30	620.942	451.962	782.822	0	782.822	1280.81	1280.81
47	2.07505	2179.91	40.4786	Existing Fill 3	0	30	509.203	370.631	641.951	0	641.951	1076.52	1076.52
48	3.23995	2476.23	42.7978	Existing Fill 2	0	36	421.151	306.541	421.918	0	421.918	811.879	811.879
49	2.31499	1027.67	45.3	Existing Fill 1 (TS)	58	29	260.705	189.758	237.698	0	237.698	501.147	501.147
50	2.31499	352.004	47.4806	Existing Fill 1 (TS)	58	29	137.25	99.8993	75.5884	0	75.5884	225.268	225.268

CROSS SECTION VIEW OF ROADWAY SIDE SLOPES

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	JASPER	P030260	I-95	X-4



R:\Projects\18-42 I-95 Bridge Replacements Jasper Co\Roadway\CorridorModeling\I-95_XS_SHEETS.dgn
6/3/2021

INFRASTRUCTURE
CONSULTING & ENGINEERING

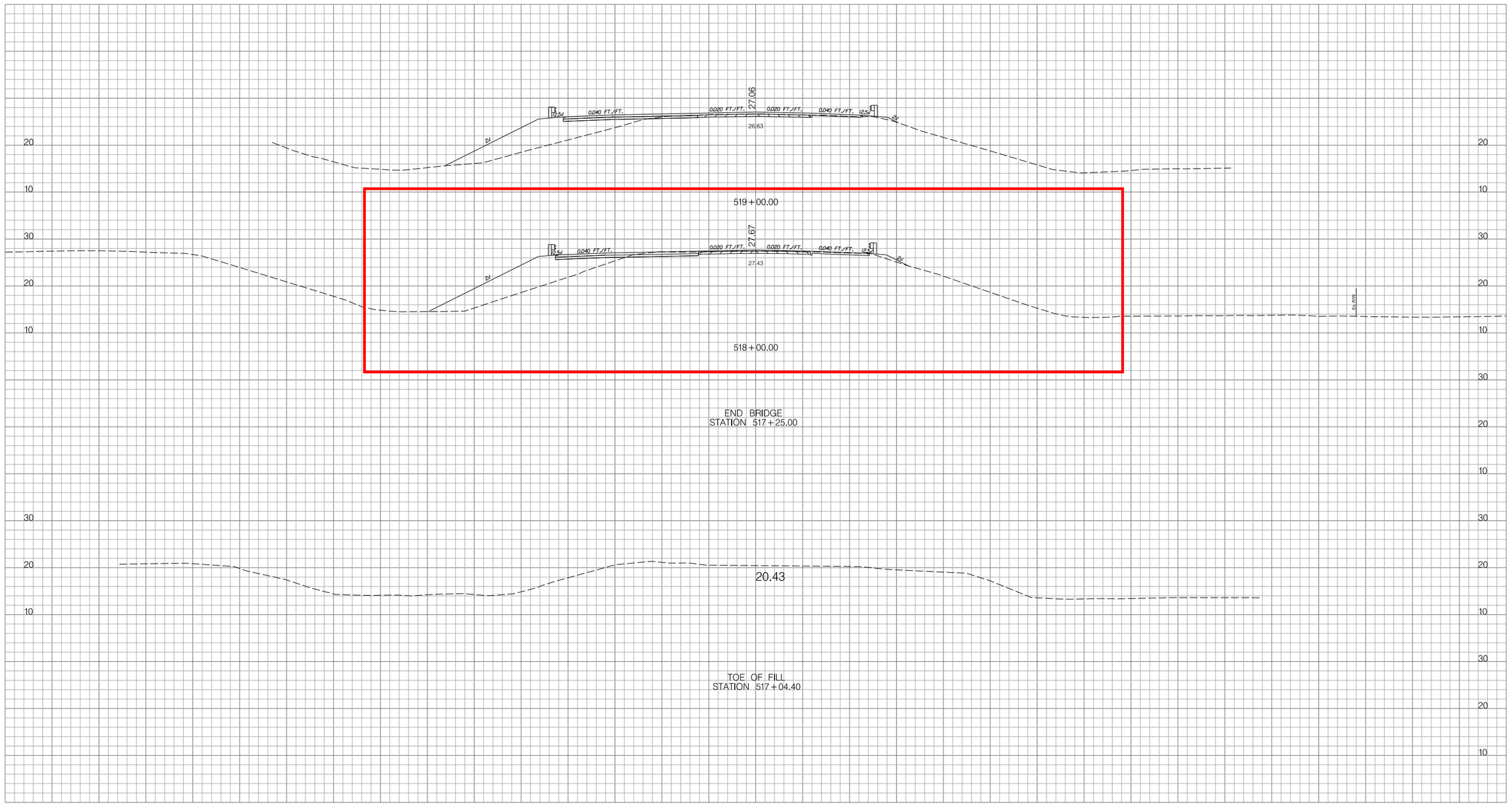
PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			
0			RELEASE FOR CONSTRUCTION

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

INTERSTATE 95 BRIDGE REPLACEMENT
JASPER COUNTY

CROSS SECTION SHEET



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6/3/2021

INFRASTRUCTURE
CONSULTING & ENGINEERING

PRELIMINARY
NOT FOR CONSTRUCTION

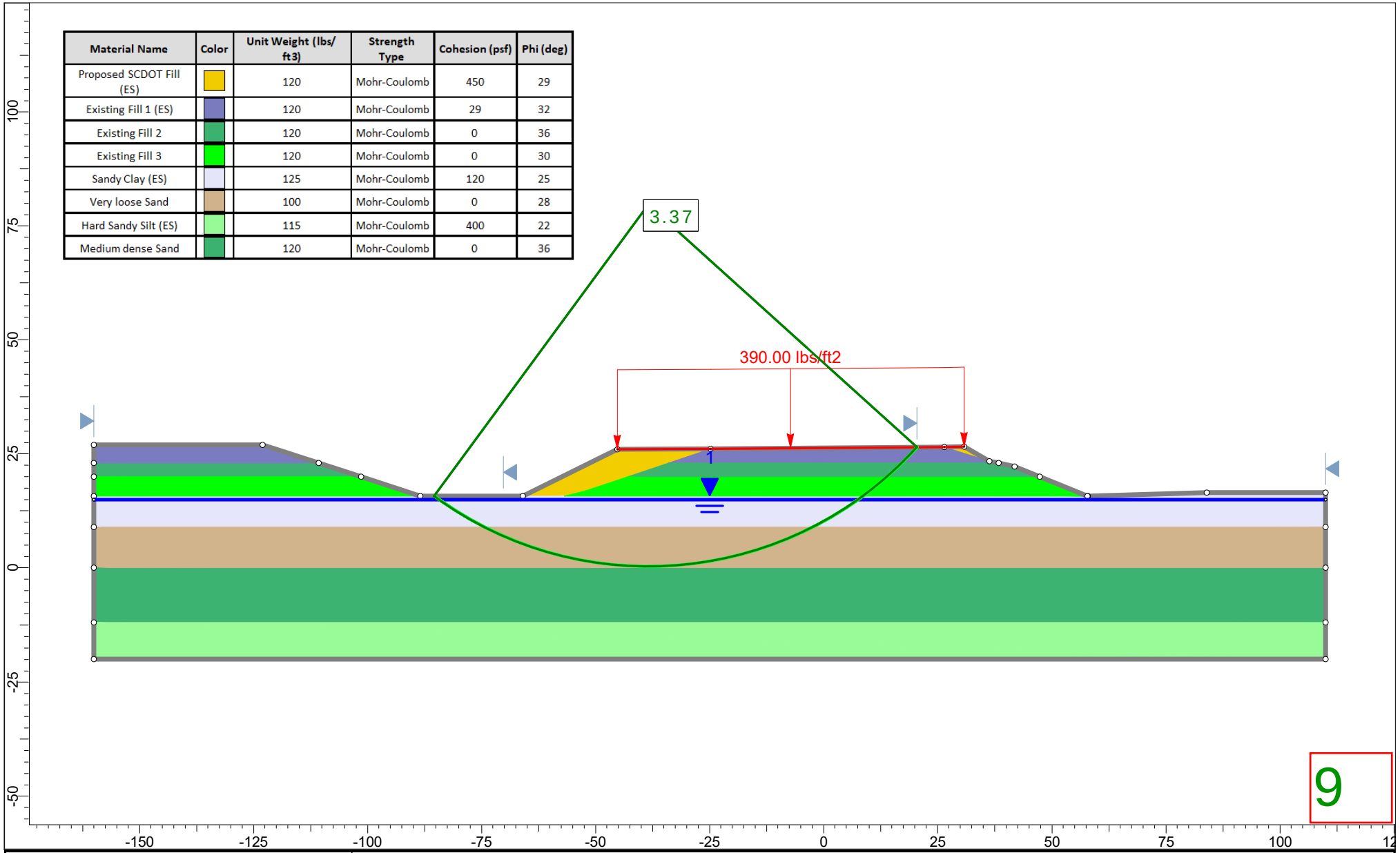
SLOPE STABILITY ANALYSIS CALCULATIONS

Slope Stability Analysis Methodology

Analysis Methodology	
Analysis Type	Slope Stability Analysis
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County, SC
SCDOT Project ID	P030260
Location of Analysis	Bridge Approach (Transverse Slope)
Geometry	Bridge plans and profiles dated 6/3/2021.
Soil Boring Model	See Exhibit C-3 for soil profile
Analysis Method	Slope stability was performed using the commercial program Slide2 version 9.012 distributed by Rocscience. The following loading conditions were considered when performing slope stability analyses. End of construction (short-term), long-term, partial submergence and earthquake. Service Limit State was checked using soil parameters based on total stress (undrained condition - end of construction) and effective stress (drained condition – long term). For end of construction, total stress parameters were used for cohesive soils. For long-term analysis, effective stress parameters were used. Spencer method was employed for checking slope stability under static and seismic loads. Extreme Events I loading conditions (seismic event) was checked using Spencer methodology and total stress soil parameters. Newmark displacement analysis was performed to estimate global instability displacements and have been reported here for the structural engineer to verify if the bridge structure can handle the displacements. Extreme Events II loading conditions (partial submergence) was checked using Spencer methodology and total stress soil parameters.
Surcharge Load	• Service Long Term and Extreme Event II (Flooding) Construction: Surcharge=390psf (250psf live load + 12 inches of asphalt pavement) per Table 8-7 and Section 17.4.1 SCDOT GDM 2019 • Service End of Construction and Extreme Event II (Partial Submergence): Surcharge=320psf (250psf live load + 6 inches of asphalt pavement, refer to pavement calculations) • Extreme Event I (Seismic) Loading Condition: Surcharge = 70psf

See next page for soil profile and parameters

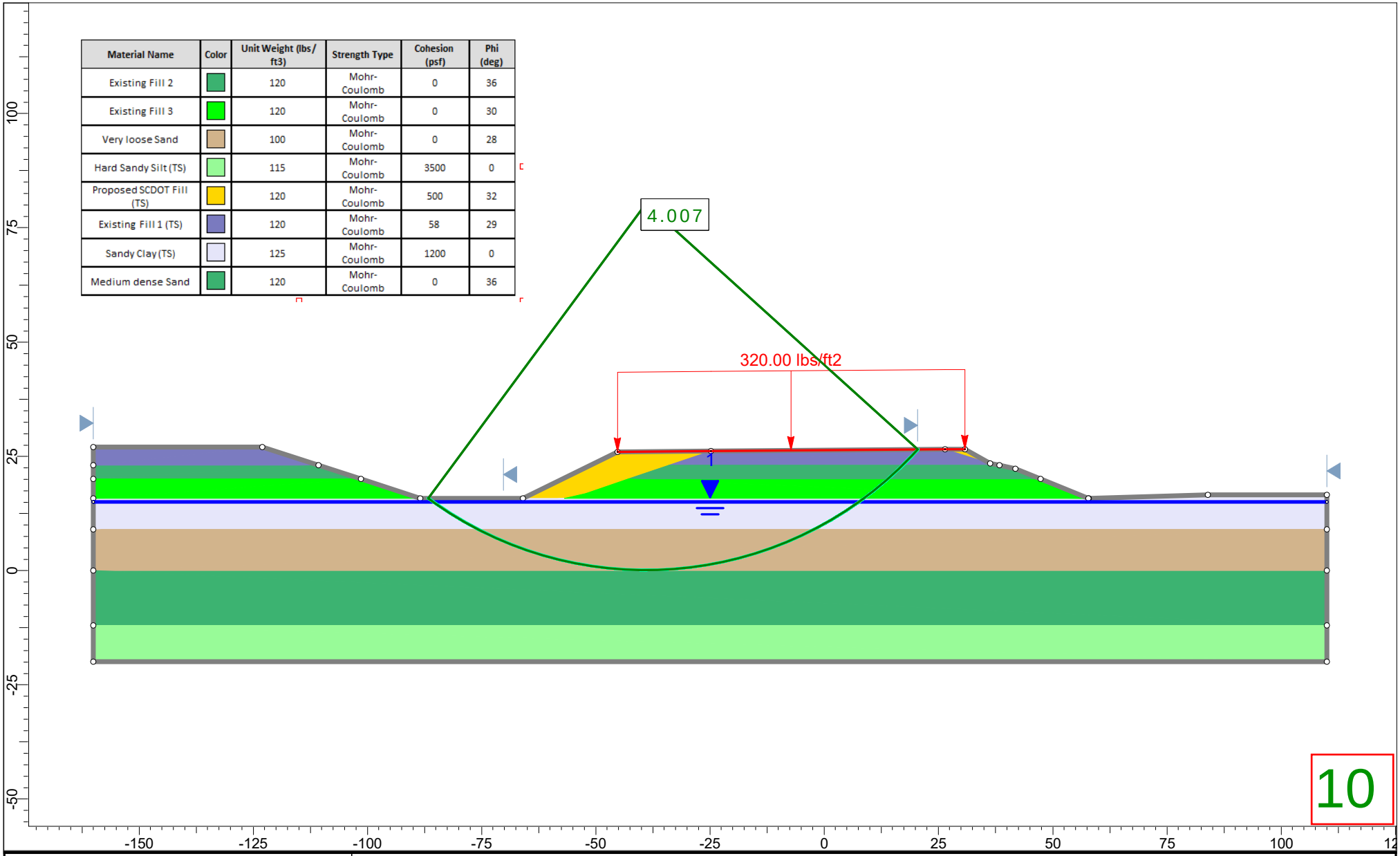
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Proposed SCDOT Fill (ES)		120	Mohr-Coulomb	450	29
Existing Fill 1 (ES)		120	Mohr-Coulomb	29	32
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Sandy Clay (ES)		125	Mohr-Coulomb	120	25
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (ES)		115	Mohr-Coulomb	400	22
Medium dense Sand		120	Mohr-Coulomb	0	36



Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Begin Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: Begin Bridge Transverse.slmd

SLIDEINTERPRET 9.012

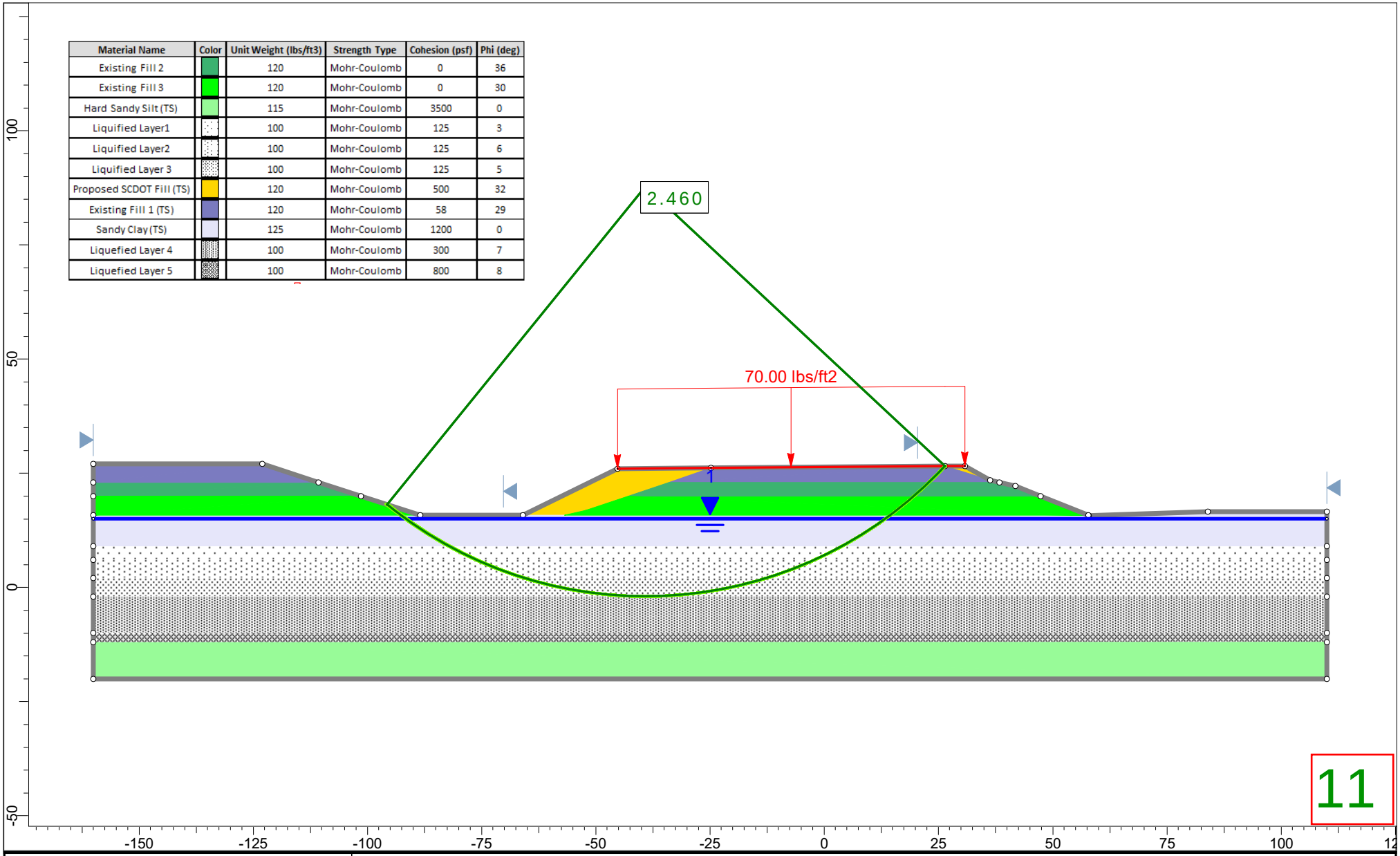
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Proposed SCDOT Fill (TS)		120	Mohr-Coulomb	500	32
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Medium dense Sand		120	Mohr-Coulomb	0	36



Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Begin Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: Begin Bridge Transverse.slmd

SLIDEINTERPRET 9.012

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Proposed SCDOT Fill (TS)		120	Mohr-Coulomb	500	32
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8

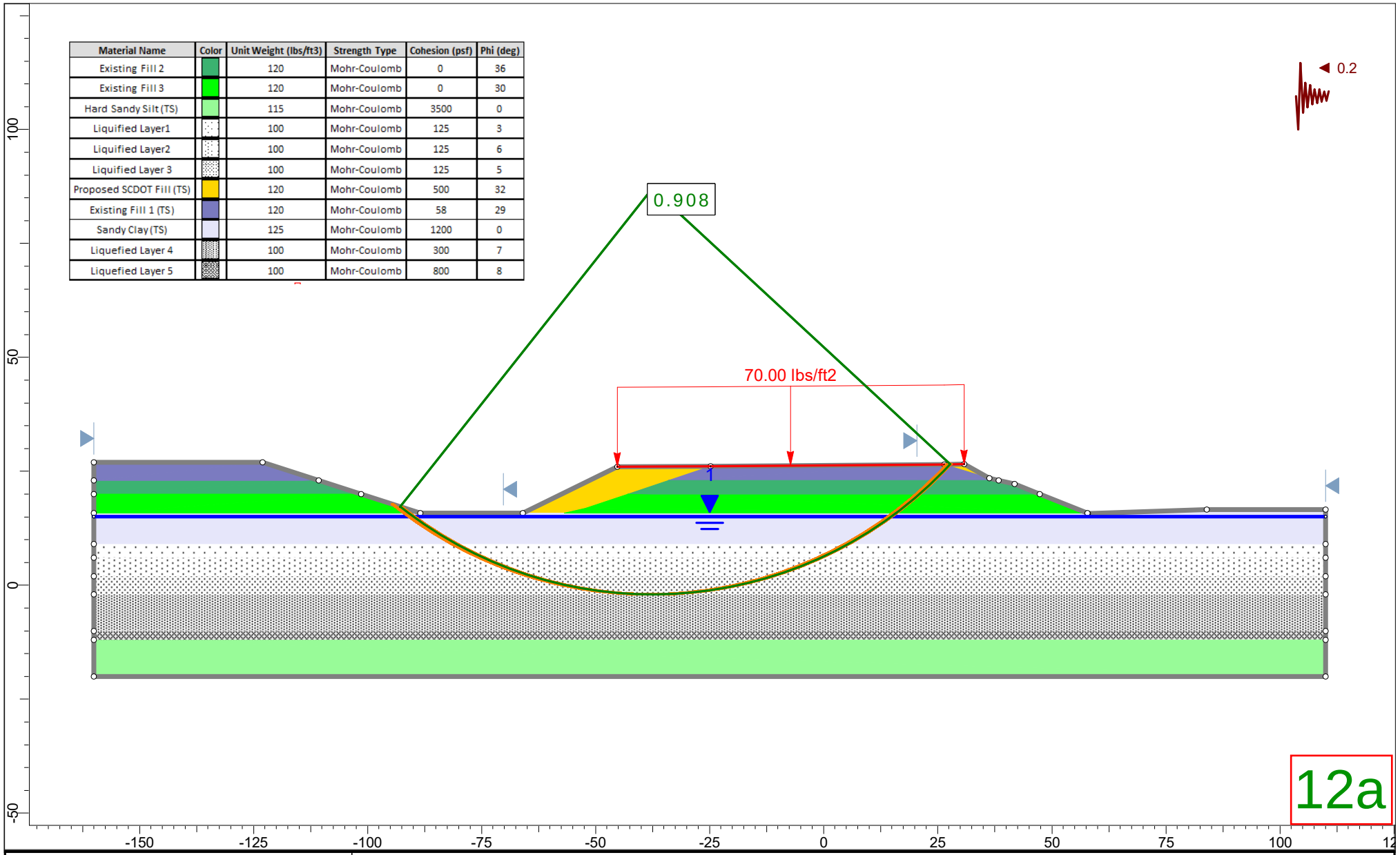


Terracon

SLIDEINTERPRET 9.012

Project	I-95 Bridge Replacement over Bagshaw Swamp		
Analysis Description	Begin Bridge Transverse Slope		
Drawn By	A. Fekrat	Company	Terracon
Date	7/28/2021, 10:51:28 AM	File Name	Begin Bridge Transverse.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Proposed SCDOT Fill (TS)		120	Mohr-Coulomb	500	32
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8

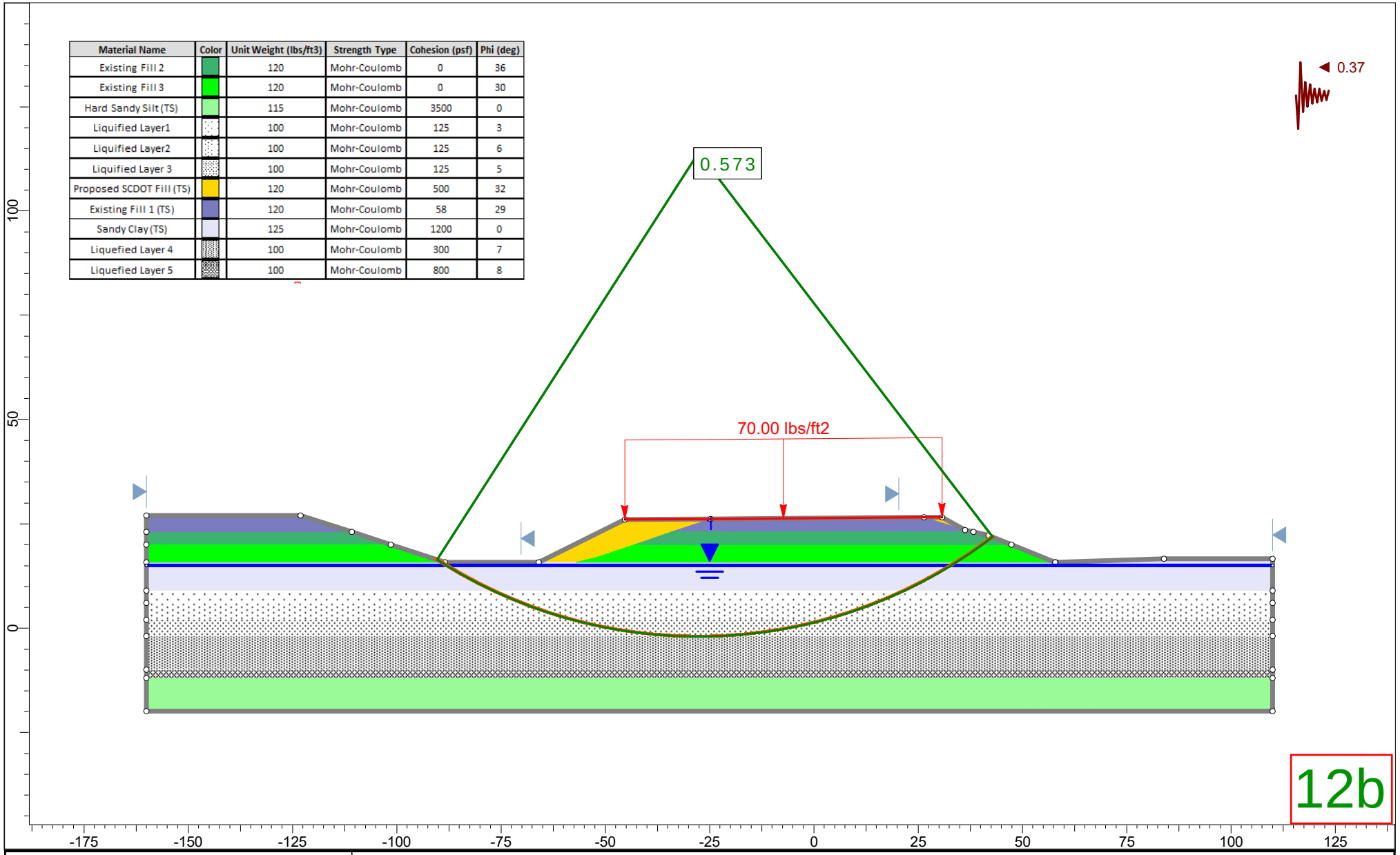


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SLIDEINTERPRET 9.012

Project	I-95 Bridge Replacement over Bagshaw Swamp		
Analysis Description	Begin Bridge Transverse Slope		
Drawn By	A. Fekrat	Company	Terracon
Date	7/28/2021, 10:51:28 AM	File Name	Begin Bridge Transverse.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Liquified Layer1		100	Mohr-Coulomb	125	3
Liquified Layer2		100	Mohr-Coulomb	125	6
Liquified Layer 3		100	Mohr-Coulomb	125	5
Proposed SCDOT Fill (TS)		120	Mohr-Coulomb	500	32
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Liquefied Layer 4		100	Mohr-Coulomb	300	7
Liquefied Layer 5		100	Mohr-Coulomb	800	8



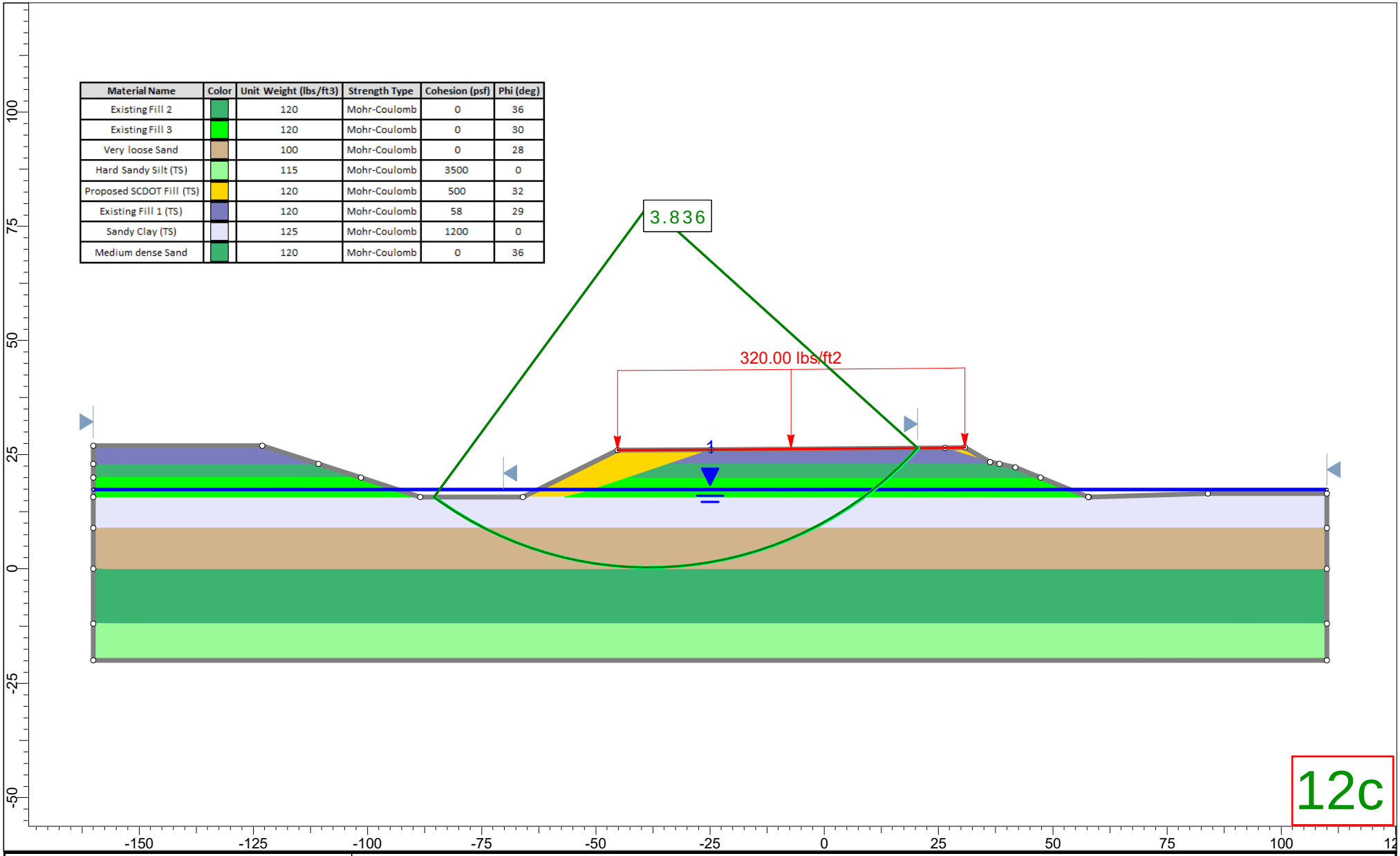
12b

Terracon

SLIDEINTERPRET 9.012

Project	I-95 Bridge Replacement over Bagshaw Swamp		
Analysis Description	Begin Bridge Transverse Slope		
Drawn By	A. Fekrat	Company	Terracon
Date	7/28/2021, 10:51:28 AM	File Name	Begin Bridge Transverse.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Fill 2		120	Mohr-Coulomb	0	36
Existing Fill 3		120	Mohr-Coulomb	0	30
Very loose Sand		100	Mohr-Coulomb	0	28
Hard Sandy Silt (TS)		115	Mohr-Coulomb	3500	0
Proposed SCDOT Fill (TS)		120	Mohr-Coulomb	500	32
Existing Fill 1 (TS)		120	Mohr-Coulomb	58	29
Sandy Clay (TS)		125	Mohr-Coulomb	1200	0
Medium dense Sand		120	Mohr-Coulomb	0	36



12c

Terracon

SLIDEINTERPRET 9.012

Project	I-95 Bridge Replacement over Bagshaw Swamp		
Analysis Description	Begin Bridge Transverse Slope		
Drawn By	A. Fekrat	Company	Terracon
Date	7/28/2021, 10:51:28 AM	File Name	Begin Bridge Transverse.slmd

NEWMARK DISPLACEMENT ANALYSIS

Ref: SCDOT Geotechnical Design Manual (2019), Section 13.14.2

Project:	**I-95 BRO Bagshaw Swamp**
County	Jasper
Terracon Project No:	EN175299
Location:	Begin Bridge Transverse Slope
Design Earthquake:	SEE
Computed By:	A. Fekrat
Checked By:	D. Corley
Date:	7/30/2021

Stability Analysis Serial No: 12a, 12b, 12c

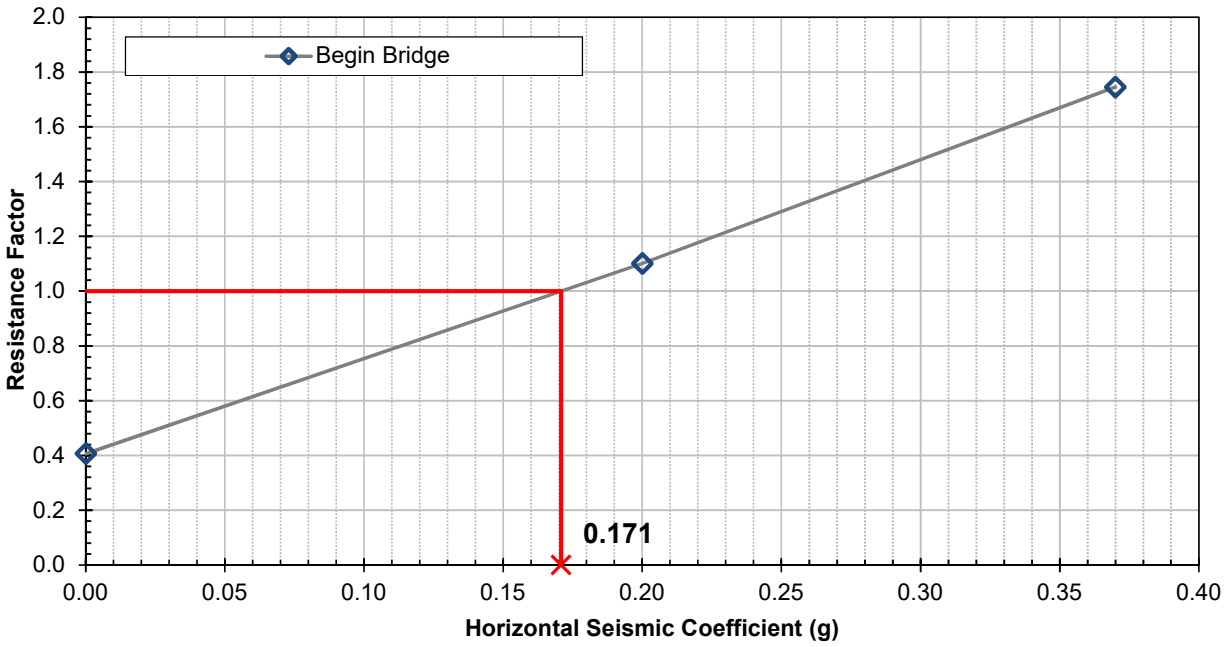
Slope Stability Analyses

Begin Bridge		
2H:1V Slope		
k_h	**Resistance Factor**	**FOS**
0.0000	0.41	2.460
0.2000	1.10	0.908
0.3700	1.75	0.573

Deformation ID (Table 10-1 GDM)
GI-01
GI-02

Lateral Deformation Analyses

R (ft)	NA
k_{max} =	0.370
k_y =	0.171
k_y/k_{max} =	0.462
S_1 =	0.480
F_v =	1.000
PGV =	18.3 in/sec
H =	13.00 ft.
β (0.5 ≤ β ≤ 1.5)	1.30
α_W (α_W=1 if H≤20)	1.00
$k_{max} = k_h = k_{av}$ =	0.370
$k_y/k_{max} = k_y/k_{av}$ =	0.462
log (d) =	0.187
Displacement	**3.07 in.**
Slice Angle of Entry	37°
Slice Angle of Exit	32°
GI-01 (V at Top)	**1.84 in.**
GI-02 (H at Top)	**2.47 in.**
(H at Bottom)	**2.60 in.**
RS-04 (Wall Rot.)	NA



Project Summary

File Name:	Begin Bridge Transverse.slmd
Slide Modeler Version:	9.012
Project Title:	I-95 Bridge Replacement over Bagshaw Swamp
Analysis:	Begin Bridge Transverse Slope
Author:	A. Fekrat
Company:	Terracon
Date Created:	7/28/2021, 10:51:28 AM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Effective Stress	Master Scenario	Spencer: 3.373220	00h:00m:02.131s
Total Stress	Master Scenario	Spencer: 4.007090	00h:00m:02.36s
Seismic	Kh=0	Spencer: 2.459610	00h:00m:01.783s
	Kh=0.2	Spencer: 0.908034	00h:00m:02.403s
	Kh=0.37	Spencer: 0.572585	00h:00m:02.199s
Partial Submergence	Master Scenario	Spencer: 3.835590	00h:00m:03.41s

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Seismic Loading

Effective Stress

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Total Stress

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - Kh=0

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - Kh=0.2

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.2

Seismic - Kh=0.37

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.37

Partial Submergence

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Effective Stress

Distribution:	Constant
Magnitude [psf]:	390
Orientation:	Vertical

Total Stress

Distribution:	Constant
Magnitude [psf]:	320
Orientation:	Vertical

Seismic

Distribution:	Constant
Magnitude [psf]:	70
Orientation:	Vertical

Partial Submergence

Distribution:	Constant
Magnitude [psf]:	320
Orientation:	Vertical

Materials

Proposed SCDOT Fill (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	450
Friction Angle [deg]	29
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 1 (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	29
Friction Angle [deg]	32
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	30
Water Surface	Assigned per scenario
Hu Value	1
Sandy Clay (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	120
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Hu Value	1
Very loose Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0

Friction Angle [deg]	28
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	400
Friction Angle [deg]	22
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	3500
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer1	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	3
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	6
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	5
Water Surface	Assigned per scenario
Hu Value	1
Proposed SCDOT Fill (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	500
Friction Angle [deg]	32
Water Surface	Assigned per scenario

Hu Value	1
Existing Fill 1 (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	58
Friction Angle [deg]	29
Water Surface	Assigned per scenario
Hu Value	1
Sandy Clay (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	1200
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Medium dense Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 4	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	300
Friction Angle [deg]	7
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 5	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	800
Friction Angle [deg]	8
Water Surface	Assigned per scenario
Hu Value	1

Materials In Use

Material	Effective Stress	Total Stress	Kh=0	Kh=0.2	Kh=0.37	Partial Submergence
Proposed SCDOT Fill (ES)	✓	✗	✗	✗	✗	✗
Existing Fill 1 (ES)	✓	✗	✗	✗	✗	✗
Existing Fill 2	✓	✓	✓	✓	✓	✓
Existing Fill 3	✓	✓	✓	✓	✓	✓
Sandy Clay (ES)	✓	✗	✗	✗	✗	✗
Very loose Sand	✓	✓	✗	✗	✗	✓
Hard Sandy Silt (ES)	✓	✗	✗	✗	✗	✗
Hard Sandy Silt (TS)	✗	✓	✓	✓	✓	✓
Liquified Layer1	✗	✗	✓	✓	✓	✗
Liquified Layer2	✗	✗	✓	✓	✓	✗
Liquified Layer 3	✗	✗	✓	✓	✓	✗
Proposed SCDOT Fill (TS)	✗	✓	✓	✓	✓	✓
Existing Fill 1 (TS)	✗	✓	✓	✓	✓	✓
Sandy Clay (TS)	✗	✓	✓	✓	✓	✓
Medium dense Sand	✓	✓	✗	✗	✗	✓
Liquefied Layer 4	✗	✗	✓	✓	✓	✗
Liquefied Layer 5	✗	✗	✓	✓	✓	✗

Slice Data

Effective Stress

Global Minimum Query (spencer) - Safety Factor: 3.37322

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.06223	50.9869	-35.8673	Sandy Clay (ES)	120	25	48.9931	165.264	97.0696	0	97.0696	61.6471	61.6471
2	1.98076	358.845	-34.5257	Sandy Clay (ES)	120	25	64.6568	218.102	252.893	42.5131	210.38	208.413	165.9
3	1.98076	685.606	-32.8064	Sandy Clay (ES)	120	25	78.8932	266.124	438.228	124.865	313.363	387.372	262.507
4	1.98076	991.711	-31.1198	Sandy Clay (ES)	120	25	91.7637	309.539	608.476	202.011	406.465	553.077	351.066
5	1.98076	1278.27	-29.4627	Sandy Clay (ES)	120	25	103.406	348.81	764.916	274.231	490.685	706.501	432.27
6	1.98076	1546.26	-27.8323	Sandy Clay (ES)	120	25	113.935	384.327	908.619	341.771	566.848	848.466	506.695
7	2.18451	1965.22	-26.1446	Very loose Sand	0	28	95.5953	322.464	1014.32	407.854	606.465	967.395	559.541
8	2.18451	2190.57	-24.3995	Very loose Sand	0	28	101.89	343.696	1118.62	472.226	646.398	1072.41	600.18
9	2.18451	2398.51	-22.6782	Very loose Sand	0	28	107.418	362.343	1213.09	531.623	681.469	1168.21	636.583
10	2.18451	2591.13	-20.9783	Very loose Sand	0	28	112.36	379.014	1299.06	586.236	712.821	1255.97	669.739
11	2.18451	2933.89	-19.2976	Very loose Sand	0	28	130.183	439.136	1462.13	636.234	825.895	1416.55	780.312
12	2.18451	3374.83	-17.6339	Very loose Sand	0	28	156.308	527.26	1673.39	681.764	991.631	1623.71	941.945
13	2.18451	3800.58	-15.9855	Very loose Sand	0	28	181.446	612.058	1874.07	722.954	1151.11	1822.09	1099.14
14	2.18451	4211.52	-14.3506	Very loose Sand	0	28	205.659	693.733	2064.64	759.917	1304.72	2012.02	1252.11
15	2.18451	4608.01	-12.7275	Very loose Sand	0	28	228.999	772.464	2245.54	792.748	1452.79	2193.82	1401.07
16	2.18451	4990.32	-11.1148	Very loose Sand	0	28	251.511	848.403	2417.15	821.532	1595.61	2367.73	1546.2
17	2.18451	5358.72	-9.51093	Very loose Sand	0	28	273.236	921.684	2579.78	846.341	1733.44	2534	1687.66
18	2.18451	5713.41	-7.91456	Very loose Sand	0	28	294.206	992.421	2733.71	867.235	1866.47	2692.81	1825.57
19	2.18451	6054.58	-6.32437	Very loose Sand	0	28	314.453	1060.72	2879.18	884.264	1994.92	2844.33	1960.07
20	2.18451	6330.73	-4.73905	Very loose Sand	0	28	369.232	1245.5	3239.91	897.468	2342.44	3209.3	2311.83
21	2.18451	6389.16	-3.15736	Very loose Sand	0	28	393.49	1327.33	3403.23	906.878	2496.35	3381.52	2474.65
22	2.18451	6413.33	-1.57808	Very loose Sand	0	28	390.87	1318.49	3392.24	912.516	2479.72	3381.47	2468.95
23	2.18451	6424.35	0	Very loose Sand	0	28	387.929	1308.57	3375.45	914.393	2461.06	3375.45	2461.06
24	2.18451	6422.22	1.57808	Very loose Sand	0	28	384.668	1297.57	3352.89	912.516	2440.37	3363.49	2450.97
25	2.18451	6406.93	3.15736	Very loose Sand	0	28	381.099	1285.53	3324.6	906.878	2417.73	3345.63	2438.75
26	2.18451	6378.43	4.73905	Very loose Sand	0	28	377.221	1272.45	3290.59	897.468	2393.12	3321.86	2424.39
27	2.18451	6336.64	6.32437	Very loose Sand	0	28	373.038	1258.34	3250.86	884.264	2366.59	3292.2	2407.94
28	2.18451	6281.47	7.91456	Very loose Sand	0	28	368.556	1243.22	3205.39	867.235	2338.15	3256.62	2389.39
29	2.18451	6212.77	9.51093	Very loose Sand	0	28	363.774	1227.09	3154.16	846.341	2307.82	3215.11	2368.77

30	2.18451	6130.36	11.1148	Very loose Sand	0	28	358.696	1209.96	3097.13	821.532	2275.6	3167.6	2346.07
31	2.18451	6034.03	12.7275	Very loose Sand	0	28	353.321	1191.83	3034.26	792.748	2241.51	3114.06	2321.31
32	2.18451	5923.54	14.3506	Very loose Sand	0	28	347.653	1172.71	2965.46	759.917	2205.54	3054.4	2294.48
33	2.18451	5798.58	15.9855	Very loose Sand	0	28	341.688	1152.59	2890.65	722.954	2167.7	2988.54	2265.58
34	2.18451	5658.83	17.6339	Very loose Sand	0	28	335.427	1131.47	2809.75	681.764	2127.99	2916.37	2234.61
35	2.18451	5503.88	19.2976	Very loose Sand	0	28	328.87	1109.35	2722.63	636.234	2086.39	2837.78	2201.54
36	2.18451	5333.28	20.9783	Very loose Sand	0	28	322.016	1086.23	2629.14	586.236	2042.91	2752.61	2166.38
37	2.18451	5146.53	22.6782	Very loose Sand	0	28	314.862	1062.1	2529.15	531.623	1997.52	2660.72	2129.09
38	2.18451	4943.04	24.3995	Very loose Sand	0	28	307.407	1036.95	2422.45	472.226	1950.22	2561.89	2089.66
39	2.18451	4722.13	26.1446	Very loose Sand	0	28	299.645	1010.77	2308.84	407.854	1900.99	2455.93	2048.07
40	1.98076	4049.87	27.8323	Sandy Clay (ES)	120	25	290.035	978.351	2182.51	341.771	1840.74	2335.64	1993.86
41	1.98076	3785.53	29.4627	Sandy Clay (ES)	120	25	280.04	944.635	2042.67	274.231	1768.44	2200.86	1926.63
42	1.98076	3502.62	31.1198	Sandy Clay (ES)	120	25	269.638	909.547	1895.2	202.011	1693.19	2057.98	1855.97
43	1.98076	3200.17	32.8064	Sandy Clay (ES)	120	25	258.823	873.066	1739.82	124.865	1614.96	1906.66	1781.8
44	1.98076	2877.06	34.5257	Sandy Clay (ES)	120	25	247.589	835.172	1576.2	42.5131	1533.69	1746.53	1704.02
45	1.06223	1402.94	35.8673	Sandy Clay (ES)	120	25	235.659	794.929	1447.39	0	1447.39	1617.77	1617.77
46	2.63353	3036.6	37.5401	Existing Fill 3	0	30	220.081	742.383	1285.85	0	1285.85	1454.96	1454.96
47	2.63353	2374.35	39.9808	Existing Fill 3	0	30	181.199	611.224	1058.67	0	1058.67	1210.61	1210.61
48	3.23787	1916.24	42.8162	Existing Fill 2	0	36	165.062	556.789	766.354	0	766.354	919.289	919.289
49	1.66693	522.008	45.2657	Existing Fill 1 (ES)	29	32	109.141	368.157	542.763	0	542.763	652.921	652.921
50	1.66693	177.514	47.0037	Existing Fill 1 (ES)	29	32	78.1992	263.783	375.731	0	375.731	459.601	459.601

Total Stress

Global Minimum Query (spencer) - Safety Factor: 4.00709

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.058	50.7839	-35.9758	Sandy Clay (TS)	1200	0	299.469	1200	310.027	0	310.027	92.6432	92.6432
2	1.96653	355.871	-34.6552	Sandy Clay (TS)	1200	0	299.469	1200	439.292	42.4124	396.88	232.276	189.863
3	1.96653	679.706	-32.9644	Sandy Clay (TS)	1200	0	299.469	1200	598.325	124.617	473.708	404.111	279.494
4	1.96653	983.446	-31.3054	Sandy Clay (TS)	1200	0	299.469	1200	746.276	201.721	544.555	564.157	362.436
5	1.96653	1268.16	-29.6751	Sandy Clay (TS)	1200	0	299.469	1200	883.813	273.995	609.818	713.171	439.176
6	1.96653	1534.79	-28.0709	Sandy Clay (TS)	1200	0	299.469	1200	1011.51	341.678	669.833	851.804	510.126
7	2.1625	1945.61	-26.4127	Very loose Sand	0	28	76.6908	307.307	985.871	407.91	577.961	947.78	539.87
8	2.1625	2169.29	-24.7004	Very loose Sand	0	28	81.9974	328.571	1090.4	472.454	617.95	1052.69	580.235
9	2.1625	2376.14	-23.0113	Very loose Sand	0	28	86.7318	347.542	1185.77	532.142	653.629	1148.94	616.794
10	2.1625	2566.81	-21.3431	Very loose Sand	0	28	90.9351	364.385	1272.47	587.161	685.309	1236.94	649.776
11	2.1625	2768.38	-19.6937	Very loose Sand	0	28	96.4293	386.401	1364.39	637.674	726.714	1329.87	692.199
12	2.1625	3160.72	-18.0611	Very loose Sand	0	28	115.198	461.607	1551.98	683.825	868.156	1514.42	830.59
13	2.1625	3581.88	-16.4436	Very loose Sand	0	28	136.19	545.727	1752.1	725.741	1026.36	1711.91	986.165
14	2.1625	3988.74	-14.8395	Very loose Sand	0	28	156.515	627.169	1943.07	763.53	1179.54	1901.6	1138.07
15	2.1625	4381.64	-13.2472	Very loose Sand	0	28	176.205	706.071	2125.21	797.29	1327.92	2083.73	1286.44
16	2.1625	4760.86	-11.6653	Very loose Sand	0	28	195.291	782.549	2298.86	827.103	1471.76	2258.54	1431.44
17	2.1625	5126.65	-10.0923	Very loose Sand	0	28	213.797	856.705	2464.27	853.042	1611.23	2426.21	1573.17
18	2.1625	5479.22	-8.52697	Very loose Sand	0	28	231.746	928.628	2621.66	875.166	1746.5	2586.92	1711.75
19	2.1625	5818.76	-6.96804	Very loose Sand	0	28	249.157	998.396	2771.24	893.528	1877.71	2740.79	1847.26
20	2.1625	6145.4	-5.41429	Very loose Sand	0	28	266.048	1066.08	2913.17	908.169	2005	2887.95	1979.78
21	2.1625	6360.85	-3.86453	Very loose Sand	0	28	313.347	1255.61	3280.58	919.122	2361.46	3259.41	2340.29
22	2.1625	6393.46	-2.31759	Very loose Sand	0	28	318.675	1276.96	3328.01	926.41	2401.6	3315.12	2388.71
23	2.1625	6410.43	-0.772342	Very loose Sand	0	28	317.053	1270.46	3319.45	930.05	2389.4	3315.17	2385.12
24	2.1625	6414.78	0.772342	Very loose Sand	0	28	315.161	1262.88	3305.18	930.05	2375.13	3309.42	2379.37
25	2.1625	6406.52	2.31759	Very loose Sand	0	28	312.995	1254.2	3285.22	926.41	2358.81	3297.89	2371.48
26	2.1625	6385.62	3.86453	Very loose Sand	0	28	310.565	1244.46	3259.62	919.122	2340.49	3280.59	2361.47
27	2.1625	6352.01	5.41429	Very loose Sand	0	28	307.869	1233.66	3228.34	908.169	2320.17	3257.52	2349.35
28	2.1625	6305.63	6.96804	Very loose Sand	0	28	304.91	1221.8	3191.39	893.528	2297.87	3228.66	2335.13
29	2.1625	6246.35	8.52697	Very loose Sand	0	28	301.688	1208.89	3148.76	875.166	2273.59	3193.99	2318.82
30	2.1625	6174.03	10.0923	Very loose Sand	0	28	298.204	1194.93	3100.38	853.042	2247.34	3153.46	2300.41
31	2.1625	6088.49	11.6653	Very loose Sand	0	28	294.461	1179.93	3046.23	827.103	2219.12	3107.02	2279.92
32	2.1625	5989.52	13.2472	Very loose Sand	0	28	290.455	1163.88	2986.23	797.29	2188.94	3054.61	2257.32

33	2.1625	5876.88	14.8395	Very loose Sand	0	28	286.188	1146.78	2920.31	763.53	2156.78	2996.13	2232.6
34	2.1625	5750.27	16.4436	Very loose Sand	0	28	281.656	1128.62	2848.38	725.741	2122.63	2931.5	2205.76
35	2.1625	5609.37	18.0611	Very loose Sand	0	28	276.862	1109.41	2770.31	683.825	2086.49	2860.6	2176.77
36	2.1625	5453.78	19.6937	Very loose Sand	0	28	271.798	1089.12	2686	637.674	2048.33	2783.29	2145.61
37	2.1625	5283.08	21.3431	Very loose Sand	0	28	266.463	1067.74	2595.29	587.161	2008.13	2699.42	2112.25
38	2.1625	5096.76	23.0113	Very loose Sand	0	28	260.855	1045.27	2498.01	532.142	1965.87	2608.8	2076.66
39	2.1625	4894.26	24.7004	Very loose Sand	0	28	254.971	1021.69	2393.97	472.454	1921.51	2511.24	2038.79
40	2.1625	4674.94	26.4127	Very loose Sand	0	28	248.802	996.972	2282.94	407.91	1875.03	2406.52	1998.61
41	2.45817	4984.28	28.2718	Sandy Clay (TS)	1200	0	299.469	1200	2115.3	333.151	1782.15	2276.36	1943.21
42	2.45817	4566.24	30.2852	Sandy Clay (TS)	1200	0	299.469	1200	1932.2	247.114	1685.08	2107.09	1859.97
43	2.45817	4112.19	32.3409	Sandy Clay (TS)	1200	0	299.469	1200	1735.29	153.763	1581.53	1924.9	1771.14
44	2.45817	3619.66	34.4445	Sandy Clay (TS)	1200	0	299.469	1200	1523.72	52.6	1471.12	1729.11	1676.51
45	1.058	1397.37	35.9758	Sandy Clay (TS)	1200	0	299.469	1200	1364.62	0	1364.62	1582.01	1582.01
46	2.62684	3028.71	37.6272	Existing Fill 3	0	30	182.276	730.397	1265.08	0	1265.08	1405.59	1405.59
47	2.62684	2368.13	40.0371	Existing Fill 3	0	30	149.126	597.562	1035.01	0	1035.01	1160.31	1160.31
48	3.23537	1914.76	42.8382	Existing Fill 2	0	36	134.247	537.939	740.408	0	740.408	864.889	864.889
49	1.66781	522.225	45.2602	Existing Fill 1 (TS)	58	29	85.1219	341.091	510.709	0	510.709	596.608	596.608
50	1.66781	177.55	46.9794	Existing Fill 1 (TS)	58	29	60.9612	244.277	336.053	0	336.053	401.378	401.378

Seismic - Kh=0

Global Minimum Query (spencer) - Safety Factor: 2.45961

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	3.01763	247.409	-37.8763	Existing Fill 3	0	30	24.1595	59.4229	102.924	0	102.924	84.132	84.132
2	1.04779	200.698	-36.2405	Sandy Clay (TS)	1200	0	487.882	1200	567.776	0	567.776	210.171	210.171
3	2.37915	657.718	-34.8992	Sandy Clay (TS)	1200	0	487.882	1200	635.982	51.7801	584.202	295.641	243.861
4	2.37915	964.091	-33.0661	Sandy Clay (TS)	1200	0	487.882	1200	742.869	151.889	590.98	425.234	273.345
5	2.37915	1397.47	-31.2705	Sandy Clay (TS)	1200	0	487.882	1200	905.04	245.296	659.744	608.747	363.451
6	2.37915	1812.54	-29.5084	Sandy Clay (TS)	1200	0	487.882	1200	1060.37	332.387	727.981	784.243	451.856
7	3.01028	2783.07	-27.551	Liquified Layer1	125	3	62.4417	153.582	968.778	423.397	545.381	936.202	512.805
8	3.01028	3234.61	-25.4024	Liquified Layer1	125	3	63.6044	156.442	1116.95	516.997	599.949	1086.74	569.744
9	2.64276	3179.86	-23.4183	Liquified Layer2	125	6.00001	78.7152	193.609	1250.08	597.311	652.771	1215.99	618.678
10	2.64276	3469.3	-21.5909	Liquified Layer2	125	6.00001	80.3751	197.691	1357.27	665.654	691.612	1325.46	659.804
11	2.64276	3733.13	-19.7862	Liquified Layer2	125	6.00001	81.8675	201.362	1454.49	727.948	726.537	1425.03	697.085
12	2.64276	3979.41	-18.0018	Liquified Layer2	125	6.00001	83.3183	204.93	1544.89	784.405	760.488	1517.82	733.414
13	2.3999	4034.3	-16.3158	Liquified Layer 3	125	5	82.2658	202.342	1717.14	833.116	884.023	1693.06	859.943
14	2.3999	4534.08	-14.7247	Liquified Layer 3	125	5	88.1681	216.859	1924.67	874.713	1049.95	1901.5	1026.78
15	2.3999	5016.82	-13.1452	Liquified Layer 3	125	5	93.9543	231.091	2124.51	911.877	1212.63	2102.57	1190.69
16	2.3999	5482.87	-11.5758	Liquified Layer 3	125	5	99.6284	245.047	2316.84	944.701	1372.14	2296.43	1351.73
17	2.3999	5932.52	-10.0152	Liquified Layer 3	125	5	105.192	258.731	2501.81	973.261	1528.55	2483.23	1509.97
18	2.3999	6366.02	-8.46201	Liquified Layer 3	125	5	110.648	272.15	2679.55	997.624	1681.93	2663.09	1665.47
19	2.3999	6783.59	-6.91509	Liquified Layer 3	125	5	115.997	285.308	2850.18	1017.85	1832.33	2836.11	1818.26
20	2.3999	7185.41	-5.37322	Liquified Layer 3	125	5	121.243	298.21	3013.77	1033.97	1979.8	3002.37	1968.4
21	2.3999	7517.87	-3.83526	Liquified Layer 3	125	5	127.003	312.379	3187.78	1046.03	2141.75	3179.27	2133.24
22	2.3999	7585.47	-2.30005	Liquified Layer 3	125	5	128.619	316.353	3241.23	1054.06	2187.17	3236.07	2182.01
23	2.3999	7606.25	-0.766501	Liquified Layer 3	125	5	128.598	316.302	3244.66	1058.07	2186.59	3242.94	2184.87
24	2.3999	7611.61	0.766501	Liquified Layer 3	125	5	128.492	316.04	3241.67	1058.07	2183.6	3243.39	2185.32
25	2.3999	7601.56	2.30005	Liquified Layer 3	125	5	128.3	315.568	3232.26	1054.06	2178.2	3237.42	2183.36
26	2.3999	7576.05	3.83526	Liquified Layer 3	125	5	128.022	314.885	3216.43	1046.03	2170.4	3225.02	2178.99
27	2.3999	7535.02	5.37322	Liquified Layer 3	125	5	127.659	313.992	3194.16	1033.97	2160.19	3206.17	2172.2
28	2.3999	7478.37	6.91509	Liquified Layer 3	125	5	127.21	312.887	3165.41	1017.85	2147.56	3180.83	2162.98
29	2.3999	7405.96	8.46201	Liquified Layer 3	125	5	126.675	311.57	3130.12	997.624	2132.5	3148.97	2151.35
30	2.3999	7317.62	10.0152	Liquified Layer 3	125	5	126.051	310.037	3088.25	973.261	2114.99	3110.51	2137.25
31	2.3999	7213.14	11.5758	Liquified Layer 3	125	5	125.34	308.288	3039.7	944.701	2094.99	3065.37	2120.67
32	2.3999	7092.26	13.1452	Liquified Layer 3	125	5	124.54	306.32	2984.37	911.877	2072.49	3013.46	2101.58

33	2.3999	6954.69	14.7247	Liquified Layer 3	125	5	123.649	304.128	2922.16	874.713	2047.45	2954.65	2079.94
34	2.3999	6800.07	16.3158	Liquified Layer 3	125	5	122.666	301.71	2852.92	833.116	2019.8	2888.83	2055.71
35	2.11421	5848.89	17.8236	Liquified Layer2	125	6.00001	135.741	333.869	2777.25	789.99	1987.26	2820.89	2030.9
36	2.11421	5703.16	19.248	Liquified Layer2	125	6.00001	134.498	330.812	2703.92	745.749	1958.17	2750.88	2005.13
37	2.11421	5544.89	20.6849	Liquified Layer2	125	6.00001	133.163	327.53	2624.76	697.81	1926.95	2675.04	1977.23
38	2.11421	5373.76	22.1355	Liquified Layer2	125	6.00001	131.736	324.019	2539.61	646.072	1893.53	2593.19	1947.12
39	2.11421	5189.36	23.6013	Liquified Layer2	125	6.00001	130.212	320.271	2448.3	590.419	1857.88	2505.19	1914.77
40	3.01028	7041.75	25.4024	Liquified Layer1	125	3	89.7824	220.83	2345.54	516.997	1828.54	2388.18	1871.18
41	3.01028	6598.65	27.551	Liquified Layer1	125	3	88.5505	217.8	2194.12	423.397	1770.72	2240.32	1816.92
42	2.37915	4834.12	29.5084	Sandy Clay (TS)	1200	0	487.882	1200	1814.63	332.387	1482.24	2090.75	1758.37
43	2.37915	4424.32	31.2705	Sandy Clay (TS)	1200	0	487.882	1200	1623.06	245.296	1377.77	1919.35	1674.06
44	2.37915	3984.41	33.0661	Sandy Clay (TS)	1200	0	487.882	1200	1418.1	151.889	1266.21	1735.74	1583.85
45	2.37915	3512.57	34.8992	Sandy Clay (TS)	1200	0	487.882	1200	1198.86	51.7801	1147.08	1539.2	1487.42
46	1.04779	1389.64	36.2405	Sandy Clay (TS)	1200	0	487.882	1200	1033.09	0	1033.09	1390.69	1390.69
47	2.63063	3046.03	37.7174	Existing Fill 3	0	30	241.676	594.429	1029.58	0	1029.58	1216.49	1216.49
48	2.63063	2384.5	39.8742	Existing Fill 3	0	30	189.665	466.501	808.004	0	808.004	966.444	966.444
49	3.28656	1963.19	42.3901	Existing Fill 2	0	36	153.721	378.094	520.403	0	520.403	660.721	660.721
50	3.47	726.737	45.3895	Existing Fill 1 (TS)	58	29	69.9359	172.015	205.688	0	205.688	276.582	276.582

Seismic - Kh=0.2

Global Minimum Query (spencer) - Safety Factor: 0.908034

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.86142	92.5951	-37.6101	Existing Fill 3	0	30	85.6263	77.7516	134.67	0	134.67	68.7045	68.7045
2	1.04026	132.325	-36.4377	Sandy Clay (TS)	1200	0	1321.54	1200	1360.16	0	1360.16	384.502	384.502
3	2.36207	516.277	-35.0924	Sandy Clay (TS)	1200	0	1321.54	1200	1400.08	51.7788	1348.3	471.547	419.768
4	2.36207	945.44	-33.2541	Sandy Clay (TS)	1200	0	1321.54	1200	1516.95	151.884	1365.06	650.373	498.489
5	2.36207	1387.41	-31.4538	Sandy Clay (TS)	1200	0	1321.54	1200	1642.78	245.289	1397.49	834.402	589.113
6	2.36207	1799.51	-29.6876	Sandy Clay (TS)	1200	0	1321.54	1200	1758.07	332.384	1425.68	1004.66	672.273
7	2.9876	2762.07	-27.7261	Liquified Layer1	125	3	175.479	159.341	1078.66	423.391	655.269	986.429	563.038
8	2.9876	3210.21	-25.5738	Liquified Layer1	125	3	178.273	161.877	1220.66	516.991	703.665	1135.34	618.351
9	2.61928	3151.47	-23.5879	Liquified Layer2	125	6.00001	226.753	205.899	1366.98	597.281	769.703	1267.98	670.695
10	2.61928	3438.18	-21.7603	Liquified Layer2	125	6.00001	230.315	209.134	1466.07	665.585	800.481	1374.13	708.546
11	2.61928	3699.66	-19.9558	Liquified Layer2	125	6.00001	233.344	211.884	1554.52	727.878	826.646	1469.8	741.92
12	2.61928	4046.89	-18.1716	Liquified Layer2	125	6.00001	241.087	218.915	1677.92	784.375	893.543	1598.78	814.41
13	2.4576	4346.95	-16.4596	Liquified Layer 3	125	5	239.311	217.303	1888.88	833.853	1055.03	1818.18	984.322
14	2.4576	4872.39	-14.8166	Liquified Layer 3	125	5	255.14	231.676	2096.1	876.789	1219.31	2028.61	1151.82
15	2.4576	5379.37	-13.186	Liquified Layer 3	125	5	270.476	245.601	2293.51	915.037	1378.47	2230.14	1315.1
16	2.4576	5868.27	-11.5663	Liquified Layer 3	125	5	285.34	259.098	2481.44	948.694	1532.75	2423.05	1474.35
17	2.4576	6339.43	-9.95583	Liquified Layer 3	125	5	299.753	272.186	2660.19	977.846	1682.34	2607.57	1629.72
18	2.4576	6793.12	-8.3533	Liquified Layer 3	125	5	313.733	284.88	2830	1002.56	1827.44	2783.94	1781.38
19	2.4576	7229.58	-6.75733	Liquified Layer 3	125	5	327.294	297.194	2991.09	1022.91	1968.18	2952.31	1929.4
20	2.4576	7627.51	-5.16662	Liquified Layer 3	125	5	342.032	310.577	3160.09	1038.93	2121.16	3129.16	2090.23
21	2.4576	7753.38	-3.57989	Liquified Layer 3	125	5	348.409	316.367	3237.99	1050.66	2187.33	3216.19	2165.53
22	2.4576	7788.42	-1.99591	Liquified Layer 3	125	5	347.12	315.197	3232.09	1058.13	2173.96	3219.99	2161.86
23	3.74214	11886.1	0	Liquified Layer 3	125	5	345.145	313.403	3214.26	1060.8	2153.46	3214.26	2153.46
24	2.23419	7094.23	1.92392	Liquified Layer 3	125	5	342.997	311.453	3189.63	1058.46	2131.17	3201.15	2142.69
25	2.23419	7075.82	3.3637	Liquified Layer 3	125	5	341.156	309.781	3164.07	1052.02	2112.05	3184.12	2132.1
26	2.23419	7044.82	4.80561	Liquified Layer 3	125	5	339.14	307.951	3133.21	1042.06	2091.15	3161.72	2119.66
27	2.23419	7001.14	6.25058	Liquified Layer 3	125	5	336.955	305.967	3097.03	1028.57	2068.46	3133.93	2105.36
28	2.23419	6944.71	7.69955	Liquified Layer 3	125	5	334.6	303.828	3055.52	1011.51	2044.01	3100.75	2089.24
29	2.23419	6875.4	9.1535	Liquified Layer 3	125	5	332.075	301.535	3008.66	990.851	2017.81	3062.17	2071.32
30	2.23419	6793.07	10.6134	Liquified Layer 3	125	5	329.382	299.09	2956.42	966.557	1989.86	3018.14	2051.58
31	2.23419	6697.53	12.0804	Liquified Layer 3	125	5	326.522	296.493	2898.75	938.576	1960.17	2968.63	2030.05
32	2.23419	6588.59	13.5554	Liquified Layer 3	125	5	323.492	293.742	2835.59	906.851	1928.74	2913.58	2006.73

33	2.23419	6466	15.0396	Liquified Layer 3	125	5	320.296	290.84	2766.87	871.315	1895.56	2852.93	1981.62
34	2.23419	6329.5	16.5343	Liquified Layer 3	125	5	316.931	287.784	2692.52	831.892	1860.63	2786.61	1954.72
35	2.61928	7226.93	18.1716	Liquified Layer2	125	6.00001	347.552	315.589	2597.71	784.375	1813.34	2711.79	1927.42
36	2.61928	6996.17	19.9558	Liquified Layer2	125	6.00001	342.19	310.72	2494.89	727.878	1767.01	2619.13	1891.26
37	2.61928	6741.08	21.7603	Liquified Layer2	125	6.00001	336.55	305.599	2383.87	665.585	1718.28	2518.21	1852.62
38	2.61928	6460.76	23.5879	Liquified Layer2	125	6.00001	330.63	300.223	2264.41	597.281	1667.13	2408.78	1811.5
39	2.9876	6992.64	25.5738	Liquified Layer1	125	3	232.413	211.039	2158.71	516.991	1641.72	2269.93	1752.94
40	2.9876	6552.81	27.7261	Liquified Layer1	125	3	228.837	207.791	2003.15	423.391	1579.75	2123.42	1700.03
41	2.36207	4802.45	29.6876	Sandy Clay (TS)	1200	0	1321.54	1200	1362.66	332.384	1030.27	2116.07	1783.68
42	2.36207	4395.54	31.4538	Sandy Clay (TS)	1200	0	1321.54	1200	1147.27	245.289	901.98	1955.64	1710.36
43	2.36207	3958.77	33.2541	Sandy Clay (TS)	1200	0	1321.54	1200	918.908	151.884	767.024	1785.48	1633.6
44	2.36207	3490.29	35.0924	Sandy Clay (TS)	1200	0	1321.54	1200	676.685	51.7788	624.906	1605.21	1553.44
45	1.04026	1380.94	36.4377	Sandy Clay (TS)	1200	0	1321.54	1200	494.599	0	494.599	1470.26	1470.26
46	2.61139	3026.95	37.9193	Existing Fill 3	0	30	505.915	459.388	795.682	0	795.682	1189.8	1189.8
47	2.61139	2370.22	40.0832	Existing Fill 3	0	30	390.445	354.537	614.075	0	614.075	942.665	942.665
48	3.26155	1952.1	42.6081	Existing Fill 2	0	36	299.395	271.861	374.185	0	374.185	649.571	649.571
49	3.14852	722.276	45.4798	Existing Fill 1 (TS)	58	29	150.367	136.539	141.688	0	141.688	294.595	294.595
50	0.302717	5.86759	47.0682	Proposed SCDOT Fill (TS)	500	32	380.427	345.441	-247.345	0	-247.345	161.588	161.588

Seismic - Kh=0.37

Global Minimum Query (spencer) - Safety Factor: 0.572585

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.957305	17.0629	-32.4279	Existing Fill 3	0	30	136.003	77.8734	134.881	0	134.881	48.4777	48.4777
2	1.23925	75.7765	-31.7877	Sandy Clay (TS)	1200	0	2095.76	1200	2028.22	0	2028.22	729.419	729.419
3	2.78575	554.595	-30.628	Sandy Clay (TS)	1200	0	2095.76	1200	2095.08	51.4575	2043.62	854.262	802.804
4	2.78575	1111.07	-29.0415	Sandy Clay (TS)	1200	0	2095.76	1200	2199.59	151.177	2048.41	1035.91	884.729
5	2.78575	1632.65	-27.479	Sandy Clay (TS)	1200	0	2095.76	1200	2294.04	244.642	2049.39	1204.03	959.386
6	2.78575	2120.83	-25.9384	Sandy Clay (TS)	1200	0	2095.76	1200	2378.77	332.123	2046.64	1359.38	1027.26
7	2.322	2087.51	-24.5429	Liquified Layer1	125	3	283.635	162.405	1121.21	407.48	713.735	991.699	584.219
8	2.322	2326.64	-23.2881	Liquified Layer1	125	3	286.139	163.839	1212.84	471.743	741.093	1089.68	617.932
9	2.322	2551.84	-22.045	Liquified Layer1	125	3	288.345	165.102	1297.45	532.262	765.189	1180.69	648.427
10	3.0283	3643.02	-20.6271	Liquified Layer2	125	6.00001	372.462	213.266	1436.96	597.163	839.799	1296.76	699.598
11	3.0283	4095.73	-19.0368	Liquified Layer2	125	6.00001	384.489	220.153	1570.65	665.329	905.317	1437.98	772.651
12	3.0283	4909.99	-17.4615	Liquified Layer2	125	6.00001	421.406	241.291	1834.09	727.65	1106.44	1701.53	973.878
13	3.0283	5725.89	-15.8998	Liquified Layer2	125	6.00001	458.555	262.562	2093.1	784.285	1308.81	1962.48	1178.19
14	2.57203	5484.36	-14.4661	Liquified Layer 3	125	5	442.053	253.113	2296.24	831.901	1464.33	2182.19	1350.29
15	2.57203	6037.31	-13.1577	Liquified Layer 3	125	5	466.121	266.894	2493.22	871.363	1621.86	2384.25	1512.89
16	2.57203	6574.36	-11.8562	Liquified Layer 3	125	5	489.382	280.213	2681.06	906.969	1774.09	2578.32	1671.35
17	2.57203	7095.76	-10.561	Liquified Layer 3	125	5	511.877	293.093	2860.09	938.777	1921.31	2764.65	1825.88
18	2.57203	7600.35	-9.27114	Liquified Layer 3	125	5	534.549	306.075	3036.53	966.838	2069.69	2949.27	1982.43
19	2.57203	7867.87	-7.98605	Liquified Layer 3	125	5	552.9	316.582	3180.99	991.195	2189.79	3103.42	2112.22
20	2.57203	7959.31	-6.70499	Liquified Layer 3	125	5	550.531	315.226	3186.18	1011.89	2174.29	3121.46	2109.57
21	2.57203	8035.78	-5.42729	Liquified Layer 3	125	5	547.906	313.723	3186.06	1028.95	2157.11	3134	2105.05
22	2.57203	8097.38	-4.15229	Liquified Layer 3	125	5	545.035	312.079	3180.71	1042.4	2138.31	3141.14	2098.74
23	2.57203	8144.19	-2.87935	Liquified Layer 3	125	5	541.925	310.298	3170.23	1052.26	2117.97	3142.97	2090.71
24	2.57203	8176.27	-1.60783	Liquified Layer 3	125	5	538.587	308.387	3154.67	1058.55	2096.12	3139.55	2081
25	3.93688	12541.2	0	Liquified Layer 3	125	5	534.003	305.762	3126.92	1060.8	2066.12	3126.92	2066.12
26	2.82923	9009.91	1.6714	Liquified Layer 3	125	5	528.963	302.876	3091.36	1058.22	2033.14	3106.8	2048.58
27	2.82923	8984.22	3.07022	Liquified Layer 3	125	5	524.446	300.29	3054.49	1050.91	2003.58	3082.62	2031.71
28	2.82923	8938.91	4.47088	Liquified Layer 3	125	5	519.692	297.568	3011.73	1039.28	1972.45	3052.37	2013.09
29	2.82923	8873.89	5.87422	Liquified Layer 3	125	5	514.706	294.713	2963.13	1023.29	1939.84	3016.08	1992.79
30	2.82923	8789.03	7.28111	Liquified Layer 3	125	5	509.5	291.732	2908.68	1002.93	1905.75	2973.78	1970.85
31	2.82923	8684.15	8.69242	Liquified Layer 3	125	5	504.077	288.627	2848.42	978.158	1870.26	2925.49	1947.33
32	2.82923	8559.06	10.1091	Liquified Layer 3	125	5	498.445	285.402	2782.33	948.924	1833.4	2871.19	1922.27

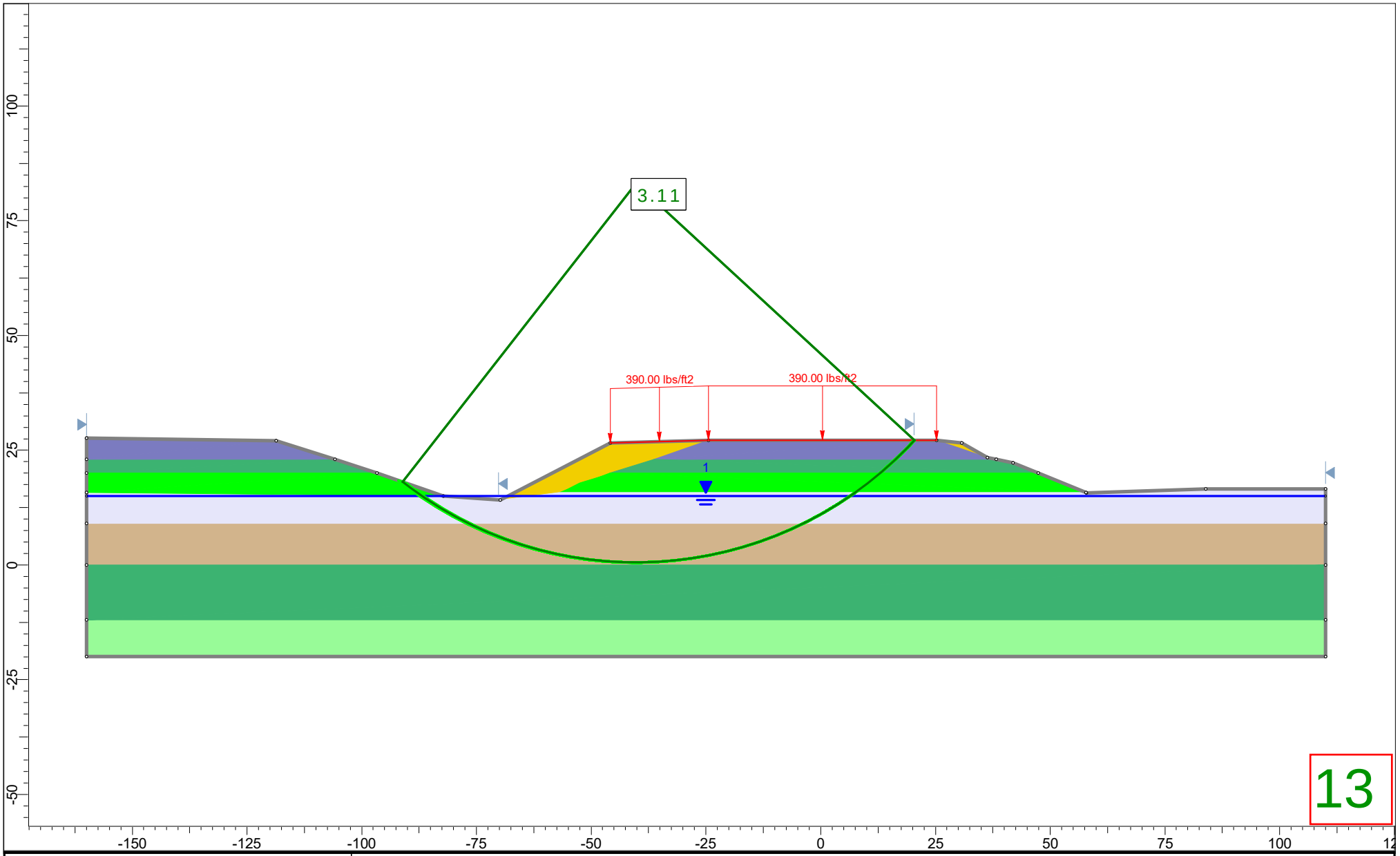
33	2.82923	8413.49	11.532	Liquified Layer 3	125	5	492.61	282.061	2710.39	915.176	1795.21	2810.9	1895.72
34	2.82923	8247.16	12.9622	Liquified Layer 3	125	5	486.578	278.607	2632.59	876.847	1755.74	2744.58	1867.74
35	2.82923	8059.73	14.4007	Liquified Layer 3	125	5	480.357	275.045	2548.88	833.864	1715.02	2672.22	1838.36
36	3.0283	8394.47	15.8998	Liquified Layer2	125	6.00001	524.366	300.244	2451.62	784.285	1667.33	2600.98	1816.7
37	3.0283	8128.16	17.4615	Liquified Layer2	125	6.00001	515.653	295.255	2347.52	727.65	1619.87	2509.72	1782.07
38	3.0283	7834.25	19.0368	Liquified Layer2	125	6.00001	506.718	290.139	2236.52	665.329	1571.19	2411.36	1746.03
39	3.0283	7511.97	20.6271	Liquified Layer2	125	6.00001	497.568	284.9	2118.51	597.163	1521.35	2305.8	1708.64
40	2.322	5524.21	22.045	Liquified Layer1	125	3	355.853	203.756	2035.01	532.262	1502.75	2179.11	1646.85
41	2.322	5304.03	23.2881	Liquified Layer1	125	3	352.427	201.794	1937.06	471.743	1465.32	2088.75	1617.01
42	2.322	5069.91	24.5429	Liquified Layer1	125	3	348.934	199.794	1834.64	407.48	1427.16	1993.97	1586.49
43	2.78575	5705.5	25.9384	Sandy Clay (TS)	1200	0	2095.76	1200	1234.52	332.123	902.396	2253.9	1921.78
44	2.78575	5224.55	27.479	Sandy Clay (TS)	1200	0	2095.76	1200	1016.94	244.642	772.303	2106.95	1862.31
45	2.78575	4710.2	29.0415	Sandy Clay (TS)	1200	0	2095.76	1200	788.839	151.177	637.662	1952.52	1801.35
46	2.78575	4016.19	30.628	Sandy Clay (TS)	1200	0	2095.76	1200	460.439	51.4575	408.982	1701.25	1649.8
47	1.23925	1438.05	31.7877	Sandy Clay (TS)	1200	0	2095.76	1200	156.493	0	156.493	1455.3	1455.3
48	3.13516	2654.81	33.0718	Existing Fill 3	0	30	497.379	284.792	493.275	0	493.275	817.164	817.164
49	3.13516	1501.28	34.9404	Existing Fill 3	0	30	271.399	155.399	269.159	0	269.159	458.774	458.774
50	2.47833	397.069	36.648	Existing Fill 2	0	36	142.501	81.5937	112.304	0	112.304	218.319	218.319

Partial Submergence

Global Minimum Query (spencer) - Safety Factor: 3.83559

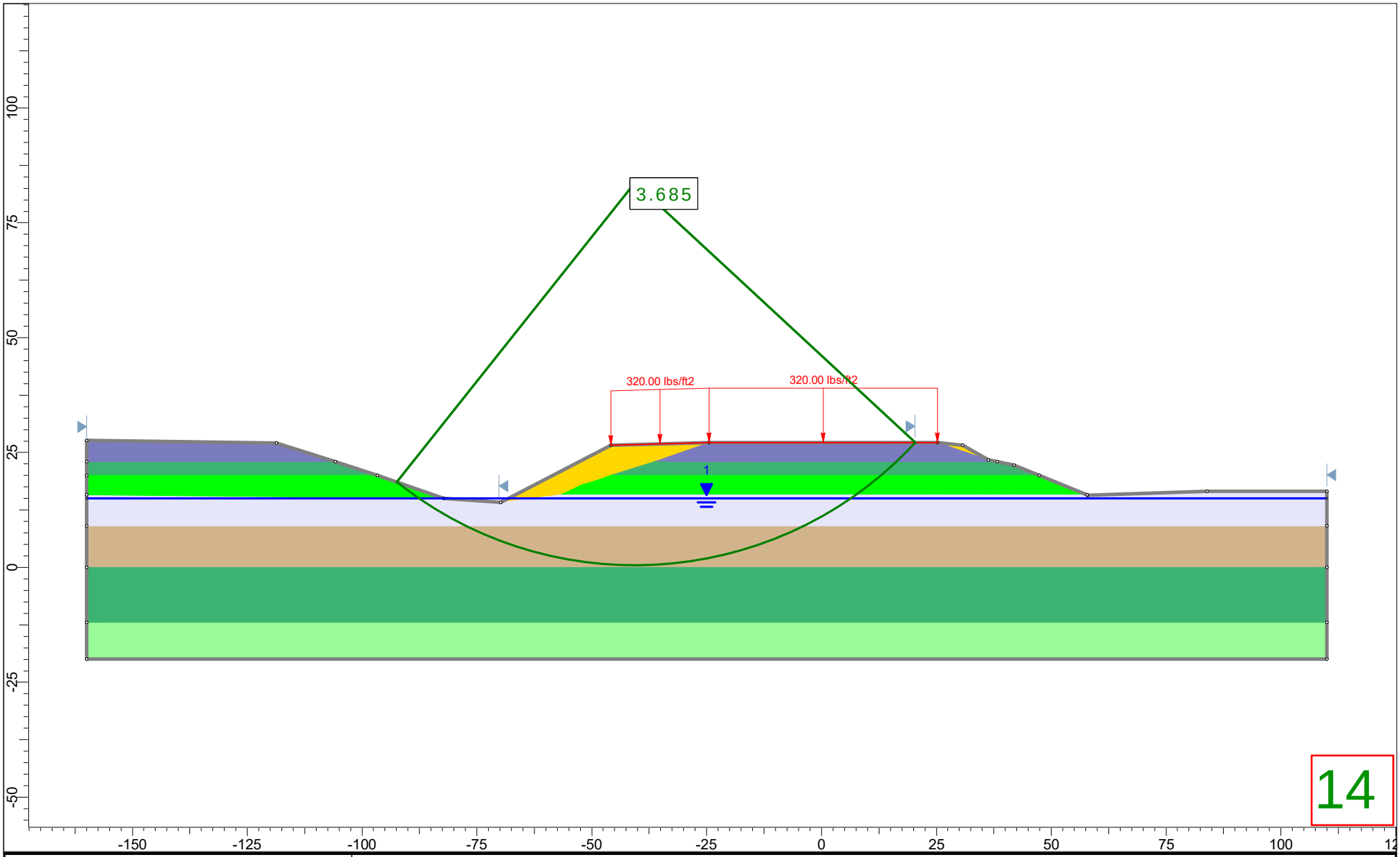
Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.19323	213.411	-35.3692	Sandy Clay (TS)	1200	0	312.859	1200	367.482	150.41	217.072	145.398	-5.01233
2	2.19323	625.423	-33.4486	Sandy Clay (TS)	1200	0	312.859	1200	548.394	244.188	304.206	341.72	97.5324
3	2.19323	1008.76	-31.5696	Sandy Clay (TS)	1200	0	312.859	1200	715.198	331.439	383.759	522.954	191.515
4	2.19323	1365.17	-29.7279	Sandy Clay (TS)	1200	0	312.859	1200	868.855	412.562	456.293	690.201	277.639
5	2.19323	1696.16	-27.9194	Sandy Clay (TS)	1200	0	312.859	1200	1010.18	487.898	522.279	844.391	356.493
6	2.1202	1904.14	-26.1699	Very loose Sand	0	28	57.4337	220.292	970.976	556.665	414.311	942.753	386.088
7	2.1202	2116.9	-24.4755	Very loose Sand	0	28	62.9197	241.334	1073.17	619.284	453.883	1044.53	425.241
8	2.1202	2313.72	-22.8036	Very loose Sand	0	28	67.8211	260.134	1166.45	677.208	489.243	1137.94	460.729
9	2.1202	2495.18	-21.152	Very loose Sand	0	28	72.1806	276.855	1251.3	730.614	520.69	1223.38	492.762
10	2.1202	2789.92	-19.5186	Very loose Sand	0	28	85.2422	326.954	1394.57	779.658	614.91	1364.35	584.693
11	2.1202	3207.37	-17.9016	Very loose Sand	0	28	107.466	412.197	1599.71	824.475	775.232	1564.99	740.518
12	2.1202	3610.91	-16.2992	Very loose Sand	0	28	128.971	494.678	1795.54	865.186	930.352	1757.83	892.64
13	2.1202	4000.86	-14.7099	Very loose Sand	0	28	149.791	574.537	1982.44	901.895	1080.54	1943.11	1041.22
14	2.1202	4377.51	-13.132	Very loose Sand	0	28	169.962	651.906	2160.75	934.694	1226.05	2121.1	1186.4
15	2.1202	4741.15	-11.5642	Very loose Sand	0	28	189.514	726.899	2330.76	963.662	1367.1	2291.98	1328.32
16	2.1202	5092.01	-10.0052	Very loose Sand	0	28	208.473	799.617	2492.73	988.868	1503.86	2455.95	1467.08
17	2.1202	5430.28	-8.4536	Very loose Sand	0	28	226.861	870.146	2646.88	1010.37	1636.51	2613.16	1602.79
18	2.1202	5756.13	-6.90824	Very loose Sand	0	28	244.698	938.562	2793.4	1028.22	1765.18	2763.75	1735.53
19	2.1202	6064.24	-5.36791	Very loose Sand	0	28	271.012	1039.49	2997.45	1042.45	1955	2971.98	1929.53
20	2.1202	6187.17	-3.83147	Very loose Sand	0	28	312.002	1196.71	3303.78	1053.09	2250.69	3282.89	2229.8
21	2.1202	6215.43	-2.29778	Very loose Sand	0	28	310.654	1191.54	3301.13	1060.18	2240.95	3288.67	2228.49
22	2.1202	6231.63	-0.765745	Very loose Sand	0	28	309.022	1185.28	3292.89	1063.72	2229.17	3288.76	2225.04
23	2.1202	6235.82	0.765745	Very loose Sand	0	28	307.111	1177.95	3279.11	1063.72	2215.39	3283.22	2219.5
24	2.1202	6227.98	2.29778	Very loose Sand	0	28	304.926	1169.57	3259.82	1060.18	2199.64	3272.05	2211.87
25	2.1202	6208.1	3.83147	Very loose Sand	0	28	302.47	1160.15	3235.02	1053.09	2181.93	3255.27	2202.18
26	2.1202	6176.11	5.36791	Very loose Sand	0	28	299.745	1149.7	3204.71	1042.45	2162.26	3232.88	2190.43
27	2.1202	6131.94	6.90824	Very loose Sand	0	28	296.752	1138.22	3168.9	1028.22	2140.68	3204.86	2176.64
28	2.1202	6075.49	8.4536	Very loose Sand	0	28	293.496	1125.73	3127.56	1010.37	2117.19	3171.18	2160.81
29	2.1202	6006.62	10.0052	Very loose Sand	0	28	289.974	1112.22	3080.65	988.868	2091.78	3131.81	2142.94
30	2.1202	5925.16	11.5642	Very loose Sand	0	28	286.188	1097.7	3028.13	963.662	2064.47	3086.69	2123.03
31	2.1202	5830.92	13.132	Very loose Sand	0	28	282.137	1082.16	2969.94	934.694	2035.25	3035.76	2101.07
32	2.1202	5723.66	14.7099	Very loose Sand	0	28	277.822	1065.61	2906.01	901.895	2004.11	2978.94	2077.05

33	2.1202	5603.11	16.2992	Very loose Sand	0	28	273.238	1048.03	2836.24	865.186	1971.06	2916.14	2050.95
34	2.1202	5468.97	17.9016	Very loose Sand	0	28	268.389	1029.43	2760.54	824.475	1936.07	2847.24	2022.77
35	2.1202	5320.88	19.5186	Very loose Sand	0	28	263.268	1009.79	2678.79	779.658	1899.13	2772.11	1992.46
36	2.1202	5158.43	21.152	Very loose Sand	0	28	257.875	989.103	2590.85	730.614	1860.23	2690.62	1960.01
37	2.1202	4981.15	22.8036	Very loose Sand	0	28	252.206	967.359	2496.55	677.208	1819.34	2602.58	1925.38
38	2.1202	4788.52	24.4755	Very loose Sand	0	28	246.258	944.543	2395.71	619.284	1776.43	2507.81	1888.52
39	2.1202	4579.94	26.1699	Very loose Sand	0	28	240.025	920.637	2288.13	556.665	1731.47	2406.08	1849.42
40	2.19323	4468.53	27.9194	Sandy Clay (TS)	1200	0	312.859	1200	2123.6	487.898	1635.7	2289.39	1801.49
41	2.19323	4142.02	29.7279	Sandy Clay (TS)	1200	0	312.859	1200	1962.27	412.562	1549.71	2140.92	1728.36
42	2.19323	3790.09	31.5696	Sandy Clay (TS)	1200	0	312.859	1200	1789.95	331.439	1458.51	1982.19	1650.75
43	2.19323	3411.23	33.4486	Sandy Clay (TS)	1200	0	312.859	1200	1606.03	244.188	1361.85	1812.71	1568.52
44	2.19323	3003.69	35.3692	Sandy Clay (TS)	1200	0	312.859	1200	1409.84	150.41	1259.43	1631.92	1481.51
45	2.14131	2518.88	37.3128	Existing Fill 3	0	30	186.191	714.151	1287.86	50.9169	1236.95	1429.77	1378.85
46	3.12577	2890.89	39.7535	Existing Fill 3	0	30	158.503	607.952	1053	0	1053	1184.84	1184.84
47	1.61894	1106.67	42.0088	Existing Fill 2	0	36	154.535	592.733	815.827	0	815.827	955.014	955.014
48	1.61894	817.698	43.603	Existing Fill 2	0	36	125.61	481.789	663.127	0	663.127	782.756	782.756
49	1.66692	522.004	45.2657	Existing Fill 1 (TS)	58	29	88.5772	339.746	508.281	0	508.281	597.684	597.684
50	1.66692	177.513	47.0038	Existing Fill 1 (TS)	58	29	63.3913	243.143	334.006	0	334.006	401.994	401.994



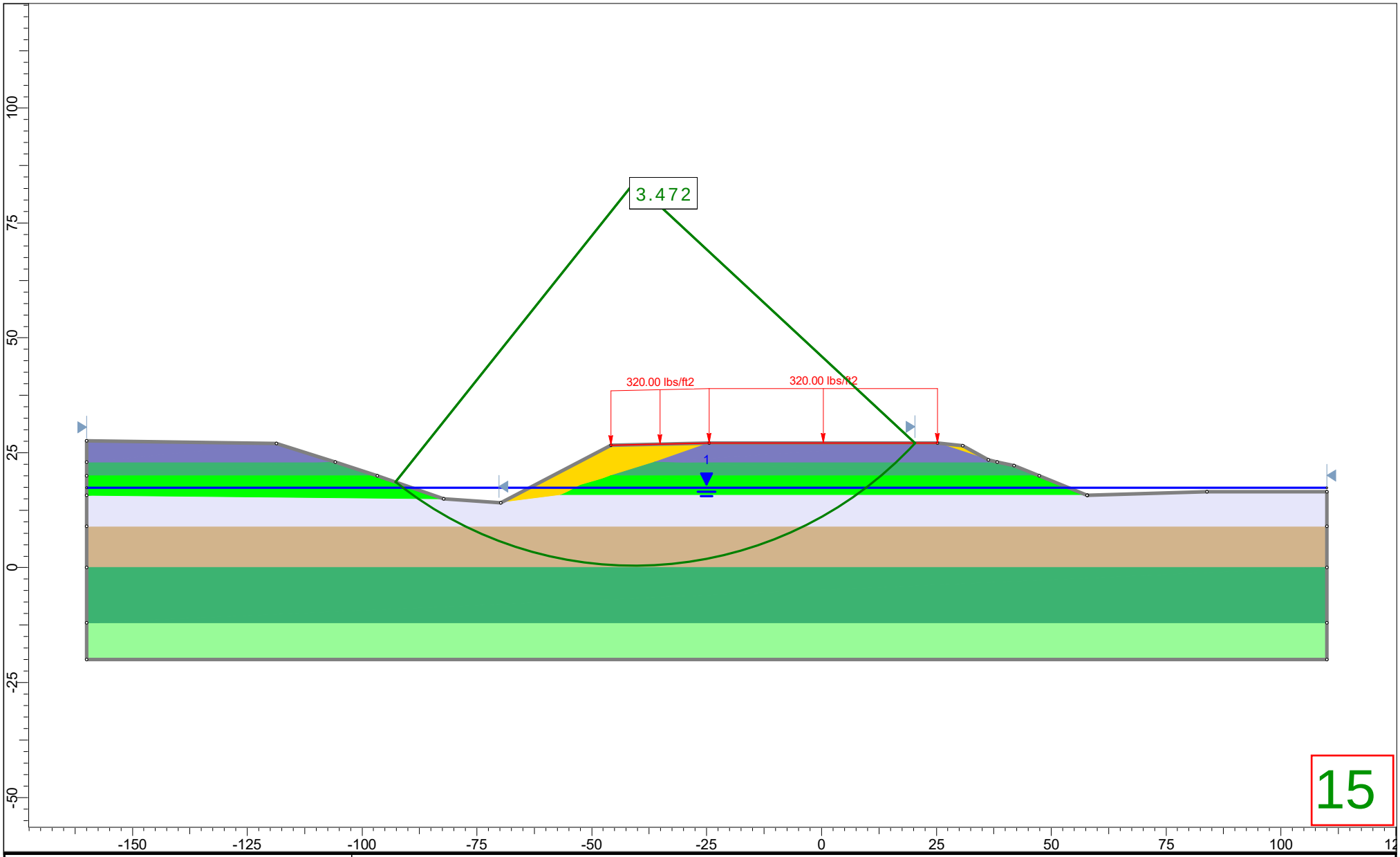
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	Analysis Description	End Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Transverse.slmd

SLIDEINTERPRET 9.012



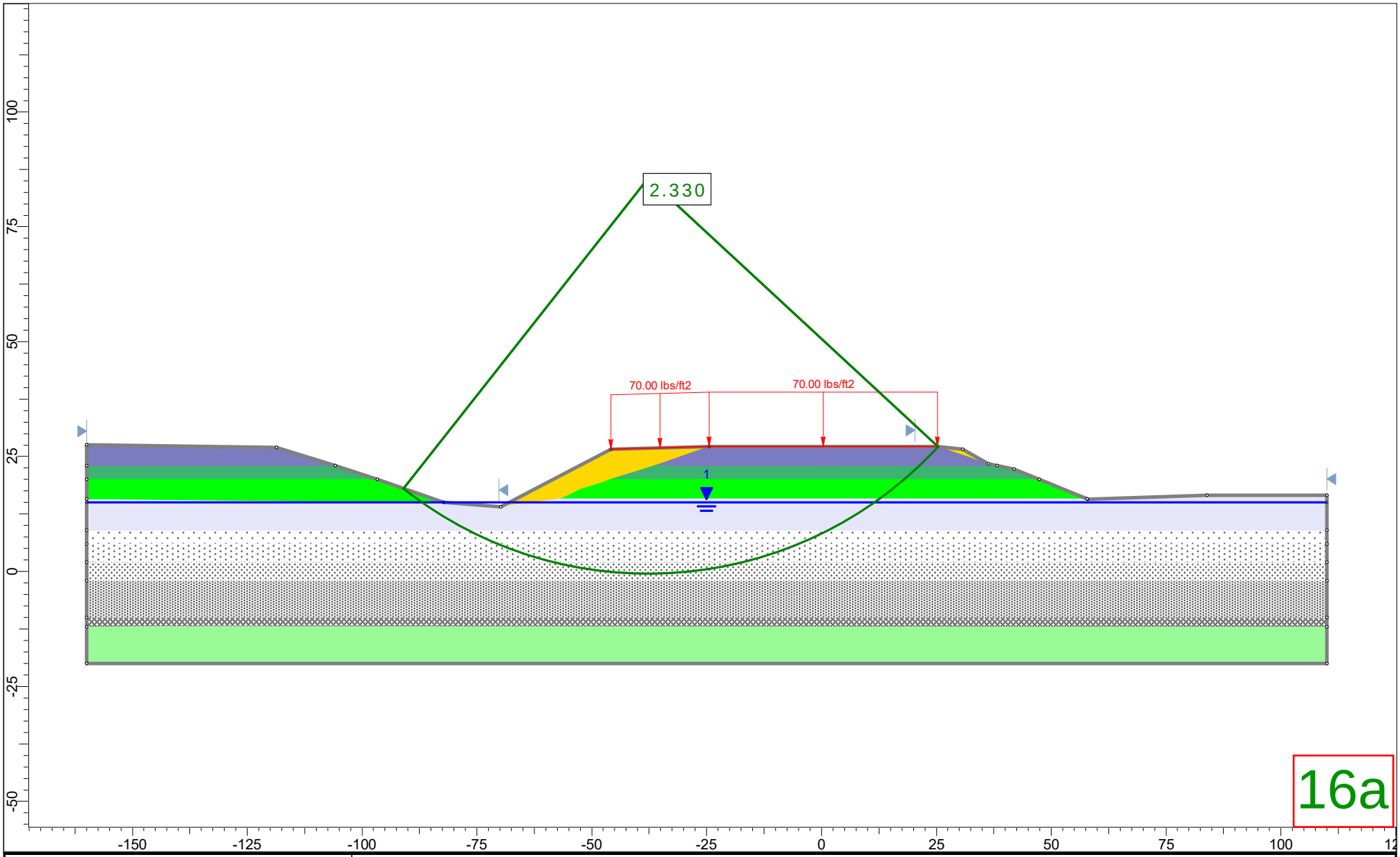
Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	End Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Transverse.slmd

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Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	End Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Transverse.slmd

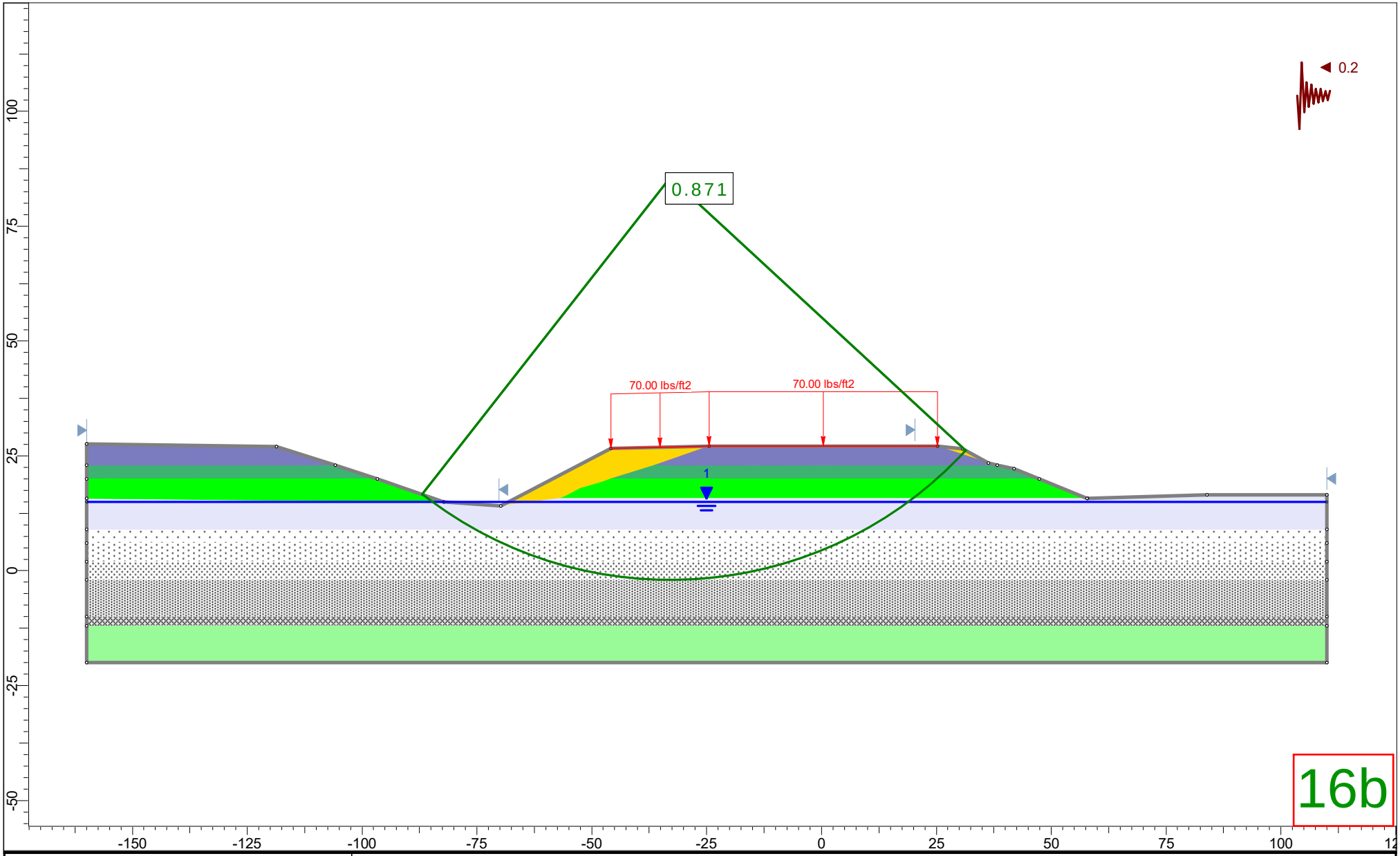
SLIDEINTERPRET 9.012



16a

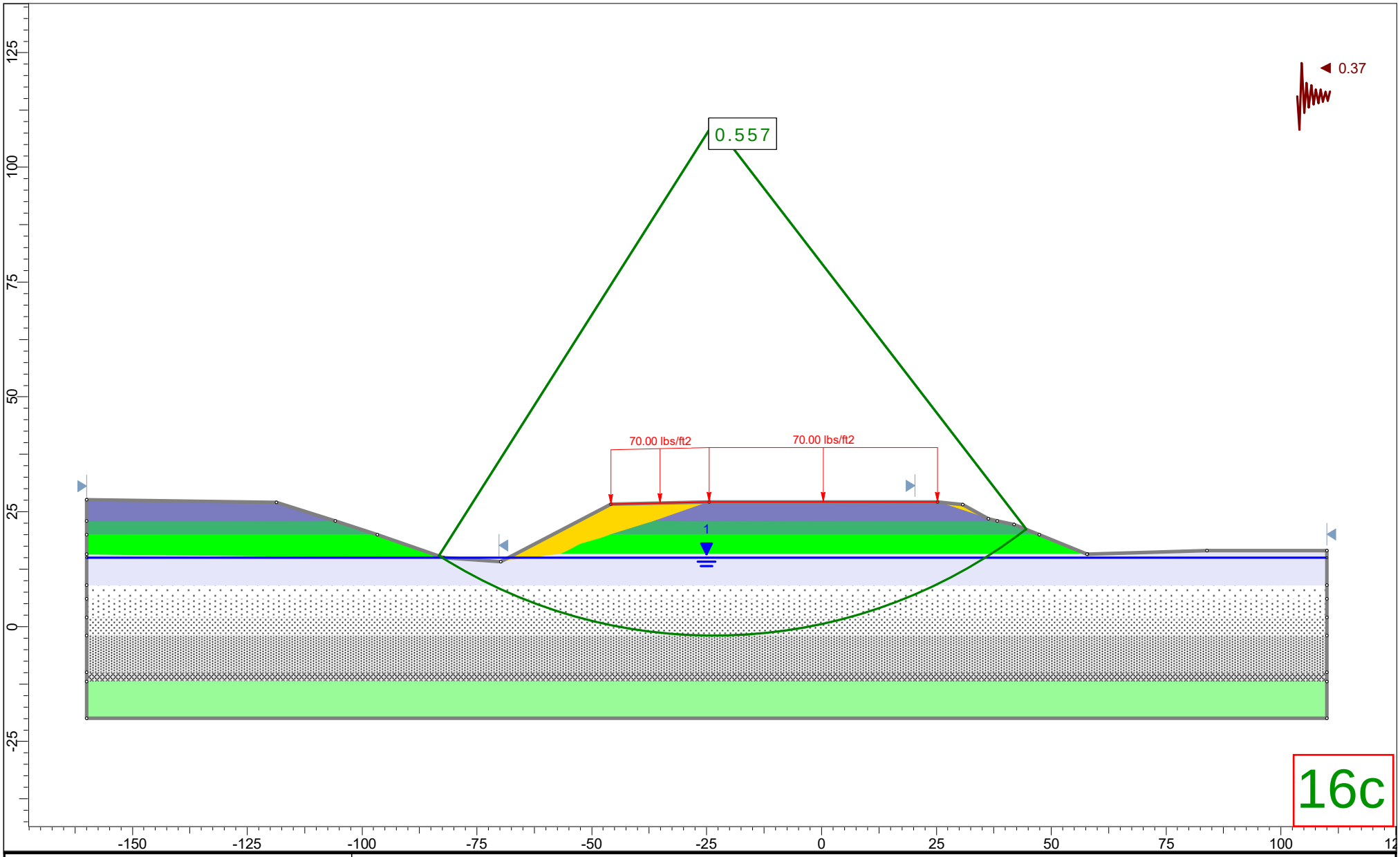
Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	End Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Transverse.slmd

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Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	End Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Transverse.slmd

SLIDEINTERPRET 9.012



Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	End Bridge Transverse Slope	
	Drawn By	A. Fekrat	Company: Terracon
	Date	7/28/2021, 10:51:28 AM	File Name: End Bridge Transverse.slmd

SLIDEINTERPRET 9.012

NEWMARK DISPLACEMENT ANALYSIS

Ref: SCDOT Geotechnical Design Manual (2019), Section 13.14.2

Project:	**I-95 BRO Bagshaw Swamp**
County	Jasper
Terracon Project No:	EN175299
Location:	End Bridge Transverse Slope
Design Earthquake:	SEE
Computed By:	A. Fekrat
Checked By:	D. Corley
Date:	7/30/2021

Stability Analysis Serial No: 16a, 16b, 16c

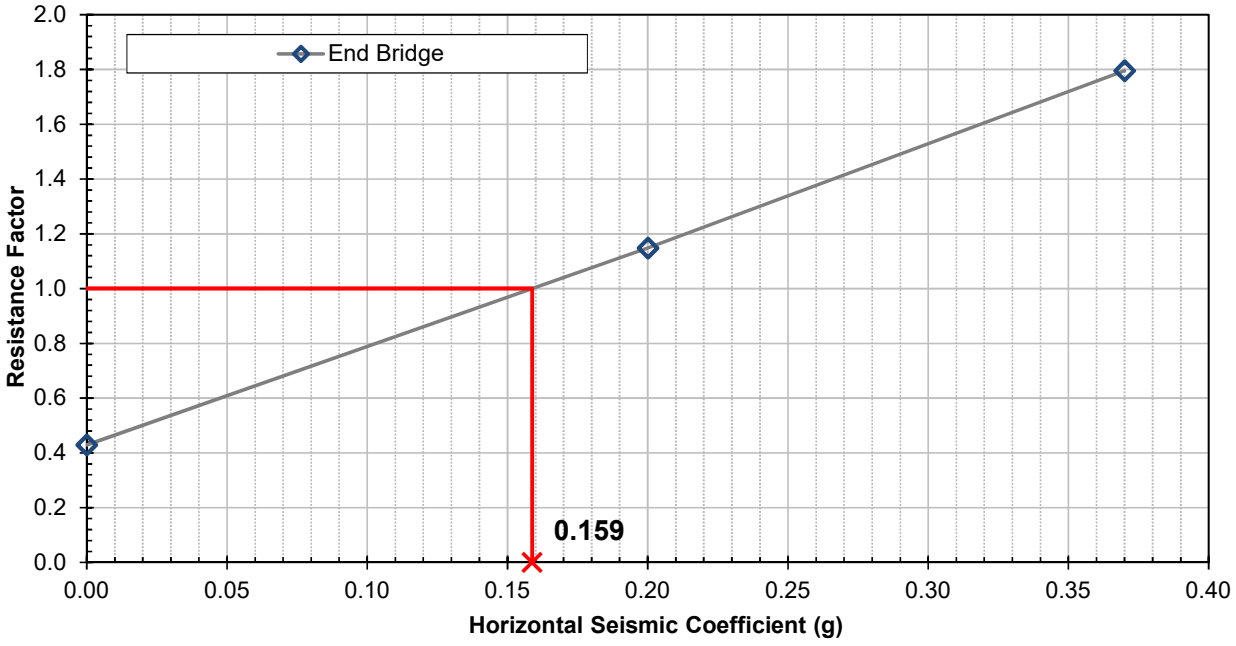
Slope Stability Analyses

End Bridge		
2H:1V Slope		
k_h	**Resistance Factor**	**FOS**
0.0000	0.43	2.330
0.2000	1.15	0.871
0.3700	1.80	0.557

Deformation ID (Table 10-1 GDM)
GI-01
GI-02

Lateral Deformation Analyses

R (ft)	NA
k_{max} =	0.370
k_y =	0.159
k_y/k_{max} =	0.429
S_1 =	0.480
F_v =	1.000
PGV =	18.3 in/sec
H =	14.00 ft.
β (0.5 ≤ β ≤ 1.5)	1.30
α_W (α_W=1 if H≤20)	1.00
$k_{max} = k_h = k_{av}$ =	0.370
$k_y/k_{max} = k_y/k_{av}$ =	0.429
log (d) =	0.303
Displacement	**4.02 in.**
Slice Angle of Entry	37°
Slice Angle of Exit	32°
GI-01 (V at Top)	**2.42 in.**
GI-02 (H at Top)	**3.21 in.**
GI-02 (H at Bottom)	**3.41 in.**
RS-04 (Wall Rot.)	NA



Project Summary

File Name:	End Bridge Transverse.slmd
Slide Modeler Version:	9.012
Project Title:	I-95 Bridge Replacement over Bagshaw Swamp
Analysis:	End Bridge Transverse Slope
Author:	A. Fekrat
Company:	Terracon
Date Created:	7/28/2021, 10:51:28 AM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Effective Stress	Master Scenario	Spencer: 3.111040	00h:00m:01.57s
Total Stress	Master Scenario	Spencer: 3.684940	00h:00m:00.969s
Seismic	Master Scenario	Spencer: 2.329720	00h:00m:01.921s
	Kh=0.2	Spencer: 0.870535	00h:00m:01.517s
	Kh=0.37	Spencer: 0.557029	00h:00m:01.795s
Partial Submergence	Master Scenario	Spencer: 3.471770	00h:00m:01.40s

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Seismic Loading

Effective Stress

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Total Stress

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - Master Scenario

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic - Kh=0.2

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.2

Seismic - Kh=0.37

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.37

Partial Submergence

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Effective Stress

Distribution:	Constant
Magnitude [psf]:	390
Orientation:	Vertical

Total Stress

Distribution:	Constant
Magnitude [psf]:	320
Orientation:	Vertical

Seismic

Distribution:	Constant
Magnitude [psf]:	70
Orientation:	Vertical

Partial Submergence

Distribution:	Constant
Magnitude [psf]:	320
Orientation:	Vertical

Materials

Proposed SCDOT Fill (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	450
Friction Angle [deg]	29
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 1 (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	29
Friction Angle [deg]	32
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	1
Existing Fill 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	30
Water Surface	Assigned per scenario
Hu Value	1
Sandy Clay (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	120
Friction Angle [deg]	25
Water Surface	Assigned per scenario
Hu Value	1
Very loose Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	0

Friction Angle [deg]	28
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (ES)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	400
Friction Angle [deg]	22
Water Surface	Assigned per scenario
Hu Value	1
Hard Sandy Silt (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	115
Cohesion [psf]	3500
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer1	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	3
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer2	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	6
Water Surface	Assigned per scenario
Hu Value	1
Liquified Layer 3	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	125
Friction Angle [deg]	5
Water Surface	Assigned per scenario
Hu Value	1
Proposed SCDOT Fill (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	500
Friction Angle [deg]	32
Water Surface	Assigned per scenario

Hu Value	1
Existing Fill 1 (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	58
Friction Angle [deg]	29
Water Surface	Assigned per scenario
Hu Value	1
Sandy Clay (TS)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	125
Cohesion [psf]	1200
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Hu Value	1
Medium dense Sand	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 4	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	300
Friction Angle [deg]	7
Water Surface	Assigned per scenario
Hu Value	0
Liquefied Layer 5	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	100
Cohesion [psf]	800
Friction Angle [deg]	8
Water Surface	Assigned per scenario
Hu Value	1

Materials In Use

Material	Effective Stress	Total Stress	Seismic	Kh=0.2	Kh=0.37	Partial Submergence
Proposed SCDOT Fill (ES)	✓	✗	✗	✗	✗	✗
Existing Fill 1 (ES)	✓	✗	✗	✗	✗	✗
Existing Fill 2	✓	✓	✓	✓	✓	✓
Existing Fill 3	✓	✓	✓	✓	✓	✓
Sandy Clay (ES)	✓	✗	✗	✗	✗	✗
Very loose Sand	✓	✓	✗	✗	✗	✓
Hard Sandy Silt (ES)	✓	✗	✗	✗	✗	✗
Hard Sandy Silt (TS)	✗	✓	✓	✓	✓	✓
Liquified Layer1	✗	✗	✓	✓	✓	✗
Liquified Layer2	✗	✗	✓	✓	✓	✗
Liquified Layer 3	✗	✗	✓	✓	✓	✗
Proposed SCDOT Fill (TS)	✗	✓	✓	✓	✓	✓
Existing Fill 1 (TS)	✗	✓	✓	✓	✓	✓
Sandy Clay (TS)	✗	✓	✓	✓	✓	✓
Medium dense Sand	✓	✓	✗	✗	✗	✓
Liquefied Layer 4	✗	✗	✓	✓	✓	✗
Liquefied Layer 5	✗	✗	✓	✓	✓	✗

Slice Data

Effective Stress

Global Minimum Query (spencer) - Safety Factor: 3.11104

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.04969	103.544	-37.1282	Existing Fill 3	0	30	12.5707	39.1081	67.7371	0	67.7371	58.2202	58.2202
2	2.04969	298.689	-35.3628	Existing Fill 3	0	30	35.5781	110.685	191.711	0	191.711	166.462	166.462
3	0.0679268	13.0361	-34.4615	Sandy Clay (ES)	120	25	80.5927	250.727	280.344	0	280.344	225.034	225.034
4	2.56693	630.602	-33.3657	Sandy Clay (ES)	120	25	80.9726	251.909	335.62	52.738	282.882	282.298	229.56
5	2.56693	881.448	-31.2558	Sandy Clay (ES)	120	25	80.5268	250.522	433.993	154.087	279.906	385.117	231.03
6	2.56693	1231.81	-29.1921	Sandy Clay (ES)	120	25	88.3004	274.706	579.209	247.442	331.767	529.876	282.434
7	2.56693	1614.39	-27.1693	Sandy Clay (ES)	120	25	99.217	308.668	737.893	333.293	404.6	686.969	353.676
8	2.2741	1690.49	-25.2941	Very loose Sand	0	28	72.9129	226.835	834.542	407.928	426.614	800.086	392.158
9	2.2741	1879.23	-23.5593	Very loose Sand	0	28	76.0456	236.581	917.339	472.396	444.943	884.18	411.784
10	2.2741	2049.44	-21.8471	Very loose Sand	0	28	78.3866	243.864	990.422	531.781	458.641	958.995	427.214
11	2.2741	2380.15	-20.1552	Very loose Sand	0	28	95.3768	296.721	1144.32	586.27	558.052	1109.31	523.045
12	2.2741	2888.54	-18.4815	Very loose Sand	0	28	127.987	398.174	1384.89	636.027	748.858	1342.11	706.08
13	2.2741	3380.31	-16.824	Very loose Sand	0	28	159.33	495.681	1613.44	681.196	932.241	1565.26	884.064
14	2.2741	3855.82	-15.1809	Very loose Sand	0	28	189.482	589.485	1830.56	721.902	1108.66	1779.15	1057.25
15	2.2741	4315.45	-13.5505	Very loose Sand	0	28	218.518	679.818	2036.8	758.254	1278.55	1984.14	1225.89
16	2.2741	4759.4	-11.9312	Very loose Sand	0	28	246.488	766.835	2232.55	790.346	1442.21	2180.47	1390.12
17	2.2741	5185.72	-10.3215	Very loose Sand	0	28	273.268	850.149	2417.16	818.261	1598.9	2367.39	1549.13
18	2.2741	5596.29	-8.72006	Very loose Sand	0	28	299.042	930.332	2591.77	842.065	1749.7	2545.9	1703.83
19	2.2741	5992.09	-7.12543	Very loose Sand	0	28	323.914	1007.71	2757.04	861.817	1895.23	2716.55	1854.74
20	2.2741	6373.29	-5.53634	Very loose Sand	0	28	347.922	1082.4	2913.25	877.564	2035.69	2879.53	2001.97
21	2.2741	6708.12	-3.95151	Very loose Sand	0	28	400.23	1245.13	3231.1	889.342	2341.76	3203.45	2314.11
22	2.2741	6797.96	-2.3697	Very loose Sand	0	28	439.525	1367.38	3468.85	897.18	2571.67	3450.66	2553.48
23	2.2741	6827.71	-0.7897	Very loose Sand	0	28	436.96	1359.4	3457.75	901.094	2556.65	3451.72	2550.63
24	2.2741	6843.19	0.7897	Very loose Sand	0	28	434.025	1350.27	3440.58	901.094	2539.49	3446.56	2545.47
25	2.2741	6844.41	2.3697	Very loose Sand	0	28	430.731	1340.02	3417.39	897.18	2520.21	3435.22	2538.04
26	2.2741	6831.34	3.95151	Very loose Sand	0	28	427.082	1328.67	3388.2	889.342	2498.86	3417.7	2528.36
27	2.2741	6803.9	5.53634	Very loose Sand	0	28	423.08	1316.22	3353.02	877.564	2475.46	3394.03	2516.47
28	2.2741	6761.99	7.12543	Very loose Sand	0	28	418.735	1302.7	3311.85	861.817	2450.03	3364.19	2502.38
29	2.2741	6705.49	8.72006	Very loose Sand	0	28	414.048	1288.12	3264.66	842.065	2422.6	3328.17	2486.1

30	2.2741	6634.2	10.3215	Very loose Sand	0	28	409.018	1272.47	3211.42	818.261	2393.16	3285.91	2467.65
31	2.2741	6539.28	11.9312	Very loose Sand	0	28	403.007	1253.77	3148.34	790.346	2358	3233.5	2443.15
32	2.2741	6422.32	13.5505	Very loose Sand	0	28	396.199	1232.59	3076.43	758.254	2318.17	3171.91	2413.66
33	2.2741	6289.84	15.1809	Very loose Sand	0	28	389.079	1210.44	2998.4	721.902	2276.5	3103.97	2382.07
34	2.2741	6141.49	16.824	Very loose Sand	0	28	381.638	1187.29	2914.17	681.196	2232.97	3029.57	2348.37
35	2.2741	5976.88	18.4815	Very loose Sand	0	28	373.881	1163.16	2823.62	636.027	2187.59	2948.59	2312.56
36	2.2741	5795.54	20.1552	Very loose Sand	0	28	365.81	1138.05	2726.63	586.27	2140.36	2860.89	2274.62
37	2.2741	5596.97	21.8471	Very loose Sand	0	28	357.417	1111.94	2623.04	531.781	2091.26	2766.34	2234.56
38	2.2741	5380.55	23.5593	Very loose Sand	0	28	348.707	1084.84	2512.69	472.396	2040.29	2664.74	2192.34
39	2.2741	5145.6	25.2941	Very loose Sand	0	28	339.674	1056.74	2395.37	407.928	1987.45	2555.89	2147.97
40	2.05354	4402.09	26.9675	Sandy Clay (ES)	120	25	327.04	1017.43	2266.35	341.799	1924.55	2432.75	2090.96
41	2.05354	4124.4	28.5795	Sandy Clay (ES)	120	25	315.775	982.39	2123.7	274.297	1849.4	2295.72	2021.42
42	2.05354	3827.33	30.2166	Sandy Clay (ES)	120	25	304.082	946.011	1973.47	202.079	1771.39	2150.56	1948.48
43	2.05354	3509.89	31.8815	Sandy Clay (ES)	120	25	291.954	908.282	1815.39	124.913	1690.47	1996.98	1872.07
44	2.05354	3170.99	33.577	Sandy Clay (ES)	120	25	279.389	869.19	1649.17	42.5298	1606.64	1834.64	1792.11
45	1.10094	1553.39	34.899	Sandy Clay (ES)	120	25	266.176	828.085	1518.49	0	1518.49	1704.17	1704.17
46	2.73136	3390.97	36.5456	Existing Fill 3	0	30	251.187	781.452	1353.52	0	1353.52	1539.69	1539.69
47	2.73136	2697.42	38.9456	Existing Fill 3	0	30	208.536	648.763	1123.69	0	1123.69	1292.23	1292.23
48	3.36355	2270.8	41.7302	Existing Fill 2	0	36	193.018	600.488	826.501	0	826.501	998.657	998.657
49	2.04074	766.691	44.2852	Existing Fill 1 (ES)	29	32	127.275	395.958	587.257	0	587.257	711.395	711.395
50	2.04074	261.487	46.3007	Existing Fill 1 (ES)	29	32	87.2824	271.539	388.145	0	388.145	479.483	479.483

Total Stress

Global Minimum Query (spencer) - Safety Factor: 3.68494

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.34793	138.732	-37.4422	Existing Fill 3	0	30	11.6261	42.8415	74.2037	0	74.2037	65.3013	65.3013
2	2.34793	398.268	-35.4328	Existing Fill 3	0	30	32.826	120.962	209.513	0	209.513	186.156	186.156
3	0.0790228	17.6075	-34.4082	Sandy Clay (TS)	1200	0	325.65	1200	507.368	0	507.368	284.322	284.322
4	2.56937	710.838	-33.3171	Sandy Clay (TS)	1200	0	325.65	1200	553.719	52.6909	501.028	339.668	286.977
5	2.56937	957.506	-31.2249	Sandy Clay (TS)	1200	0	325.65	1200	635.005	153.98	481.025	437.591	283.611
6	2.56937	1250.59	-29.1782	Sandy Clay (TS)	1200	0	325.65	1200	735.867	247.339	488.528	554.031	306.692
7	2.56937	1632.69	-27.1715	Sandy Clay (TS)	1200	0	325.65	1200	873.318	333.25	540.068	706.161	372.911
8	2.29534	1722.42	-25.3038	Very loose Sand	0	28	59.2843	218.459	819.117	408.256	410.861	791.088	382.832
9	2.29534	1914.8	-23.5683	Very loose Sand	0	28	61.9649	228.337	902.791	473.355	429.436	875.76	402.405
10	2.29534	2088.3	-21.8554	Very loose Sand	0	28	64.0279	235.939	977.057	533.319	443.738	951.376	418.057
11	2.29534	2332.47	-20.1628	Very loose Sand	0	28	71.7238	264.298	1085.41	588.34	497.073	1059.08	470.737
12	2.29534	2831.53	-18.4885	Very loose Sand	0	28	97.6445	359.814	1315.3	638.582	676.713	1282.65	644.064
13	2.29534	3332.6	-16.8303	Very loose Sand	0	28	123.967	456.811	1543.33	684.191	859.137	1505.83	821.638
14	2.29534	3817.09	-15.1865	Very loose Sand	0	28	149.418	550.596	1760.82	725.293	1035.52	1720.26	994.964
15	2.29534	4285.4	-13.5555	Very loose Sand	0	28	174.045	641.347	1968.2	761.999	1206.2	1926.24	1164.24
16	2.29534	4737.88	-11.9356	Very loose Sand	0	28	197.891	729.216	2165.86	794.404	1371.46	2124.03	1329.63
17	2.29534	5172.9	-10.3253	Very loose Sand	0	28	220.862	813.862	2353.24	822.589	1530.65	2313	1490.41
18	2.29534	5591.2	-8.72324	Very loose Sand	0	28	243.025	895.533	2530.88	846.624	1684.25	2493.59	1646.96
19	2.29534	5994.46	-7.12802	Very loose Sand	0	28	264.505	974.686	2699.68	866.568	1833.12	2666.61	1800.04
20	2.29534	6382.84	-5.53834	Very loose Sand	0	28	285.326	1051.41	2859.88	882.468	1977.41	2832.21	1949.74
21	2.29534	6745.99	-3.95294	Very loose Sand	0	28	317.129	1168.6	3092.18	894.361	2197.81	3070.26	2175.9
22	2.29534	6877.22	-2.37056	Very loose Sand	0	28	357.007	1315.55	3376.47	902.274	2474.19	3361.69	2459.41
23	2.29534	6907.54	-0.789985	Very loose Sand	0	28	355.669	1310.62	3371.15	906.226	2464.92	3366.25	2460.02
24	2.29534	6923.31	0.789985	Very loose Sand	0	28	354.003	1304.48	3359.6	906.226	2453.37	3364.48	2458.26
25	2.29534	6924.55	2.37056	Very loose Sand	0	28	352.014	1297.15	3341.85	902.274	2439.58	3356.43	2454.15
26	2.29534	6911.22	3.95294	Very loose Sand	0	28	349.702	1288.63	3317.93	894.361	2423.57	3342.09	2447.73
27	2.29534	6883.25	5.53834	Very loose Sand	0	28	347.075	1278.95	3287.82	882.468	2405.36	3321.48	2439.01
28	2.29534	6840.54	7.12802	Very loose Sand	0	28	344.133	1268.11	3251.54	866.568	2384.97	3294.57	2428
29	2.29534	6782.95	8.72324	Very loose Sand	0	28	340.879	1256.12	3209.04	846.624	2362.42	3261.34	2414.72
30	2.29534	6710.31	10.3253	Very loose Sand	0	28	337.313	1242.98	3160.29	822.589	2337.7	3221.74	2399.15
31	2.29534	6615.26	11.9356	Very loose Sand	0	28	332.99	1227.05	3102.14	794.404	2307.74	3172.53	2378.13
32	2.29534	6496.08	13.5555	Very loose Sand	0	28	327.856	1208.13	3034.15	761.999	2272.15	3113.2	2351.2

33	2.29534	6361.06	15.1865	Very loose Sand	0	28	322.42	1188.1	2959.79	725.293	2234.5	3047.31	2322.02
34	2.29534	6209.86	16.8303	Very loose Sand	0	28	316.689	1166.98	2878.95	684.191	2194.76	2974.75	2290.56
35	2.29534	6042.1	18.4885	Very loose Sand	0	28	310.654	1144.74	2791.52	638.582	2152.94	2895.39	2256.81
36	2.29534	5857.28	20.1628	Very loose Sand	0	28	304.314	1121.38	2697.34	588.34	2109	2809.08	2220.74
37	2.29534	5654.89	21.8554	Very loose Sand	0	28	297.668	1096.89	2596.26	533.319	2062.94	2715.65	2182.34
38	2.29534	5434.32	23.5683	Very loose Sand	0	28	290.71	1071.25	2488.09	473.355	2014.73	2614.9	2141.55
39	2.29534	5194.86	25.3038	Very loose Sand	0	28	283.44	1044.46	2372.59	408.256	1964.34	2506.6	2098.34
40	2.0555	4406.13	26.9713	Sandy Clay (TS)	1200	0	325.65	1200	2224.2	341.762	1882.44	2389.93	2048.16
41	2.0555	4127.95	28.5704	Sandy Clay (TS)	1200	0	325.65	1200	2077.33	274.204	1803.12	2254.66	1980.45
42	2.0555	3830.5	30.1943	Sandy Clay (TS)	1200	0	325.65	1200	1921.66	201.964	1719.69	2111.15	1909.18
43	2.0555	3512.82	31.8454	Sandy Clay (TS)	1200	0	325.65	1200	1756.8	124.813	1631.99	1959.07	1834.25
44	2.0555	3173.85	33.5267	Sandy Clay (TS)	1200	0	325.65	1200	1582.3	42.4892	1539.81	1798.06	1755.58
45	1.10345	1556.92	34.8379	Sandy Clay (TS)	1200	0	325.65	1200	1442.35	0	1442.35	1669	1669
46	2.73941	3400.85	36.4729	Existing Fill 3	0	30	209.275	771.167	1335.7	0	1335.7	1490.4	1490.4
47	2.73941	2705.26	38.856	Existing Fill 3	0	30	172.813	636.807	1102.98	0	1102.98	1242.21	1242.21
48	3.37647	2279.52	41.6211	Existing Fill 2	0	36	158.445	583.86	803.614	0	803.614	944.392	944.392
49	2.05023	770.2	44.1591	Existing Fill 1 (TS)	58	29	99.7455	367.556	558.454	0	558.454	655.314	655.314
50	2.05023	262.644	46.1613	Existing Fill 1 (TS)	58	29	68.3924	252.022	350.025	0	350.025	421.248	421.248

Seismic - Master Scenario

Global Minimum Query (spencer) - Safety Factor: 2.32972

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.00717	101.527	-37.4634	Existing Fill 3	0	30	16.0937	37.4937	64.941	0	64.941	52.6083	52.6083
2	2.00717	293.654	-35.7957	Existing Fill 3	0	30	45.8085	106.721	184.846	0	184.846	151.813	151.813
3	0.0670763	12.944	-34.9436	Sandy Clay (TS)	1200	0	515.083	1200	581.284	0	581.284	221.373	221.373
4	2.49302	616.796	-33.915	Sandy Clay (TS)	1200	0	515.083	1200	622.504	52.2956	570.209	276.186	223.891
5	2.49302	863.077	-31.9346	Sandy Clay (TS)	1200	0	515.083	1200	696.492	153.073	543.419	375.45	222.377
6	2.49302	1196.11	-29.9959	Sandy Clay (TS)	1200	0	515.083	1200	807.351	246.454	560.897	510.016	263.562
7	2.49302	1572.17	-28.0945	Sandy Clay (TS)	1200	0	515.083	1200	936.874	332.876	603.998	661.909	329.033
8	2.16768	1618.52	-26.3463	Liquified Layer1	125	3	62.2835	145.103	791.486	407.892	383.594	760.641	352.749
9	2.16768	1801.17	-24.7445	Liquified Layer1	125	3	62.6883	146.046	874.141	472.557	401.584	845.249	372.692
10	2.16768	1967.99	-23.1631	Liquified Layer1	125	3	63.0264	146.834	949.281	532.663	416.618	922.316	389.653
11	2.45099	2518.21	-21.4992	Liquified Layer2	125	6.00001	75.3409	175.523	1072.42	591.72	480.698	1042.74	451.022
12	2.45099	3107.1	-19.7532	Liquified Layer2	125	6.00001	83.6801	194.951	1314.84	649.302	665.542	1284.79	635.492
13	2.45099	3692.74	-18.026	Liquified Layer2	125	6.00001	92.1542	214.694	1555.03	701.648	853.377	1525.04	823.388
14	2.45099	4258.44	-16.3157	Liquified Layer2	125	6.00001	100.443	234.003	1786.01	748.918	1037.09	1756.61	1007.69
15	2.45099	4804.75	-14.6202	Liquified Layer2	125	6.00001	108.552	252.896	2008.1	791.25	1216.85	1979.79	1188.54
16	2.40795	5233.69	-12.9524	Liquified Layer 3	125	5	105.79	246.461	2216.79	828.477	1388.31	2192.46	1363.98
17	2.40795	5721.96	-11.3104	Liquified Layer 3	125	5	112.097	261.154	2417.03	860.782	1556.25	2394.61	1533.83
18	2.40795	6192.44	-9.67769	Liquified Layer 3	125	5	118.267	275.528	2609.17	888.62	1720.55	2589	1700.38
19	2.40795	6645.95	-8.05293	Liquified Layer 3	125	5	124.312	289.612	2793.58	912.061	1881.52	2776	1863.93
20	2.40795	7082.72	-6.43466	Liquified Layer 3	125	5	130.235	303.41	2970.4	931.164	2039.24	2955.71	2024.55
21	2.40795	7373.82	-4.82155	Liquified Layer 3	125	5	136.297	317.535	3146.66	945.974	2200.69	3135.17	2189.19
22	2.40795	7435.1	-3.21225	Liquified Layer 3	125	5	136.971	319.104	3175.14	956.527	2218.61	3167.45	2210.93
23	2.40795	7476.85	-1.60549	Liquified Layer 3	125	5	137.138	319.493	3185.91	962.849	2223.06	3182.07	2219.22
24	2.40795	7502.34	0	Liquified Layer 3	125	5	137.209	319.658	3189.91	964.955	2224.95	3189.91	2224.95
25	2.40795	7511.58	1.60549	Liquified Layer 3	125	5	137.184	319.601	3187.15	962.849	2224.3	3190.99	2228.14
26	2.40795	7504.54	3.21225	Liquified Layer 3	125	5	137.065	319.322	3177.63	956.527	2221.11	3185.33	2228.8
27	2.40795	7481.18	4.82155	Liquified Layer 3	125	5	136.849	318.821	3161.35	945.974	2215.38	3172.9	2226.92
28	2.40795	7441.39	6.43466	Liquified Layer 3	125	5	136.539	318.098	3138.28	931.164	2207.11	3153.68	2222.51
29	2.40795	7385.04	8.05293	Liquified Layer 3	125	5	136.133	317.151	3108.36	912.061	2196.3	3127.62	2215.56
30	2.40795	7303.38	9.67769	Liquified Layer 3	125	5	135.497	315.671	3068	888.62	2179.38	3091.1	2202.48
31	2.40795	7195.96	11.3104	Liquified Layer 3	125	5	134.63	313.65	3017.07	860.782	2156.29	3044	2183.21
32	2.40795	7071.29	12.9524	Liquified Layer 3	125	5	133.665	311.403	2959.08	828.477	2130.6	2989.82	2161.34

33	2.45099	7051.49	14.6202	Liquified Layer2	125	6.00001	148.324	345.553	2889.67	791.25	2098.42	2928.36	2137.11
34	2.45099	6885.21	16.3157	Liquified Layer2	125	6.00001	146.879	342.187	2815.32	748.918	2066.4	2858.31	2109.39
35	2.45099	6699.54	18.026	Liquified Layer2	125	6.00001	145.308	338.526	2733.21	701.648	2031.57	2780.5	2078.85
36	2.45099	6493.93	19.7532	Liquified Layer2	125	6.00001	143.606	334.562	2643.15	649.302	1993.85	2694.72	2045.42
37	2.45099	6267.76	21.4992	Liquified Layer2	125	6.00001	141.772	330.288	2544.9	591.72	1953.18	2600.75	2009.03
38	2.16768	5338.11	23.1631	Liquified Layer1	125	3	97.0477	226.094	2461.65	532.663	1928.99	2503.17	1970.51
39	2.16768	5129.31	24.7445	Liquified Layer1	125	3	96.1452	223.991	2361.43	472.557	1888.87	2405.74	1933.18
40	2.16768	4904.68	26.3463	Liquified Layer1	125	3	95.185	221.755	2254.08	407.892	1846.19	2301.22	1893.33
41	2.49302	5299.62	28.0945	Sandy Clay (TS)	1200	0	515.083	1200	1905.33	332.876	1572.45	2180.29	1847.42
42	2.49302	4868.02	29.9959	Sandy Clay (TS)	1200	0	515.083	1200	1710.74	246.454	1464.29	2008.08	1761.62
43	2.49302	4401.68	31.9346	Sandy Clay (TS)	1200	0	515.083	1200	1501.56	153.073	1348.49	1822.6	1669.53
44	2.49302	3898.39	33.915	Sandy Clay (TS)	1200	0	515.083	1200	1276.78	52.2956	1224.49	1623.1	1570.8
45	1.08233	1527.13	35.3587	Sandy Clay (TS)	1200	0	515.083	1200	1107.08	0	1107.08	1472.57	1472.57
46	2.69978	3351.02	36.9267	Existing Fill 3	0	30	270.388	629.928	1091.07	0	1091.07	1294.28	1294.28
47	2.69978	2665.49	39.2139	Existing Fill 3	0	30	214.818	500.466	866.832	0	866.832	1042.12	1042.12
48	3.34667	2259.4	41.8735	Existing Fill 2	0	36	179.081	417.208	574.238	0	574.238	734.769	734.769
49	2.03588	765.149	44.3202	Existing Fill 1 (TS)	58	29	104.947	244.498	336.451	0	336.451	438.937	438.937
50	2.03588	262.438	46.2499	Existing Fill 1 (TS)	58	29	56.653	131.986	133.473	0	133.473	192.654	192.654

Seismic - Kh=0.2

Global Minimum Query (spencer) - Safety Factor: 0.870535

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.09552	108.835	-37.2123	Existing Fill 3	0	30	110.064	95.8144	165.955	0	165.955	82.3751	82.3751
2	0.0345722	3.62124	-36.3376	Sandy Clay (TS)	1200	0	1378.46	1200	1483.11	0	1483.11	469.132	469.132
3	2.33763	375.797	-35.3857	Sandy Clay (TS)	1200	0	1378.46	1200	1498.75	51.8026	1446.95	519.648	467.845
4	2.33763	691.93	-33.5306	Sandy Clay (TS)	1200	0	1378.46	1200	1559.81	151.937	1407.87	646.369	494.432
5	2.33763	1079.81	-31.7145	Sandy Clay (TS)	1200	0	1378.46	1200	1657.88	245.337	1412.55	806.047	560.71
6	2.33763	1438.7	-29.9334	Sandy Clay (TS)	1200	0	1378.46	1200	1745.9	332.403	1413.5	952.184	619.781
7	2.95919	2232.51	-27.9552	Liquified Layer1	125	3	173.615	151.138	922.138	423.397	498.741	829.999	406.602
8	2.95919	2600.19	-25.7845	Liquified Layer1	125	3	174.896	152.253	1037.01	516.997	520.017	952.524	435.527
9	2.59594	2836.65	-23.7816	Liquified Layer2	125	6.00001	225.556	196.355	1276.18	597.29	678.892	1176.79	579.496
10	2.59594	3547.16	-21.9383	Liquified Layer2	125	6.00001	251.212	218.689	1556.99	665.603	891.389	1455.81	790.208
11	2.59594	4232.61	-20.1186	Liquified Layer2	125	6.00001	275.781	240.077	1822.78	727.895	1094.89	1721.76	993.864
12	2.59594	4893.91	-18.3199	Liquified Layer2	125	6.00001	299.352	260.596	2074.49	784.381	1290.11	1975.37	1190.99
13	2.43747	5176.49	-16.5936	Liquified Layer 3	125	5	290.066	252.513	2291.34	833.86	1457.48	2204.91	1371.05
14	2.43747	5717.9	-14.9365	Liquified Layer 3	125	5	306.989	267.245	2502.68	876.809	1625.87	2420.79	1543.98
15	2.43747	6239.34	-13.2921	Liquified Layer 3	125	5	323.271	281.419	2702.94	915.063	1787.88	2626.57	1711.51
16	2.43747	6742.83	-11.6589	Liquified Layer 3	125	5	339.012	295.122	2893.22	948.721	1944.5	2823.27	1874.55
17	2.43747	7228.71	-10.0351	Liquified Layer 3	125	5	354.236	308.375	3073.86	977.871	2095.99	3011.18	2033.3
18	2.43747	7645.52	-8.41954	Liquified Layer 3	125	5	370.795	322.79	3263.34	1002.58	2260.76	3208.45	2205.87
19	2.43747	7780.16	-6.81066	Liquified Layer 3	125	5	375.153	326.584	3327.04	1022.92	2304.12	3282.24	2259.32
20	2.43747	7860.5	-5.20715	Liquified Layer 3	125	5	374.284	325.827	3334.4	1038.94	2295.46	3300.29	2261.35
21	2.43747	7924.1	-3.60773	Liquified Layer 3	125	5	373.18	324.866	3335.15	1050.66	2284.49	3311.62	2260.96
22	2.43747	7971.05	-2.01113	Liquified Layer 3	125	5	371.849	323.708	3329.37	1058.13	2271.24	3316.31	2258.18
23	3.70947	12180.7	0	Liquified Layer 3	125	5	369.815	321.937	3311.8	1060.8	2251	3311.8	2251
24	2.21588	7287.63	1.93857	Liquified Layer 3	125	5	367.613	320.02	3287.54	1058.46	2229.08	3299.99	2241.53
25	2.21588	7279.48	3.38982	Liquified Layer 3	125	5	365.728	318.379	3262.35	1052.02	2210.33	3284.01	2231.99
26	2.21588	7258.83	4.84325	Liquified Layer 3	125	5	363.669	316.587	3231.92	1042.07	2189.85	3262.74	2220.67
27	2.21588	7217.86	6.29982	Liquified Layer 3	125	5	361.103	314.353	3192.89	1028.58	2164.31	3232.76	2204.18
28	2.21588	7157.3	7.76049	Liquified Layer 3	125	5	358.075	311.717	3145.72	1011.53	2134.19	3194.52	2182.99
29	2.21588	7083.96	9.22626	Liquified Layer 3	125	5	354.89	308.944	3093.36	990.874	2102.49	3151.01	2160.14
30	2.21588	6997.7	10.6981	Liquified Layer 3	125	5	351.548	306.035	3035.82	966.583	2069.24	3102.23	2135.65
31	2.21588	6898.34	12.1772	Liquified Layer 3	125	5	348.05	302.99	2973.04	938.603	2034.43	3048.14	2109.54
32	2.21588	6785.68	13.6646	Liquified Layer 3	125	5	344.399	299.811	2904.97	906.876	1998.1	2988.7	2081.83

33	2.21588	6659.47	15.1614	Liquified Layer 3	125	5	340.593	296.498	2831.56	871.334	1960.23	2923.85	2052.52
34	2.21588	6519.43	16.6689	Liquified Layer 3	125	5	336.633	293.051	2752.73	831.899	1920.83	2853.53	2021.63
35	2.59594	7439.93	18.3199	Liquified Layer2	125	6.00001	369.322	321.508	2654.03	784.381	1869.65	2776.32	1991.93
36	2.59594	7204.94	20.1186	Liquified Layer2	125	6.00001	363.164	316.147	2546.54	727.895	1818.65	2679.57	1951.68
37	2.59594	6945.8	21.9383	Liquified Layer2	125	6.00001	356.761	310.573	2431.21	665.603	1765.61	2574.91	1909.31
38	2.59594	6661.6	23.7816	Liquified Layer2	125	6.00001	350.113	304.786	2307.84	597.29	1710.55	2462.13	1864.84
39	2.95919	7212.96	25.7845	Liquified Layer1	125	3	244.755	213.068	2197.43	516.997	1680.43	2315.67	1798.67
40	2.95919	6769.09	27.9552	Liquified Layer1	125	3	240.839	209.659	2038.78	423.397	1615.38	2166.6	1743.2
41	2.33763	4967.07	29.9334	Sandy Clay (TS)	1200	0	1378.46	1200	1416.84	332.403	1084.44	2210.56	1878.16
42	2.33763	4559.37	31.7145	Sandy Clay (TS)	1200	0	1378.46	1200	1199.78	245.337	954.441	2051.62	1806.28
43	2.33763	4122	33.5306	Sandy Clay (TS)	1200	0	1378.46	1200	970.314	151.937	818.377	1883.76	1731.82
44	2.33763	3653.09	35.3857	Sandy Clay (TS)	1200	0	1378.46	1200	727.608	51.8026	675.806	1706.71	1654.91
45	1.02872	1451.48	36.7435	Sandy Clay (TS)	1200	0	1378.46	1200	545.611	0	545.611	1574.71	1574.71
46	2.58092	3202.75	38.2382	Existing Fill 3	0	30	547.668	476.764	825.779	0	825.779	1257.34	1257.34
47	2.58092	2547.4	40.4219	Existing Fill 3	0	30	427.391	372.059	644.425	0	644.425	1008.45	1008.45
48	3.22043	2113.56	42.9705	Existing Fill 2	0	36	297.101	258.637	355.984	0	355.984	632.75	632.75
49	2.28136	691.204	45.4744	Existing Fill 1 (TS)	58	29	154.618	134.6	138.191	0	138.191	295.391	295.391
50	0.804386	62.908	46.9238	Proposed SCDOT Fill (TS)	500	32	395.094	343.943	-249.743	0	-249.743	172.815	172.815

Seismic - Kh=0.37

Global Minimum Query (spencer) - Safety Factor: 0.557029

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.54905	5.13251	-32.2135	Existing Fill 3	0	30	147.81	82.3346	142.608	0	142.608	49.4782	49.4782
2	2.72449	261.351	-31.2298	Sandy Clay (TS)	1200	0	2154.29	1200	2282.41	51.2537	2231.15	976.194	924.94
3	2.72449	736.46	-29.6087	Sandy Clay (TS)	1200	0	2154.29	1200	2346.23	151.101	2195.13	1121.99	970.892
4	2.72449	1180.59	-28.0133	Sandy Clay (TS)	1200	0	2154.29	1200	2402.32	244.63	2157.69	1256.22	1011.59
5	2.72449	1591.79	-26.4413	Sandy Clay (TS)	1200	0	2154.29	1200	2449.6	332.126	2117.47	1378.26	1046.14
6	2.27269	1591.73	-25.0175	Liquified Layer1	125	3	274.806	153.075	943.19	407.49	535.7	814.943	407.453
7	2.27269	1999.71	-23.7374	Liquified Layer1	125	3	285.293	158.917	1118.93	471.763	647.169	993.475	521.712
8	2.27269	2546.84	-22.4698	Liquified Layer1	125	3	302.152	168.307	1358.62	532.271	826.353	1233.66	701.384
9	2.37376	3229.73	-21.1859	Liquified Layer2	125	6.00001	428.186	238.512	1670.3	590.304	1079.99	1504.34	914.031
10	2.37376	3797.29	-19.8855	Liquified Layer2	125	6.00001	462.552	257.655	1907.93	645.798	1262.13	1740.62	1094.82
11	2.37376	4350.45	-18.5956	Liquified Layer2	125	6.00001	495.45	275.98	2133.98	697.505	1436.48	1967.29	1269.78
12	2.37376	4888.9	-17.3154	Liquified Layer2	125	6.00001	526.931	293.516	2348.84	745.512	1603.32	2184.56	1439.05
13	2.37376	5410.89	-16.0441	Liquified Layer2	125	6.00001	556.915	310.218	2552.13	789.9	1762.23	2391.97	1602.07
14	2.52791	6320.55	-14.7401	Liquified Layer 3	125	5	520.152	289.74	2714.94	831.949	1882.99	2578.09	1746.14
15	2.52791	6880.88	-13.4031	Liquified Layer 3	125	5	544.535	303.322	2909.72	871.493	2038.23	2779.97	1908.47
16	2.52791	7423.09	-12.0735	Liquified Layer 3	125	5	569.267	317.098	3102.84	907.158	2195.68	2981.08	2073.92
17	2.52791	7721.36	-10.7504	Liquified Layer 3	125	5	588.188	327.638	3255.17	939.003	2316.16	3143.49	2204.49
18	2.52791	7854.24	-9.43314	Liquified Layer 3	125	5	585.962	326.398	3269.08	967.081	2302	3171.72	2204.64
19	2.52791	7972.06	-8.12088	Liquified Layer 3	125	5	583.476	325.013	3277.59	991.439	2286.15	3194.33	2202.89
20	2.52791	8074.95	-6.8129	Liquified Layer 3	125	5	580.738	323.488	3280.85	1012.12	2268.73	3211.46	2199.34
21	2.52791	8163.08	-5.50847	Liquified Layer 3	125	5	577.765	321.832	3278.94	1029.15	2249.79	3223.22	2194.07
22	2.52791	8236.53	-4.20691	Liquified Layer 3	125	5	574.564	320.049	3271.97	1042.55	2229.42	3229.71	2187.16
23	2.52791	8295.39	-2.90752	Liquified Layer 3	125	5	571.148	318.146	3260.03	1052.36	2207.67	3231.02	2178.66
24	2.52791	8339.73	-1.60962	Liquified Layer 3	125	5	567.527	316.129	3243.19	1058.58	2184.61	3227.24	2168.66
25	3.74638	12395.5	0	Liquified Layer 3	125	5	562.218	313.172	3211.61	1060.8	2150.81	3211.61	2150.81
26	2.7807	9189.91	1.67451	Liquified Layer 3	125	5	555.598	309.484	3166.92	1058.26	2108.66	3183.17	2124.91
27	2.7807	9157.66	3.10235	Liquified Layer 3	125	5	549.686	306.191	3122.04	1051.02	2071.02	3151.83	2100.81
28	2.7807	9106.06	4.53213	Liquified Layer 3	125	5	543.591	302.796	3071.66	1039.44	2032.22	3114.75	2075.31
29	2.7807	9035.02	5.96474	Liquified Layer 3	125	5	537.32	299.303	3015.8	1023.5	1992.3	3071.94	2048.44
30	2.7807	8944.4	7.40111	Liquified Layer 3	125	5	530.886	295.719	2954.49	1003.17	1951.32	3023.45	2020.28
31	2.7807	8834.04	8.84217	Liquified Layer 3	125	5	524.292	292.046	2887.74	978.403	1909.34	2969.3	1990.9
32	2.7807	8703.72	10.2889	Liquified Layer 3	125	5	517.546	288.288	2815.55	949.158	1866.39	2909.5	1960.34

33	2.7807	8553.17	11.7423	Liquified Layer 3	125	5	510.657	284.451	2737.91	915.375	1822.53	2844.05	1928.68
34	2.7807	8382.11	13.2034	Liquified Layer 3	125	5	503.633	280.538	2654.79	876.987	1777.8	2772.95	1895.96
35	2.7807	8190.17	14.6733	Liquified Layer 3	125	5	496.479	276.553	2566.17	833.916	1732.25	2696.17	1862.25
36	2.9672	8503.53	16.2032	Liquified Layer2	125	6.00001	541.855	301.829	2466.71	784.297	1682.42	2624.17	1839.87
37	2.9672	8234.32	17.7951	Liquified Layer2	125	6.00001	532.121	296.407	2358.51	727.681	1630.83	2529.3	1801.62
38	2.9672	7937.99	19.4013	Liquified Layer2	125	6.00001	522.26	290.914	2243.93	665.363	1578.57	2427.86	1762.5
39	2.9672	7613.77	21.0236	Liquified Layer2	125	6.00001	512.289	285.36	2122.9	597.179	1525.72	2319.79	1722.61
40	2.27269	5595.27	22.4698	Liquified Layer1	125	3	365.427	203.554	2031.17	532.271	1498.89	2182.3	1650.03
41	2.27269	5374.88	23.7374	Liquified Layer1	125	3	361.784	201.524	1931.93	471.763	1460.17	2091.02	1619.26
42	2.27269	5140.79	25.0175	Liquified Layer1	125	3	358.107	199.476	1828.57	407.49	1421.08	1995.69	1588.2
43	2.72267	5748.72	26.4408	Sandy Clay (TS)	1200	0	2154.29	1200	1238.69	332.155	906.539	2310	1977.85
44	2.72267	5180.51	28.0117	Sandy Clay (TS)	1200	0	2154.29	1200	988.785	244.722	744.063	2134.81	1890.08
45	2.72267	4435.53	29.606	Sandy Clay (TS)	1200	0	2154.29	1200	695.847	151.264	544.583	1919.95	1768.69
46	2.72267	3392.82	31.2259	Sandy Clay (TS)	1200	0	2154.29	1200	318.274	51.4969	266.777	1624.29	1572.79
47	1.2097	1172.97	32.4101	Sandy Clay (TS)	1200	0	2154.29	1200	47.488	0	47.488	1415.17	1415.17
48	3.05755	2261.19	33.7206	Existing Fill 3	0	30	434.582	242.075	419.285	0	419.285	709.341	709.341
49	3.05755	1226.32	35.6284	Existing Fill 3	0	30	226.688	126.272	218.709	0	218.709	381.172	381.172
50	1.4903	154.722	37.0724	Existing Fill 2	0	36	97.0605	54.0655	74.415	0	74.415	147.748	147.748

Partial Submergence

Global Minimum Query (spencer) - Safety Factor: 3.47177

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.57185	63.9328	-37.8675	Existing Fill 3	0	30	8.59098	29.8259	51.6599	0	51.6599	44.9798	44.9798
2	3.24956	502.006	-35.8071	Existing Fill 3	0	30	17.8419	61.9431	180.428	73.1398	107.289	167.557	94.4172
3	2.07222	560.505	-33.5763	Sandy Clay (TS)	1200	0	345.645	1200	563.944	189.198	374.746	334.504	145.306
4	2.07222	726.945	-31.8837	Sandy Clay (TS)	1200	0	345.645	1200	631.471	272.333	359.138	416.463	144.13
5	2.07222	877.034	-30.2216	Sandy Clay (TS)	1200	0	345.645	1200	691.107	350.212	340.895	489.762	139.55
6	2.07222	1104.79	-28.5872	Sandy Clay (TS)	1200	0	345.645	1200	790.531	423.105	367.426	602.18	179.075
7	2.07222	1349.29	-26.9778	Sandy Clay (TS)	1200	0	345.645	1200	898.471	491.248	407.223	722.525	231.277
8	2.29971	1729.14	-25.3053	Very loose Sand	0	28	38.1405	132.415	807.121	558.083	249.038	789.088	231.005
9	2.29971	1922.27	-23.5696	Very loose Sand	0	28	41.1453	142.847	891.964	623.31	268.654	874.014	250.704
10	2.29971	2096.44	-21.8566	Very loose Sand	0	28	43.4836	150.965	967.318	683.392	283.926	949.876	266.484
11	2.29971	2326.07	-20.164	Very loose Sand	0	28	50.6747	175.931	1069.4	738.521	330.878	1050.79	312.269
12	2.29971	2818.79	-18.4895	Very loose Sand	0	28	77.845	270.26	1297.15	788.862	508.284	1271.11	482.253
13	2.29971	3321.77	-16.8312	Very loose Sand	0	28	106.038	368.139	1526.93	834.56	692.368	1494.85	660.29
14	2.29971	3808.11	-15.1874	Very loose Sand	0	28	133.284	462.733	1746.02	875.743	870.275	1709.84	834.094
15	2.29971	4278.22	-13.5562	Very loose Sand	0	28	159.638	554.227	1954.87	912.521	1042.35	1916.38	1003.86
16	2.29971	4732.44	-11.9362	Very loose Sand	0	28	185.145	642.781	2153.89	944.989	1208.9	2114.75	1169.76
17	2.29971	5169.29	-10.3259	Very loose Sand	0	28	209.718	728.094	2342.57	973.229	1369.35	2304.36	1331.14
18	2.29971	5589.2	-8.72371	Very loose Sand	0	28	233.408	810.339	2521.34	997.312	1524.02	2485.52	1488.21
19	2.29971	5993.99	-7.1284	Very loose Sand	0	28	256.359	890.02	2691.18	1017.3	1673.88	2659.12	1641.82
20	2.29971	6383.86	-5.53864	Very loose Sand	0	28	278.597	967.226	2852.32	1033.23	1819.09	2825.3	1792.07
21	2.29971	6751.56	-3.95315	Very loose Sand	0	28	310.568	1078.22	3072.97	1045.14	2027.83	3051.51	2006.37
22	2.29971	6893.49	-2.37068	Very loose Sand	0	28	355.83	1235.36	3376.45	1053.07	2323.38	3361.72	2308.65
23	2.29971	6923.92	-0.790027	Very loose Sand	0	28	354.456	1230.59	3371.43	1057.03	2314.4	3366.54	2309.51
24	2.29971	6939.76	0.790027	Very loose Sand	0	28	352.728	1224.59	3360.15	1057.03	2303.12	3365.02	2307.99
25	2.29971	6941	2.37068	Very loose Sand	0	28	350.657	1217.4	3342.67	1053.07	2289.6	3357.19	2304.12
26	2.29971	6927.61	3.95315	Very loose Sand	0	28	348.246	1209.03	3318.99	1045.14	2273.85	3343.06	2297.92
27	2.29971	6899.53	5.53864	Very loose Sand	0	28	345.498	1199.49	3289.14	1033.23	2255.91	3322.64	2289.41
28	2.29971	6856.65	7.1284	Very loose Sand	0	28	342.416	1188.79	3253.08	1017.3	2235.78	3295.9	2278.6
29	2.29971	6798.84	8.72371	Very loose Sand	0	28	339.003	1176.94	3210.81	997.312	2213.5	3262.83	2265.51
30	2.29971	6725.92	10.3259	Very loose Sand	0	28	335.258	1163.94	3162.27	973.229	2189.04	3223.36	2250.13
31	2.29971	6630.87	11.9362	Very loose Sand	0	28	330.733	1148.23	3104.49	944.989	2159.5	3174.4	2229.41
32	2.29971	6511.25	13.5562	Very loose Sand	0	28	325.324	1129.45	3036.71	912.521	2124.19	3115.15	2202.63

33	2.29971	6375.71	15.1874	Very loose Sand	0	28	319.598	1109.57	2962.54	875.743	2086.8	3049.3	2173.55
34	2.29971	6223.93	16.8312	Very loose Sand	0	28	313.555	1088.59	2881.89	834.56	2047.33	2976.75	2142.19
35	2.29971	6055.51	18.4895	Very loose Sand	0	28	307.192	1066.5	2794.65	788.862	2005.79	2897.37	2108.51
36	2.29971	5869.99	20.164	Very loose Sand	0	28	300.507	1043.29	2700.67	738.521	1962.15	2811.02	2072.5
37	2.29971	5666.81	21.8566	Very loose Sand	0	28	293.499	1018.96	2599.78	683.392	1916.39	2717.51	2034.12
38	2.29971	5445.38	23.5696	Very loose Sand	0	28	286.164	993.495	2491.8	623.31	1868.49	2616.64	1993.33
39	2.29971	5205	25.3053	Very loose Sand	0	28	278.497	966.876	2376.51	558.083	1818.43	2508.19	1950.11
40	2.27674	4863.75	27.0573	Sandy Clay (TS)	1200	0	345.645	1200	2210.1	487.875	1722.22	2386.65	1898.77
41	2.27674	4519.95	28.8282	Sandy Clay (TS)	1200	0	345.645	1200	2045.67	412.495	1633.18	2235.92	1823.42
42	2.27674	4149.82	30.6297	Sandy Clay (TS)	1200	0	345.645	1200	1870.33	331.339	1538.99	2074.99	1743.65
43	2.27674	3751.88	32.4656	Sandy Clay (TS)	1200	0	345.645	1200	1683.52	244.086	1439.43	1903.43	1659.34
44	2.27674	3324.43	34.3396	Sandy Clay (TS)	1200	0	345.645	1200	1484.59	150.364	1334.22	1720.72	1570.36
45	2.22697	2817.21	36.2352	Existing Fill 3	0	30	217.173	753.973	1356.84	50.9169	1305.92	1515.99	1465.07
46	3.25524	3291.44	38.6148	Existing Fill 3	0	30	186.177	646.362	1119.53	0	1119.53	1268.23	1268.23
47	1.68959	1296.89	40.8128	Existing Fill 2	0	36	183.714	637.814	877.874	0	877.874	1036.52	1036.52
48	1.68959	992.764	42.3651	Existing Fill 2	0	36	151.544	526.126	724.149	0	724.149	862.359	862.359
49	2.05222	770.935	44.1328	Existing Fill 1 (TS)	58	29	105.324	365.662	555.035	0	555.035	657.218	657.218
50	2.05222	262.887	46.1322	Existing Fill 1 (TS)	58	29	72.1839	250.606	347.47	0	347.47	422.565	422.565

EXHIBIT C-9: EMBANKMENT SETTLEMENT ANALYSIS

Project Name: I-95 Bridge Replacement over Bagshaw Swamp

Project Location: Jasper County

SCDOT Project ID: P030260

Location of Analysis:

Station	Location	Bridge Operational Classification (OC)
514+50 to 515+95	Begin Bridge	OC I
517+25 to 518+70	End Bridge	OC I

Given Geometry: Bridge plans and profiles and roadway cross sections dated 6/3/2021

Soil Profile and Parameters Used in Analysis: See each analysis section methodology sheet.

Analysis Methodology: Since the soil profile is consisted of sand-like and clay-like strata, settlement was analyzed following guidelines for immediate settlement, primary consolidation and secondary consolidation from SCDOT GDM Section 17.8 to Section 17.10.
The existing embankment was modeled by placing fill and allowing it to settle for sufficient time (100 years). Setting this as a reference stage, construction stage was modeled by placing fill, and paving 4 months after. Following construction stages, settlement was investigated 5 years and 20 years post construction.

Summary of Analysis Results: Calculated total settlement at each station is as follows.

STATION		Calculated Immediate Settlement (in.)	Calculated Consolidation Settlement (in.)	Calculated Secondary Settlement (in.)	Calculated Total Settlement (in.)
514+50 to 515+95	Begin Bridge	0.49	2.01	0.00	2.5
517+25 to 518+70	End Bridge	0.41	1.79	0.00	2.2

Comparison of Results to Performance Limits: See Exhibit C-10.

GEOMETRY

(CROSS SECTIONS)

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	JASPER	P030260	I-95	X-4

Begin Bridge: Sta. 514+50 to Sta. 515+95

22.52

TOE OF FILL
STATION 516+12.42

BEGIN BRIDGE
STATION 515+95.00

27.49

20 ft

12.5% 0.040 FT./FT. 0.020 FT./FT. 0.020 FT./FT. 0.040 FT./FT. 12.5%

27.29

94 ft

74 ft

13 ft

2:1

13 ft

108 ft

515+00.00

Elev. 16 feet

Elev. 16 feet

Ex. R/W

26.69

12.5% 0.040 FT./FT. 0.020 FT./FT. 0.020 FT./FT. 0.040 FT./FT. 12.5%

26.35

3:1

Ex. R/W

514+00.00

25.57

12.5% 0.040 FT./FT. 0.020 FT./FT. 0.020 FT./FT. 0.040 FT./FT. 12.5%

25.24

4:1

3:1

Ex. R/W

513+00.00

24.35

12.5% 0.040 FT./FT. 0.020 FT./FT. 0.020 FT./FT. 0.040 FT./FT. 12.5%

23.92

4:1

4:1

Ex. R/W

10'

10'

INFRASTRUCTURE CONSULTING & ENGINEERING

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			
0			RELEASE FOR CONSTRUCTION

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

INTERSTATE 95 BRIDGE REPLACEMENT
JASPER COUNTY

CROSS SECTION SHEET

R:\Projects\18-42 I-95 Bridge Replacements Jasper Co\Roadway\CorridorModeling\I-95_XS_SHEETS.dgn
6/3/2021

End Bridge: Sta. 517+25 to Sta. 518+70

27.06

26.63

0.040 FT./FT. 0.020 FT./FT. 0.020 FT./FT. 0.040 FT./FT.

12.5d 12.5d 2d 2d

20 ft 54 ft

519+00.00

27.67

27.43

74 ft

126 ft

518+00.00

14 ft

Ex. ROW

Elev. 14 feet

Elev. ~ 14 feet

END BRIDGE
STATION 517+25.00

20.43

TOE OF FILL
STATION 517+04.40

20 10 30 20 10

20 10 30 20 10 30 20 10

INFRASTRUCTURE
CONSULTING & ENGINEERING

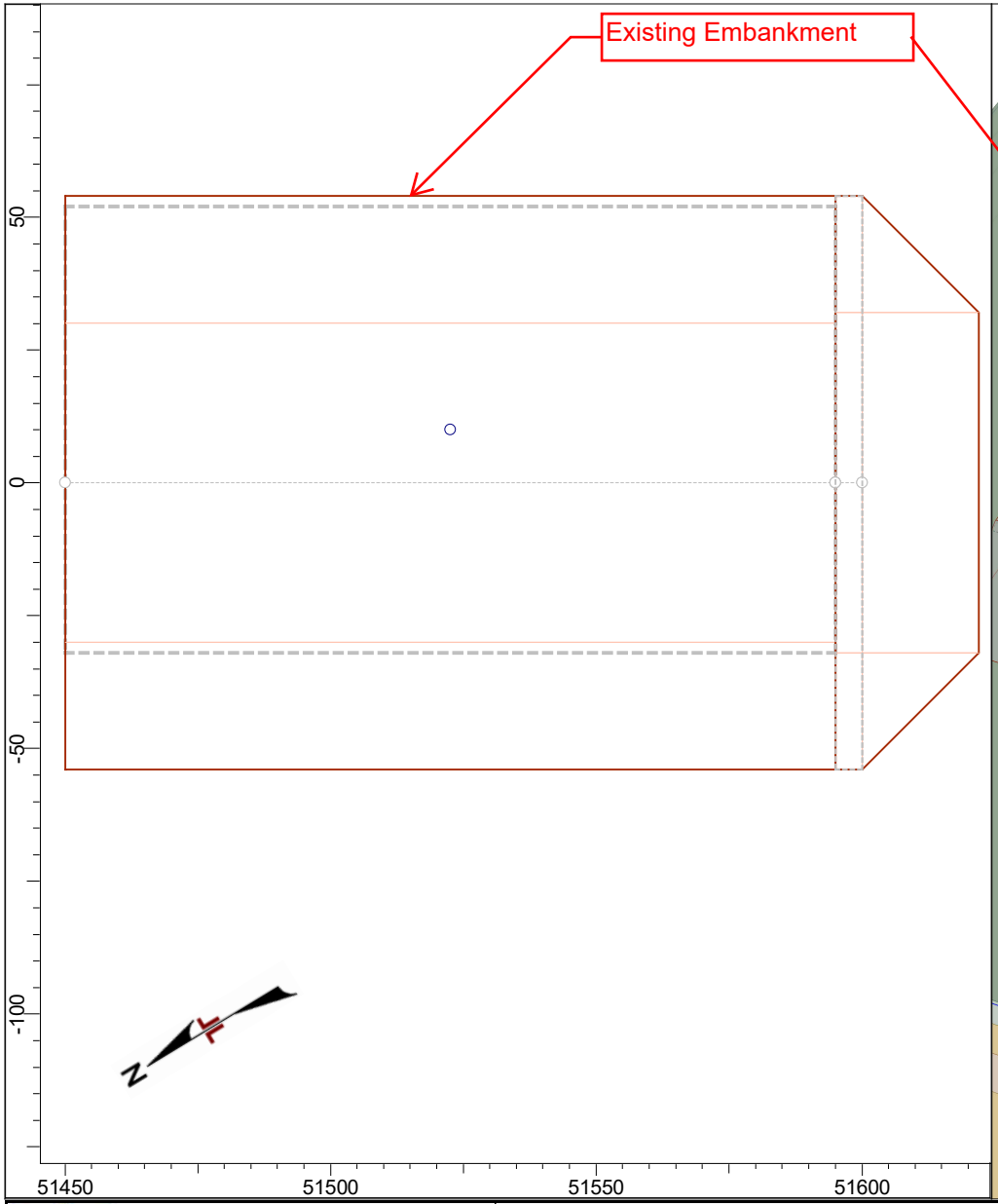
PRELIMINARY
NOT FOR CONSTRUCTION

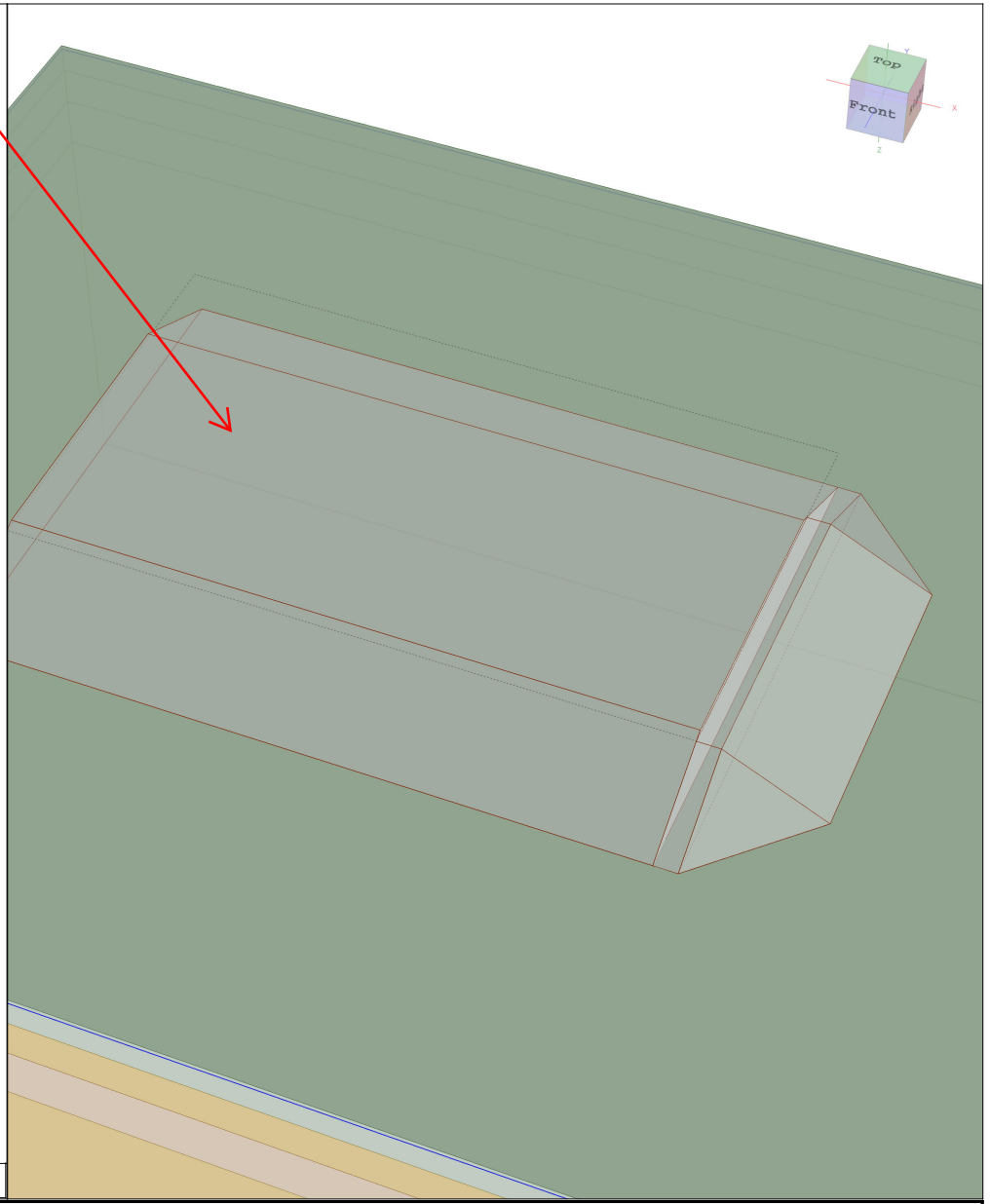
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6/3/2021

SETTLEMENT ANALYSIS AT BEGIN BRIDGE

Settlement Analysis Methodology

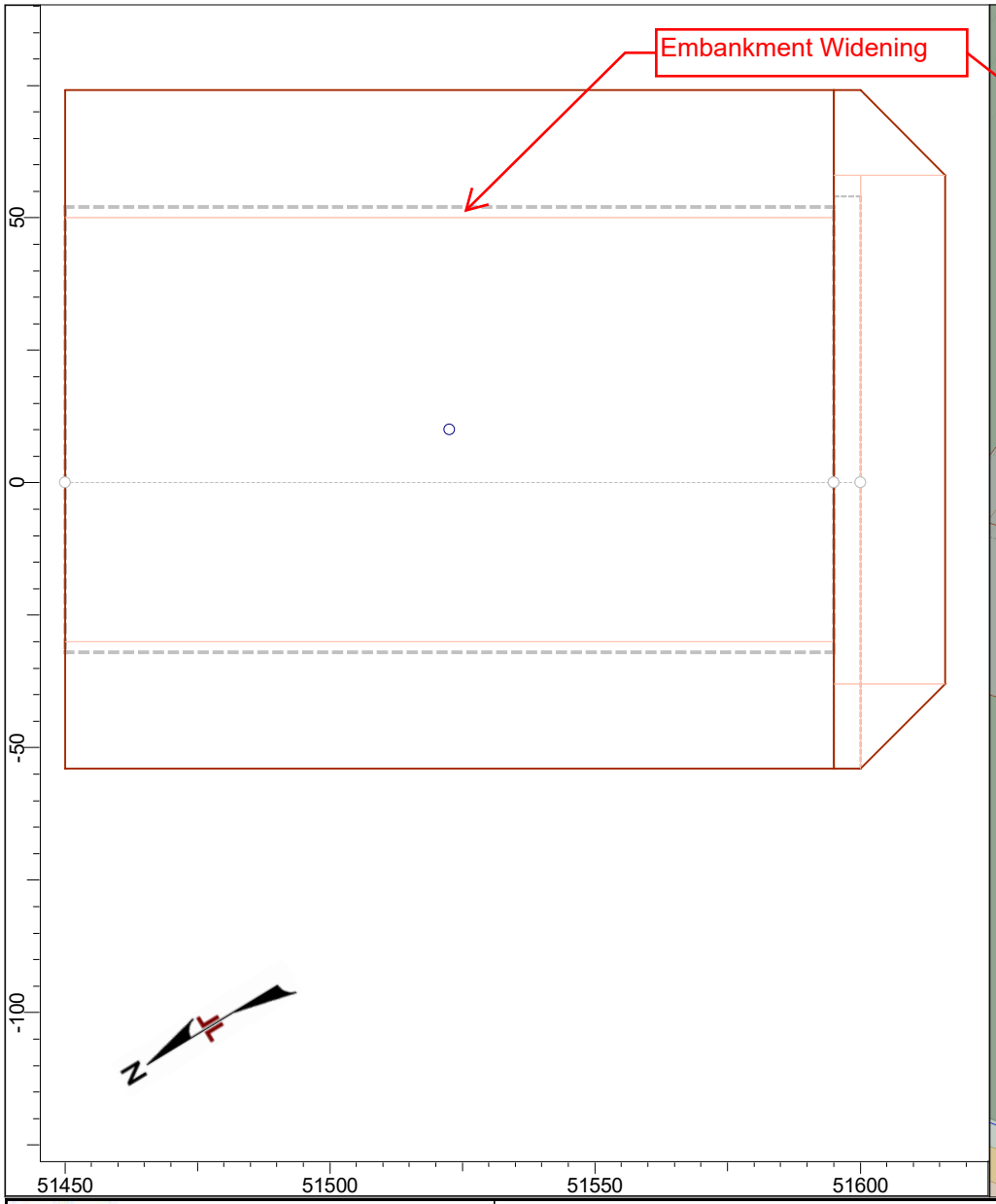
Analysis Methodology	
Analysis Type	Embankment Settlement
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County
SCDOT Project ID	P030260
Location of Analysis	Begin Bridge Approach Embankment
Geometry	Bridge plans and profiles and roadway cross sections dated 6/3/2021
Soil Profile	See Exhibit C-3 for soil profile and parameters.
Settlement Analysis Method	Settlement analysis was performed using Settle3 Version 5.008. Since the soil profile is comprised of sand-like and clay-like strata, settlement was analyzed following guidelines for immediate settlement, primary consolidation and secondary consolidation from SCDOT GDM Section 17.8 to Section 17.10. Compressibility of the hard sandy silt layer has been neglected in the analysis because of age it being overconsolidated. Soil profile and parameters can be found in Exhibit C-3. For settlement analysis, soil strata begin at the Alluvium from Elevation 16 ft. Above Elevation 16 ft, the existing and new embankments have been placed as embankment loads of unit weight 120 pcf.
Design Notes	• Stress increase from 13 ft of fill is 1.0 ksf • Settlements essentially complete in about 4 months after widening. Settlements after that is in the order of less than an inch.

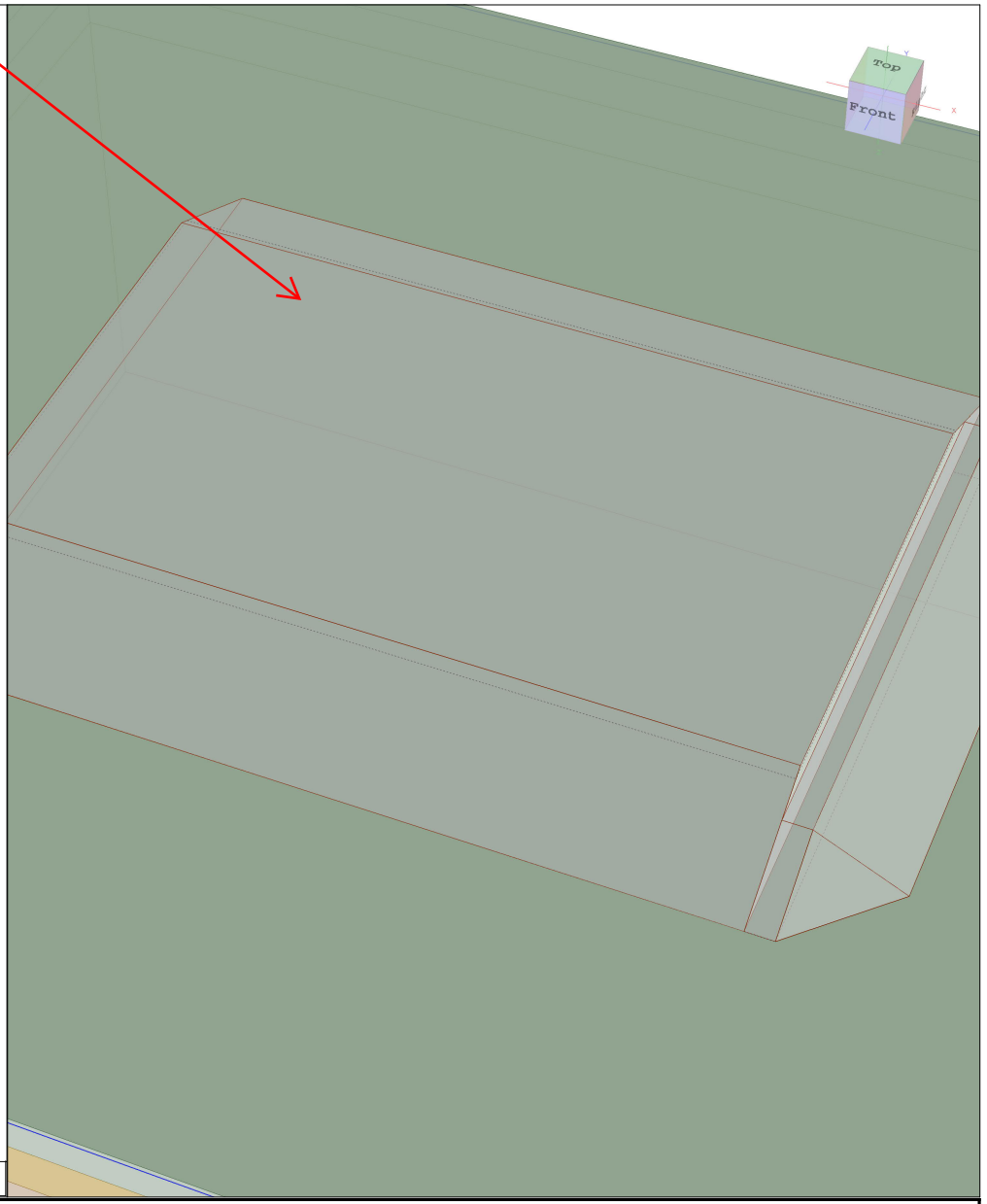




Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp Begin Bridge.s3z

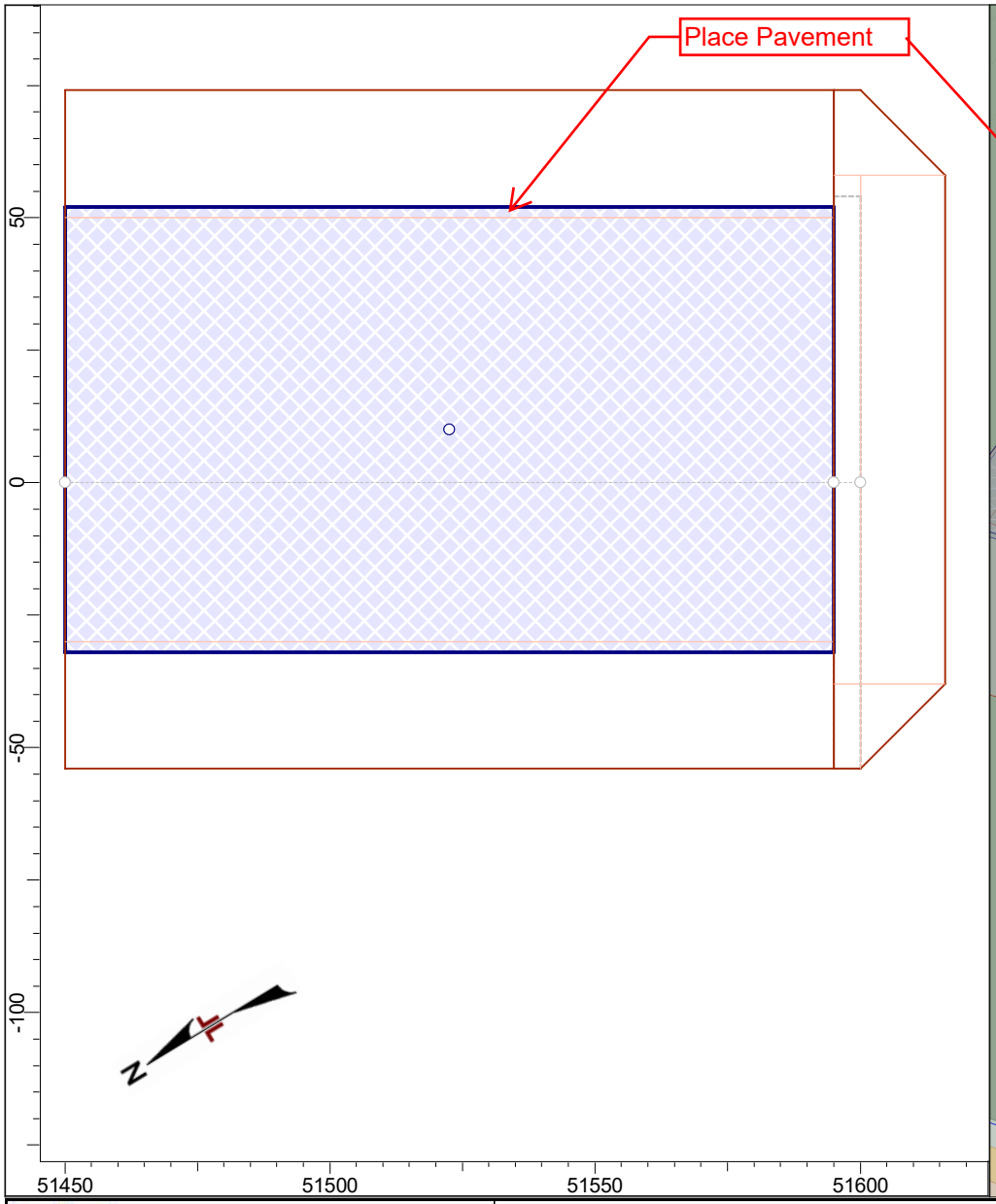
SETTLE3 5.008

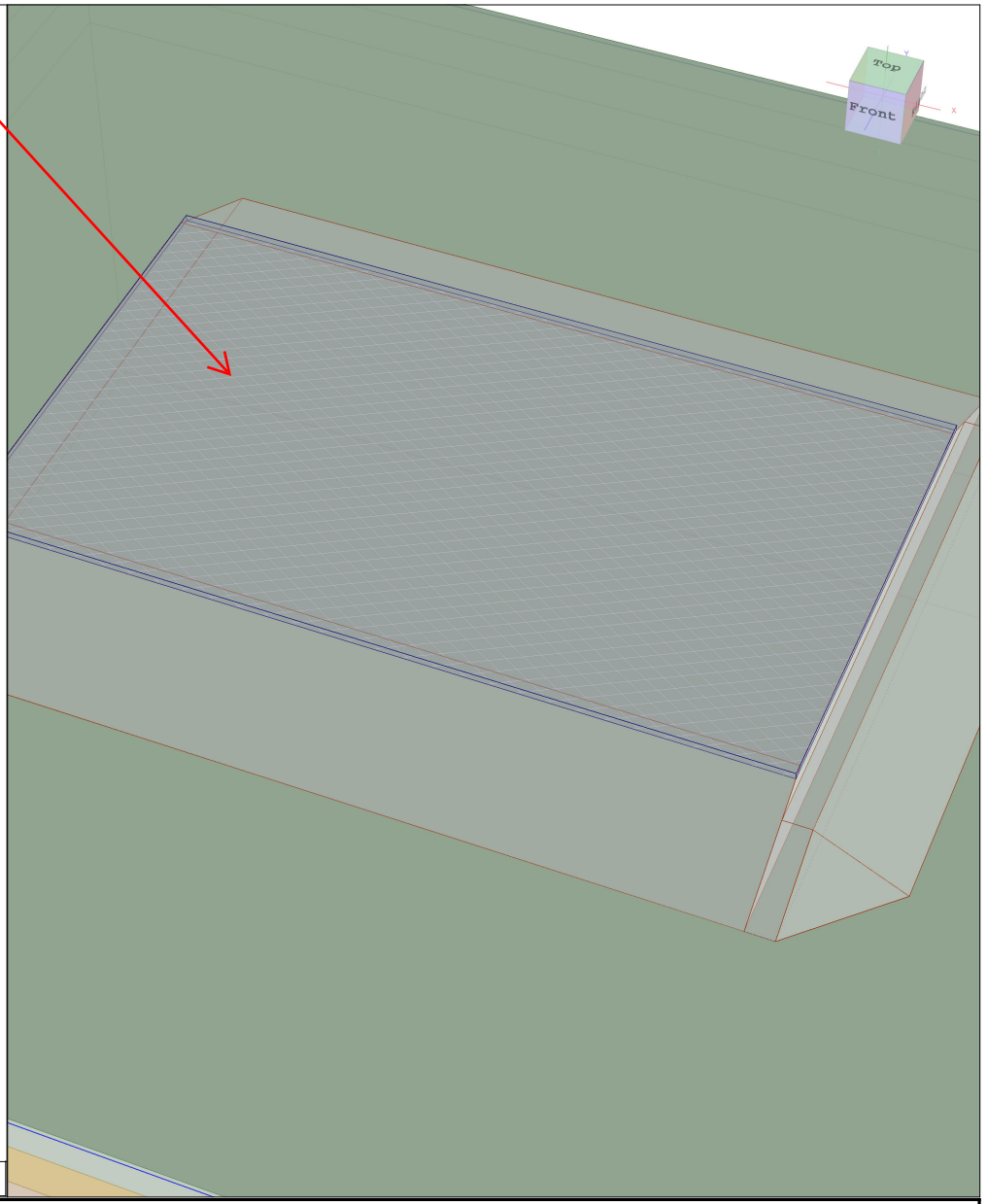




Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp Begin Bridge.s3z

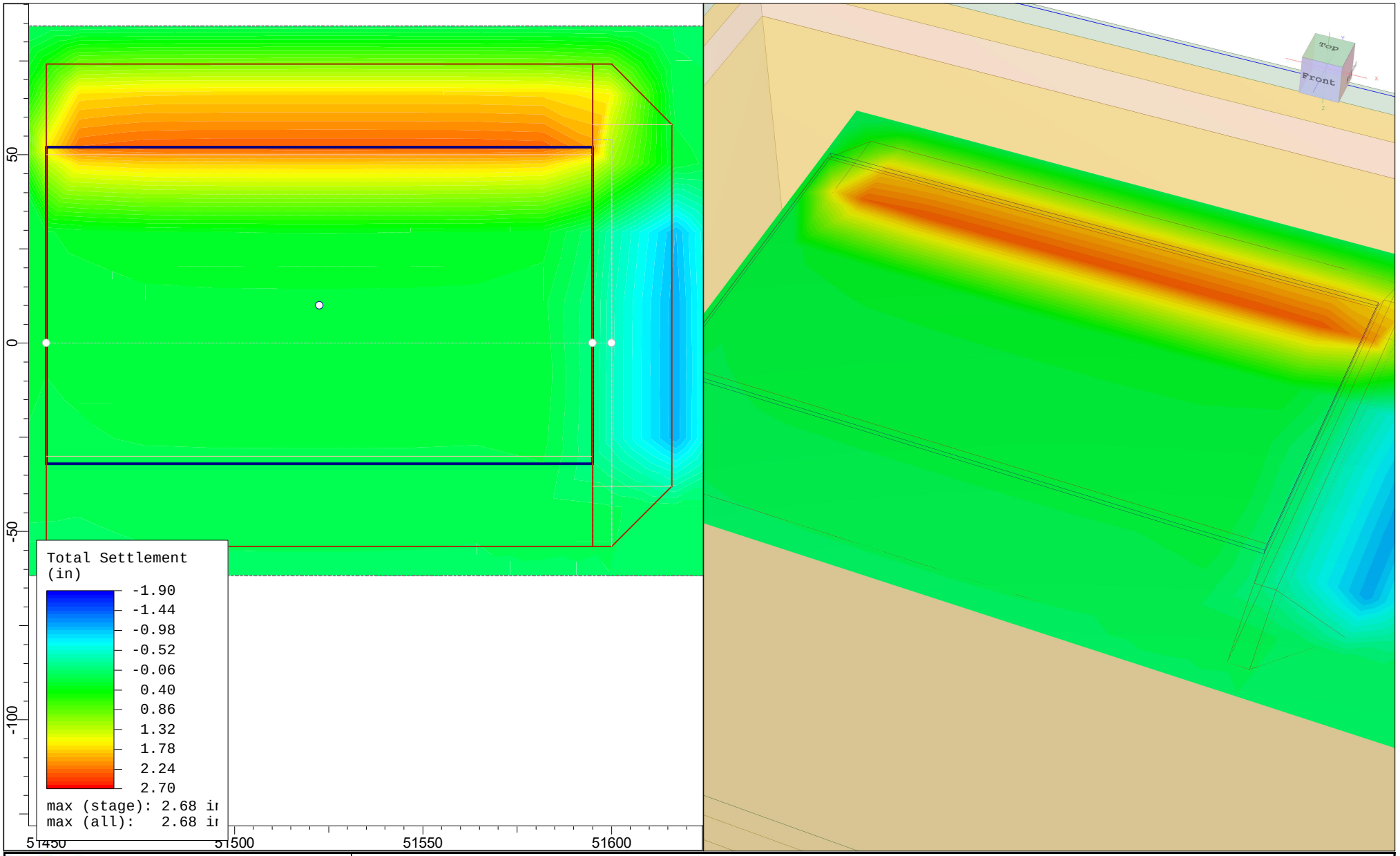
SETTLE3 5.008





Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp Begin Bridge.s3z

SETTLE3 5.008



Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp Begin Bridge.s3z

SETTLE3 5.008

BEGIN BRIDGE SETTLEMENT ANALYSIS

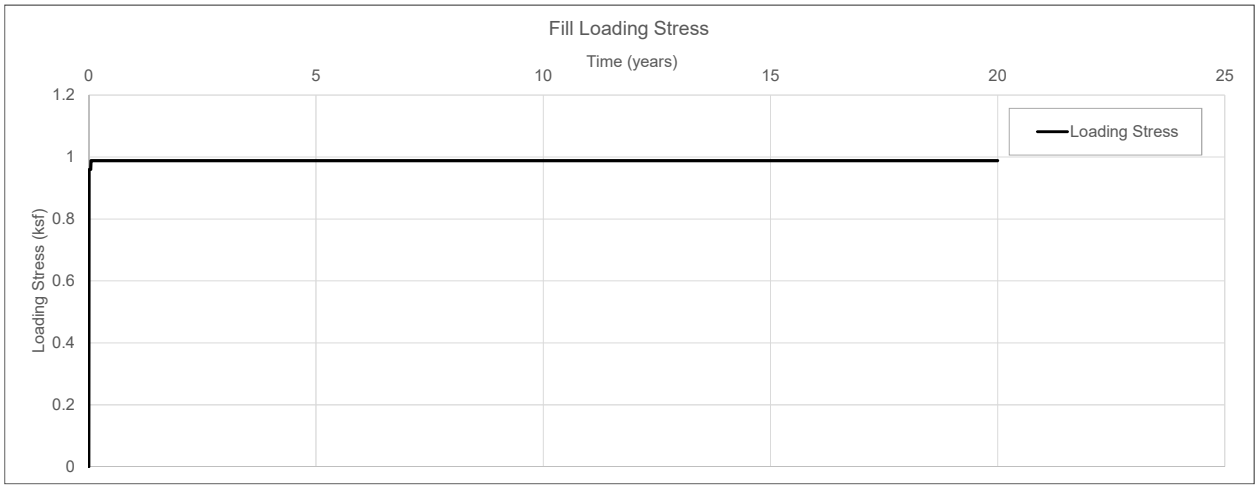
I-95 Bridge Replacement over Bagshaw Swamp

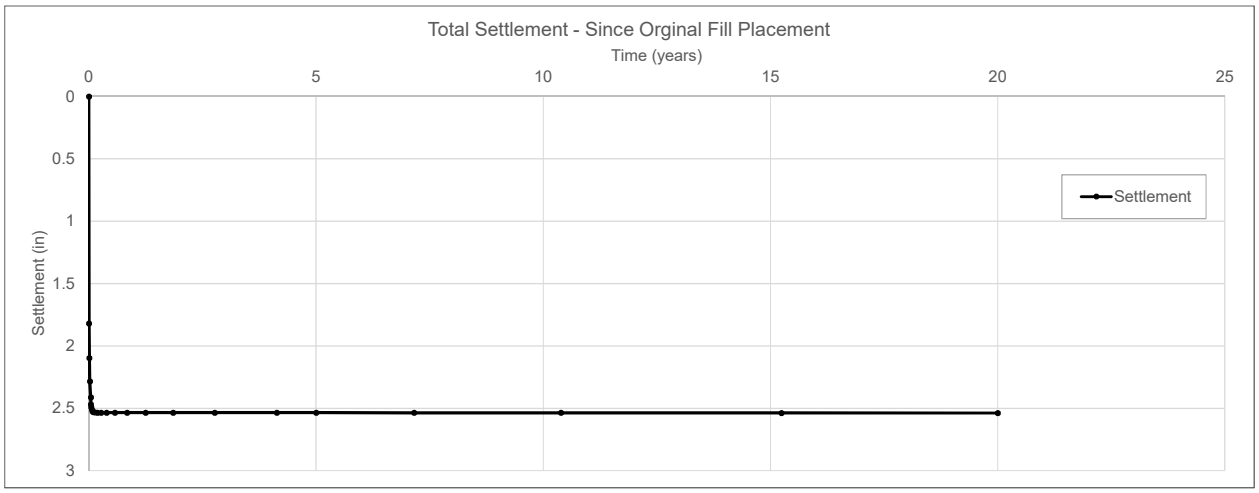
				Total			Post-Pavement		
Stage	Time (years)	Time (months)	Loading Stress (ksf)	Calculated Consolidation (in)	Calculated Secondary Settlement (in)	Calculated Total Settlement (in)	Calculated Consolidation (in)	Calculated Secondary Settlement (in)	Calculated Total Settlement (in)
3	0.00	0.00	0.00	0.00	0.00	0.0			
	0.00	0.06	0.96	1.32	0.00	1.8			
	0.01	0.14	0.96	1.60	0.00	2.1			
	0.02	0.27	0.96	1.79	0.00	2.3			
4	0.04	0.50	0.96	1.91	0.00	2.4	0.00	0.00	0.00
	0.05	0.56	0.99	1.94	0.00	2.5	0.03	0.00	0.06
	0.05	0.64	0.99	1.97	0.00	2.5	0.05	0.00	0.08
	0.06	0.77	0.99	1.98	0.00	2.5	0.07	0.00	0.10
	0.08	0.96	0.99	2.00	0.00	2.5	0.09	0.00	0.11
	0.10	1.24	0.99	2.01	0.00	2.5	0.09	0.00	0.12
	0.14	1.67	0.99	2.01	0.00	2.5	0.09	0.00	0.12
	0.19	2.31	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	0.27	3.27	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	0.39	4.71	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	0.57	6.87	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	0.84	10.12	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	1.25	14.98	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	1.86	22.28	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	2.77	33.23	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	4.14	49.65	0.99	2.01	0.00	2.5	0.10	0.00	0.12
5	5.00	60.00	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	7.16	85.87	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	10.39	124.68	0.99	2.01	0.00	2.5	0.10	0.00	0.12
	15.24	182.90	0.99	2.01	0.00	2.5	0.10	0.00	0.12
6	20.00	240.00	0.99	2.01	0.00	2.5	0.10	0.00	0.13

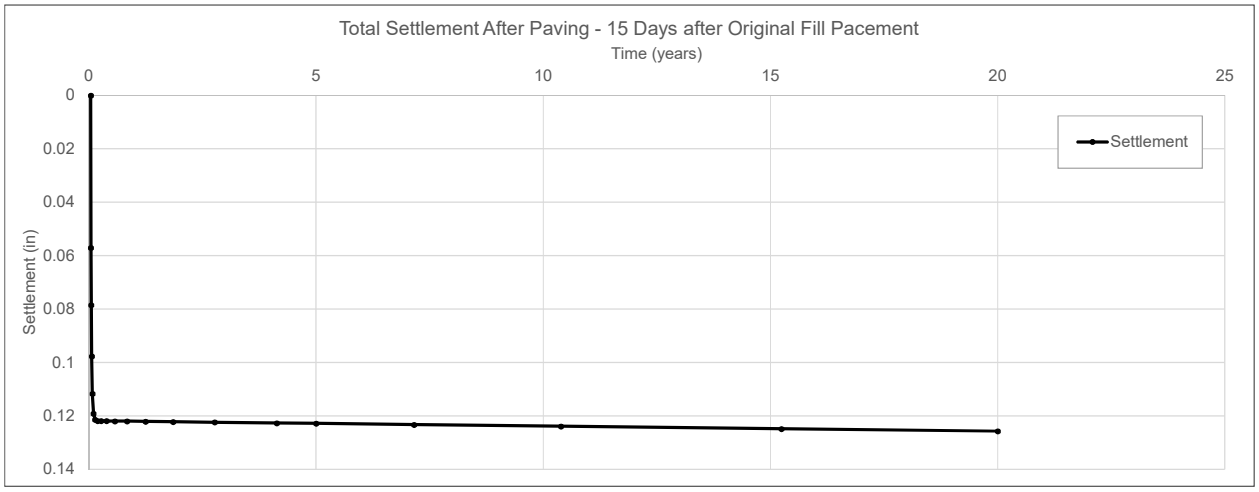
Construction Stage	Description	Time (years)	Time (months)	Time since Intervention (years)	Time since Intervention (months)
1	Placement of Existing Embankment	0	0		
2	Allow Sufficient Time (100 years): Reference Stage	100	1200		
3	Embankment Widening	100.0	1200	0	0
4	Pavement (15 Days After)	100.04	1200.5	0.04	0.5
5	Post-Construction 5 Years After	105	1260	5	60
6	Post-Construction 20 Years After	120	1440	20	240

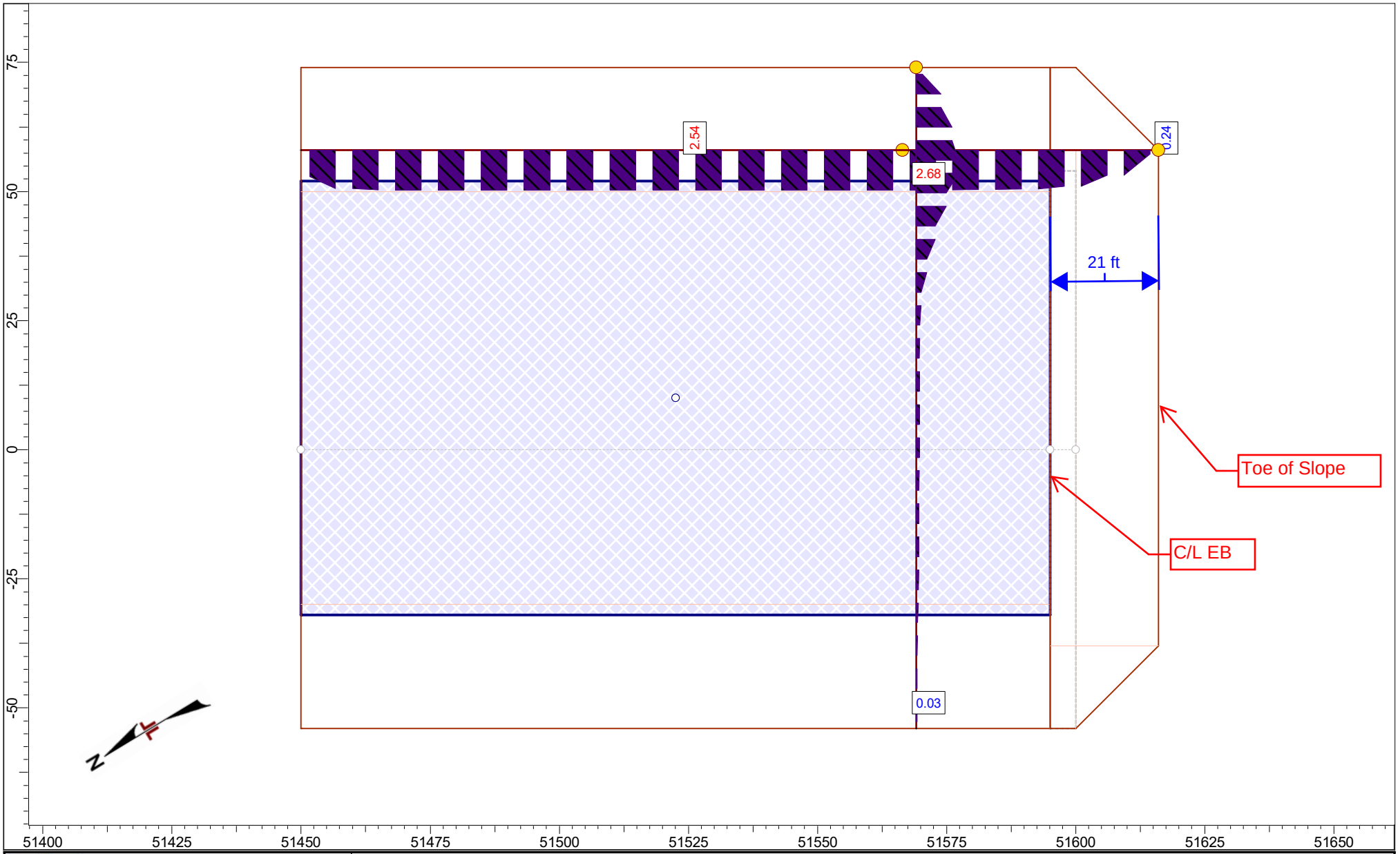
BEGIN BRIDGE SETTLEMENT ANALYSIS

I-95 Bridge Replacement over Bagshaw Swamp





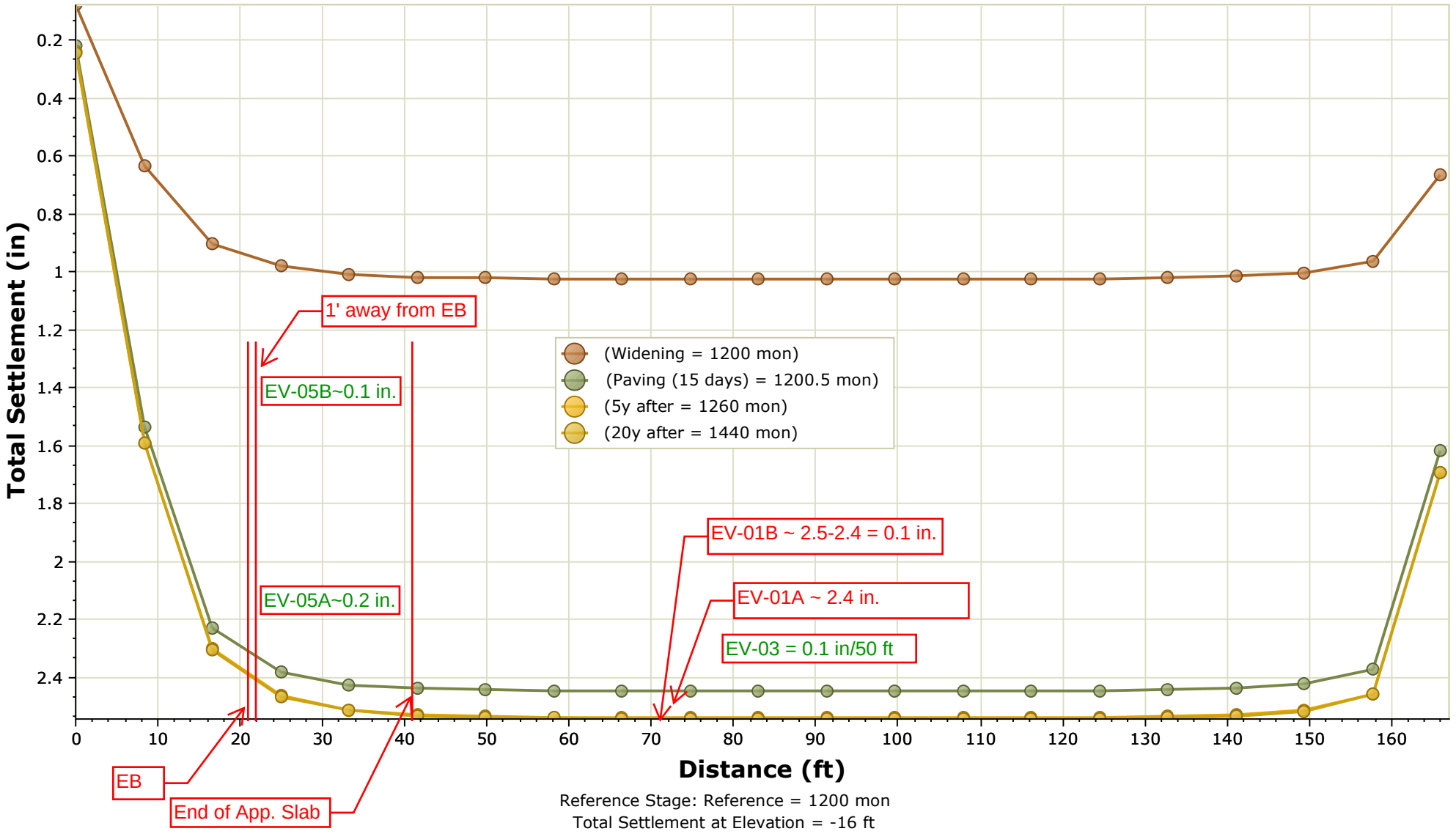




Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp Begin Bridge.s3z

SETTLE3 5.008

Distance vs. Total Settlement (Longitudinal)

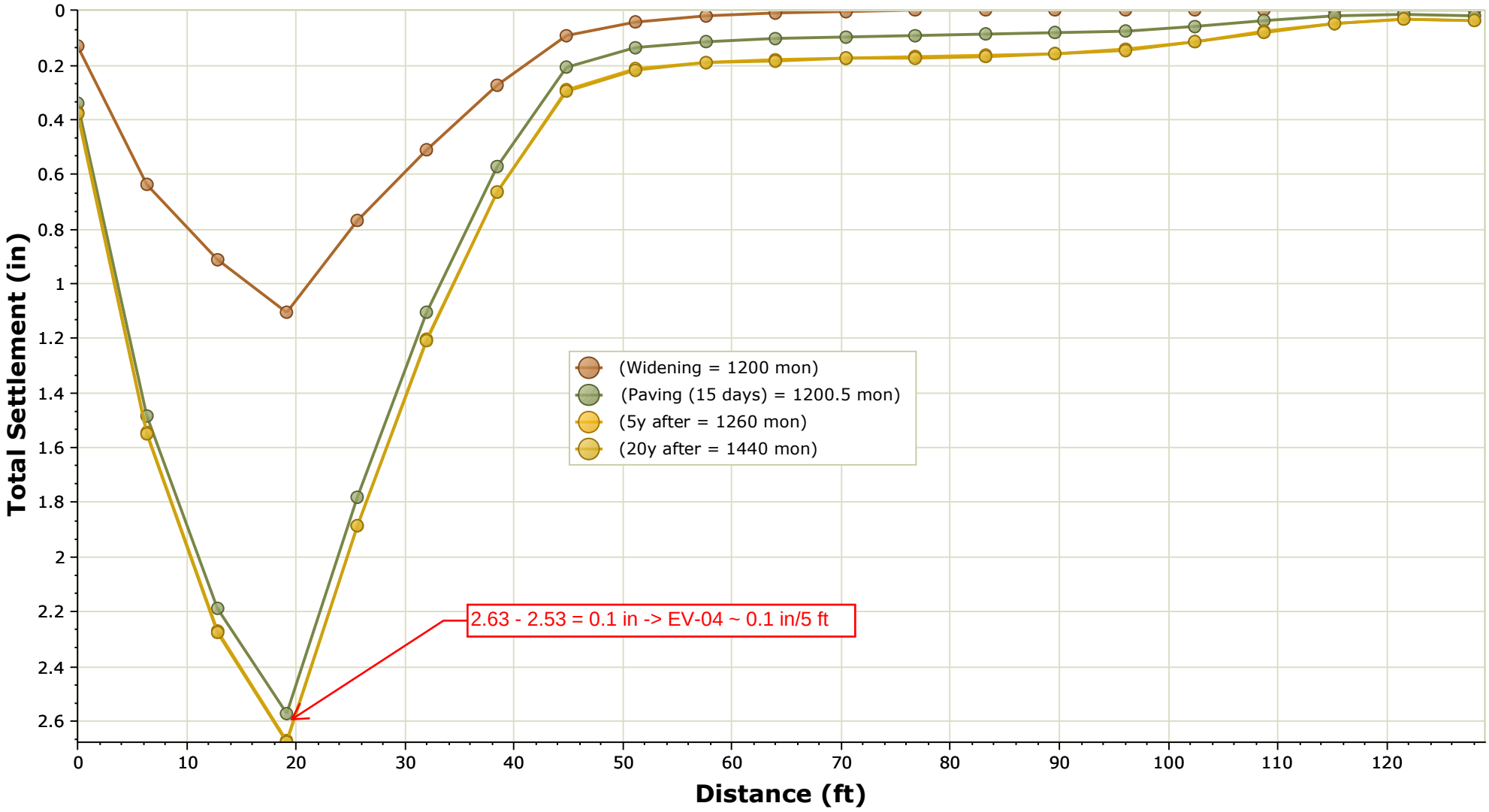


Reference Stage: Reference = 1200 mon
Total Settlement at Elevation = -16 ft

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	Company: Terracon
	Date	7/30/2021, 3:10:26 PM updated 10/5/2021	File Name: Bagshaw Swamp Begin Bridge-updated.s3z

SETTLE3 5.008

Distance vs. Total Settlement (Transverse)

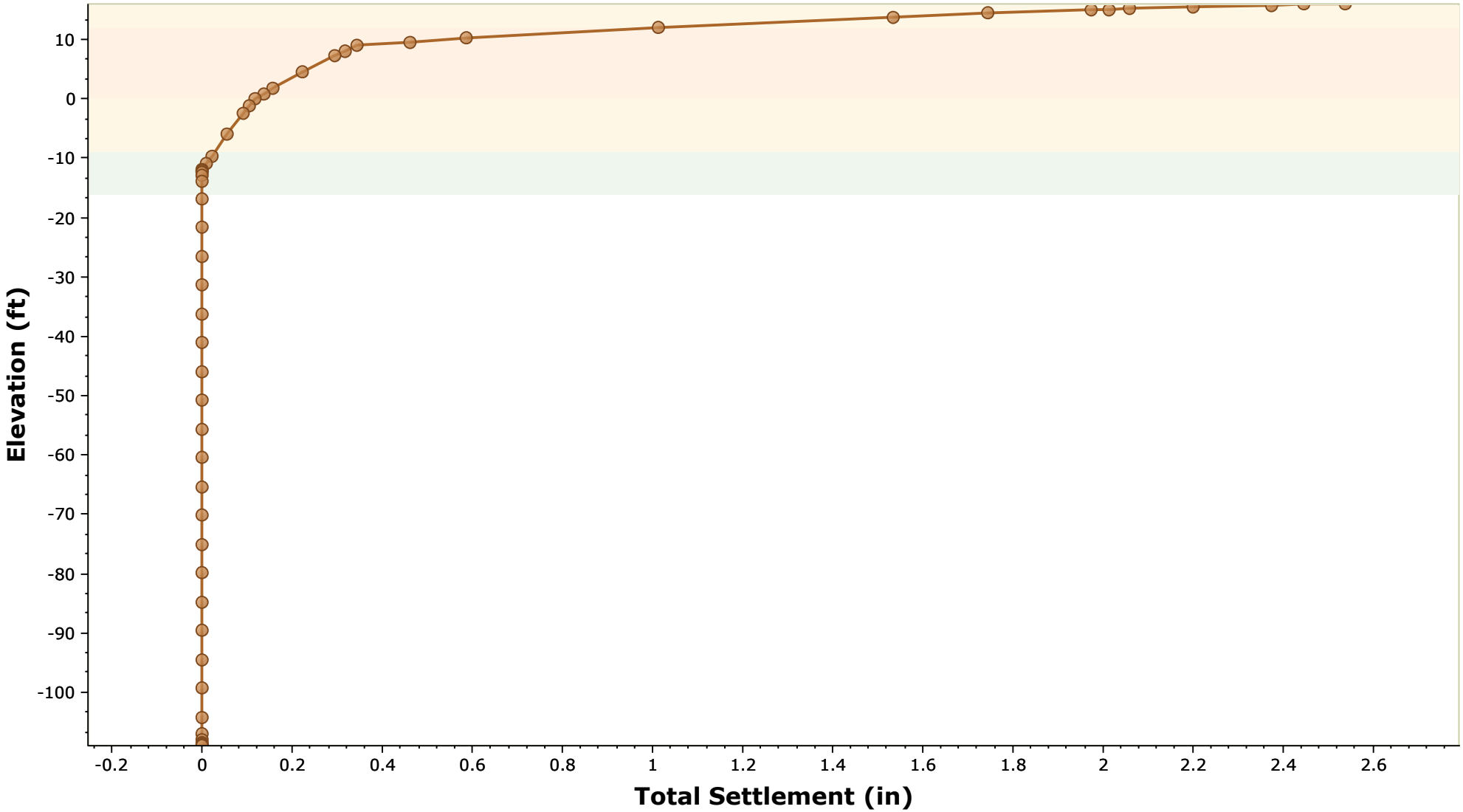


Reference Stage: Reference = 1200 mon
Total Settlement at Elevation = -16 ft

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	Company: Terracon
	Date	7/30/2021, 3:10:26 PM updated 10/5/2021	File Name: Bagshaw Swamp Begin Bridge-updated.s3z

SETTLE3 5.008

Total Settlement vs. Elevation

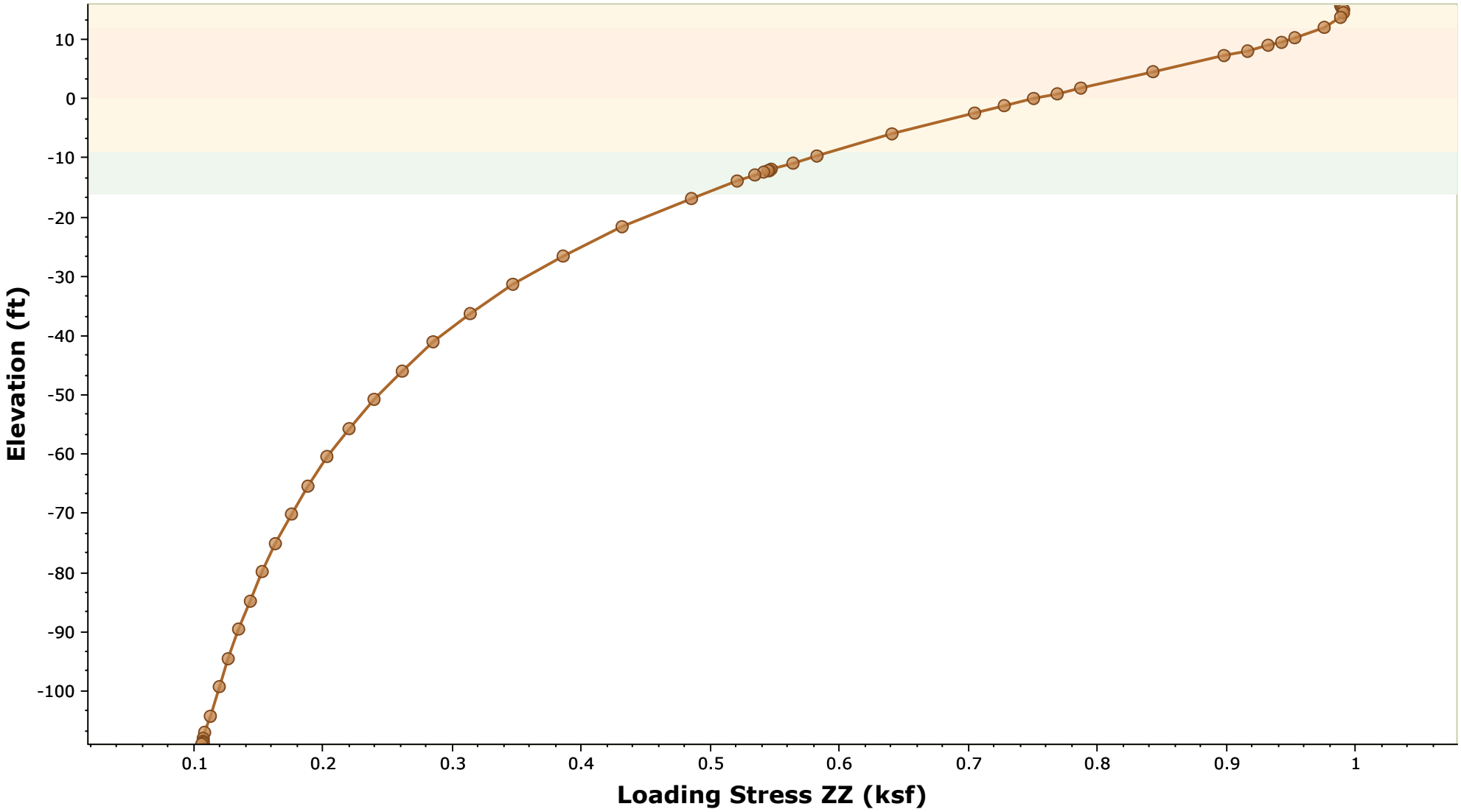


Reference Stage: Reference = 1200 mon

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	Company: Terracon
	Date	7/30/2021, 3:10:26 PM updated 10/5/2021	File Name: Bagshaw Swamp Begin Bridge-updated.s3z

SETTLE3 5.008

Loading Stress ZZ vs. Elevation



Reference Stage: Reference = 1200 mon

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - Begin Bridge	
	Drawn By	A.Fekrat	Company: Terracon
	Date	7/30/2021, 3:10:26 PM updated 10/5/2021	File Name: Bagshaw Swamp Begin Bridge-updated.s3z

SETTLE3 5.008

Settle3 Analysis Information
I-95 Bridge Replacement over Bagshaw Swamp

Project Settings

Document Name	Bagshaw Swamp Begin Bridge-updated.s3z
Project Title	I-95 Bridge Replacement over Bagshaw Swamp
Analysis	Settlement - Begin Bridge
Author	A.Fekrat
Company	Terracon
Date Created	7/30/2021, 3:10:26 PM updated 10/5/2021
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	months
Permeability Units	feet/year
Minimum settlement ratio for subgrade modulus	0.9

Use average properties to calculate layered stresses

Improve consolidation accuracy

Ignore negative effective stresses in settlement calculations

Stage Settings

Stage #	Name	Time [months]
1	Existing	0
2	Reference	1200
3	Widening	1200
4	Paving (15 days)	1200.5
5	5y after	1260
6	20y after	1440

Results

Time taken to compute: 0 seconds

Stage: Existing = 0 mon

Data Type	Minimum	Maximum
Total Settlement [in]	0	1.48392
Total Consolidation Settlement [in]	0	0.589232
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0.589232
Immediate Settlement [in]	0	0.895146
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-2.2111e-08	1.44992
Loading Stress XX [ksf]	-0.478973	1.65301
Loading Stress YY [ksf]	-0.608023	2.24478
Effective Stress ZZ [ksf]	-2.2111e-08	7.2524
Effective Stress XX [ksf]	-0.303275	8.69054
Effective Stress YY [ksf]	-0.257786	9.26664
Total Stress ZZ [ksf]	-2.2111e-08	15.3988
Total Stress XX [ksf]	-0.303275	16.7567

Total Stress YY [ksf]	-0.216285	17.413
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-2.2775e-08	0.082368
Pore Water Pressure [ksf]	0	8.14637
Excess Pore Water Pressure [ksf]	0	1.43999
Degree of Consolidation [%]	0	38.5524
Pre-consolidation Stress [ksf]	0.56894	7.24961
Over-consolidation Ratio	1	1072
Void Ratio	0	0.675
Permeability [ft/y]	0	74.3053
Coefficient of Consolidation [ft^2/y]	0	512
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-5.55112e-17	1.11022e-16

Stage: Reference = 1200 mon

Data Type	Minimum	Maximum
Total Settlement [in]	0	3.32495
Total Consolidation Settlement [in]	0	2.42981
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	2.42981
Immediate Settlement [in]	0	0.895146
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-2.2111e-08	1.44992
Loading Stress XX [ksf]	-0.478973	1.65301
Loading Stress YY [ksf]	-0.608023	2.24478
Effective Stress ZZ [ksf]	0	7.66117
Effective Stress XX [ksf]	-0.303275	9.01907
Effective Stress YY [ksf]	-0.216285	9.67541
Total Stress ZZ [ksf]	0	15.3988
Total Stress XX [ksf]	-0.303275	16.7567
Total Stress YY [ksf]	-0.216285	17.413
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0.082368
Pore Water Pressure [ksf]	0	7.7376
Excess Pore Water Pressure [ksf]	-1.46011e-24	1.27791e-24
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.569349	7.6586
Over-consolidation Ratio	1	1072
Void Ratio	0	0.675
Permeability [ft/y]	0	74.3053
Coefficient of Consolidation [ft^2/y]	0	512
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0.151876

Stage: Widening = 1200 mon

Data Type	Minimum	Maximum
Total Settlement [in]	0	3.33443
Total Consolidation Settlement [in]	0	2.42981
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	2.42981
Immediate Settlement [in]	0	0.904858
Secondary Settlement [in]	0	0

Loading Stress ZZ [ksf]	-1.19703e-10	1.44
Loading Stress XX [ksf]	-0.452221	1.43068
Loading Stress YY [ksf]	-0.640578	2.17536
Effective Stress ZZ [ksf]	-1.18837e-10	7.66117
Effective Stress XX [ksf]	-0.299002	8.81116
Effective Stress YY [ksf]	-0.273553	9.68412
Total Stress ZZ [ksf]	-1.18837e-10	15.4701
Total Stress XX [ksf]	-0.299002	16.5918
Total Stress YY [ksf]	-0.237356	17.4964
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0.0822474
Pore Water Pressure [ksf]	-0.359485	7.83508
Excess Pore Water Pressure [ksf]	-0.359485	1.19731
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.569349	7.6586
Over-consolidation Ratio	1	1072
Void Ratio	0	0.675
Permeability [ft/y]	0	74.3053
Coefficient of Consolidation [ft^2/y]	0	512
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0.151876

Stage: Paving (15 days) = 1200.5 mon

Data Type	Minimum	Maximum
Total Settlement [in]	0	3.43286
Total Consolidation Settlement [in]	0	2.4448
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	2.4448
Immediate Settlement [in]	0	0.988049
Secondary Settlement [in]	0	0.0198287
Loading Stress ZZ [ksf]	8.46012e-05	1.57889
Loading Stress XX [ksf]	-0.443034	1.44228
Loading Stress YY [ksf]	-0.628191	2.17864
Effective Stress ZZ [ksf]	8.46012e-05	7.73228
Effective Stress XX [ksf]	-0.281782	8.84078
Effective Stress YY [ksf]	-0.229044	9.75801
Total Stress ZZ [ksf]	8.46012e-05	15.5035
Total Stress XX [ksf]	-0.281782	16.619
Total Stress YY [ksf]	-0.229044	17.5293
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0.812684
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	2.92123
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	1.47417
Total Strain	0	0.0838873
Pore Water Pressure [ksf]	0	7.92794
Excess Pore Water Pressure [ksf]	-0.0307002	0.237149
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.569951	7.88375
Over-consolidation Ratio	1	1057.5
Void Ratio	0	0.674998
Permeability [ft/y]	0	74.3053
Coefficient of Consolidation [ft^2/y]	0	512
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0.152011

Stage: 5y after = 1260 mon

Data Type	Minimum	Maximum
Total Settlement [in]	0	3.51322
Total Consolidation Settlement [in]	0	2.52413
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	2.52413
Immediate Settlement [in]	0	0.988049
Secondary Settlement [in]	0	0.0208511
Loading Stress ZZ [ksf]	8.46012e-05	1.57889
Loading Stress XX [ksf]	-0.443034	1.44228
Loading Stress YY [ksf]	-0.628191	2.17864
Effective Stress ZZ [ksf]	8.46012e-05	7.76594
Effective Stress XX [ksf]	-0.281782	8.88145
Effective Stress YY [ksf]	-0.229044	9.79167
Total Stress ZZ [ksf]	8.46012e-05	15.5035
Total Stress XX [ksf]	-0.281782	16.619
Total Stress YY [ksf]	-0.229044	17.5293
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0.645818
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	2.92123
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0.932667
Total Strain	0	0.0839003
Pore Water Pressure [ksf]	0	7.7376
Excess Pore Water Pressure [ksf]	-2.36727e-25	3.05587e-25
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.570368	7.88375
Over-consolidation Ratio	1	1057.5
Void Ratio	0	0.674979
Permeability [ft/y]	0	74.3053
Coefficient of Consolidation [ft^2/y]	0	512
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0.16087

Stage: 20y after = 1440 mon

Data Type	Minimum	Maximum
Total Settlement [in]	0	3.51607
Total Consolidation Settlement [in]	0	2.52413
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	2.52413
Immediate Settlement [in]	0	0.988049
Secondary Settlement [in]	0	0.0236735
Loading Stress ZZ [ksf]	8.46012e-05	1.57889
Loading Stress XX [ksf]	-0.443034	1.44228
Loading Stress YY [ksf]	-0.628191	2.17864
Effective Stress ZZ [ksf]	8.46012e-05	7.76594
Effective Stress XX [ksf]	-0.281782	8.88145
Effective Stress YY [ksf]	-0.229044	9.79167
Total Stress ZZ [ksf]	8.46012e-05	15.5035
Total Stress XX [ksf]	-0.281782	16.619
Total Stress YY [ksf]	-0.229044	17.5293
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0.640541
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	2.92123
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0.932667
Total Strain	0	0.0839361
Pore Water Pressure [ksf]	0	7.7376
Excess Pore Water Pressure [ksf]	-2.16066e-25	1.67378e-25
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.570368	7.88375

Over-consolidation Ratio	1	1057.5
Void Ratio	0	0.674979
Permeability [ft/y]	0	74.3053
Coefficient of Consolidation [ft^2/y]	0	512
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0.16087

Loads

1. Rectangular Load: "Rectangular Load 1"

Length	145 ft
Width	84 ft
Rotation angle	0 degrees
Load Type	Flexible
Area of Load	12180 ft^2
Load	0.14 ksf

Advanced Staging

Stage	Load Factor	Depth [ft]
Existing = 0 mon	0	-27
Reference = 1200 mon	0	-27
Widening = 1200 mon	0	-27
Paving (15 days) = 1200.5 mon	1	-27
5y after = 1260 mon	1	-27
20y after = 1440 mon	1	-27

Coordinates

X [ft]	Y [ft]
51450	-32
51595	-32
51595	52
51450	52

Embankments

1. Embankment: "Embankment Load 1"

Label	Embankment Load 1
Center Line	(51450, 0) to (51595, 0)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	1
Base Width	108

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	Existing = 0 mon	0	26.5651	12	0.12	26.5651	0

2. Embankment: "Embankment Load 2"

Label	Embankment Load 2
Center Line	(51595, 0) to (51600, 0)

Near End Angle	90 degrees
Far End Angle	26.565 degrees
Number of Layers	1
Base Width	108

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	Existing = 0 mon	0	26.5651	11	0.12	26.5651	0

3. Embankment: "Embankment Load 4"

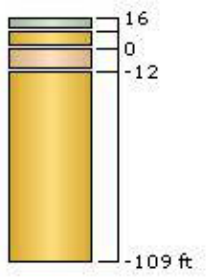
Label	Embankment Load 4
Center Line	(51595, 0) to (51600, 0)
Near End Angle	90 degrees
Far End Angle	26.565 degrees
Number of Layers	1
Base Width	108

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	Widening = 1200 mon	0	26.5651	8	0.12	26.5651	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	Sandy Clay	7	-16	No
2	Very loose Sand	9	-9	No
3	Medium Dense Sand	12	0	No
4	Hard Sandy Silt	97	12	No



Soil Properties

Property	Sandy Clay	Medium Dense Sand	Hard Sandy Silt	Very loose Sand
Color				
Unit Weight [kips/ft^3]	0.125	0.12	0.115	0.1
Saturated Unit Weight [kips/ft^3]	0.13	0.125	0.12	0.105
K0	1	0.41	1	0.53
Immediate Settlement	Enabled	Enabled	Disabled	Enabled
Es [ksf]	450	800	-	400
Esur [ksf]	450	800	-	400
Primary Consolidation	Enabled	Disabled	Disabled	Disabled
Material Type	Non-Linear			

Cc	0.373	-	-	-
Cr	0.056	-	-	-
e0	0.675	-	-	-
Pc [ksf]	6.7	-	-	-
Cv [ft^2/y]	131	-	-	-
Cvr [ft^2/y]	512	-	-	-
B-bar	1	-	-	-
Secondary Consolidation	Mesri	Disabled	Disabled	Disabled
Ca/Cc	0.017	-	-	-
Undrained Su A [kips/ft2]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1

Groundwater

Groundwater method Piezometric Lines
Water Unit Weight 0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	-15 ft

Query Points

Point #	Query Point Name	(X,Y) Location	Number of Divisions
1	Maximum Response	51566.4, 58	Auto: 55

Query Lines

Line #	Query Line Name	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	Longitudinal	51616, 58	51450, 58	20	Auto: 55
2	Transverse	51569.1, 74	51569.1, -54	20	Auto: 55

Field Point Grid

Number of points 138
Expansion Factor 2

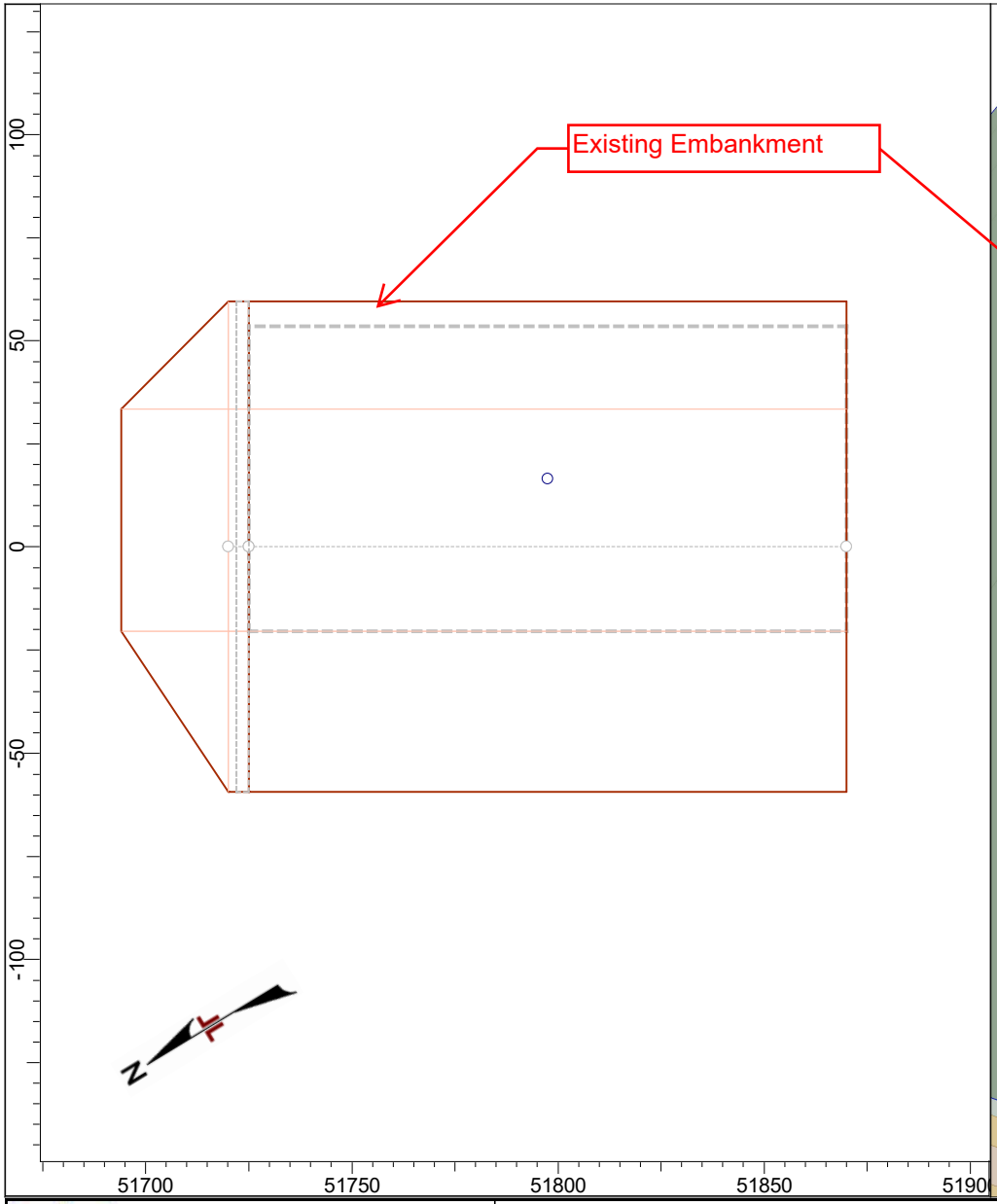
Grid Coordinates

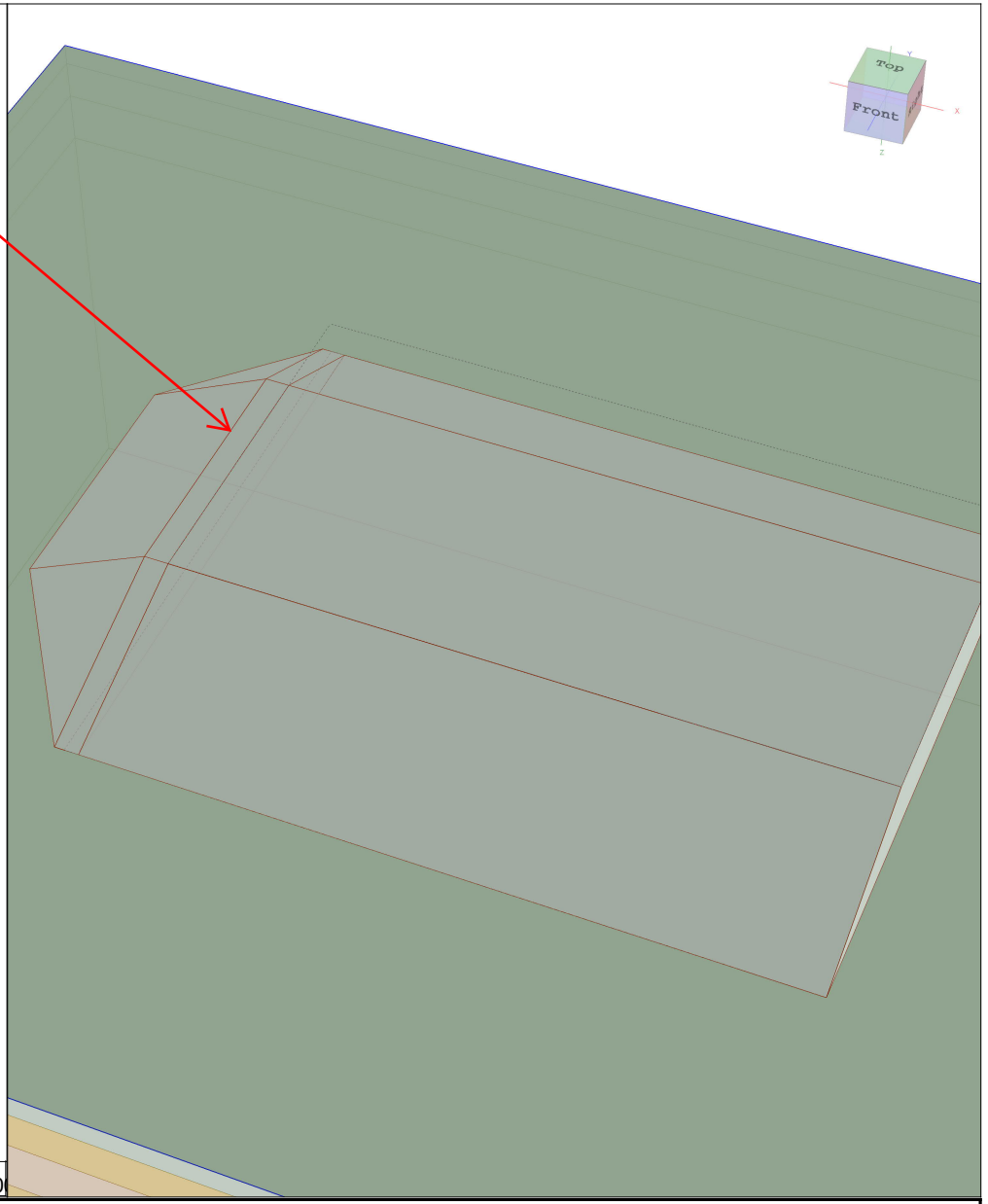
X [ft]	Y [ft]
51694.5	126.5
51694.5	-126.5
51377.5	-126.5
51377.5	126.5

SETTLEMENT ANALYSIS AT END BRIDGE

Settlement Analysis Methodology

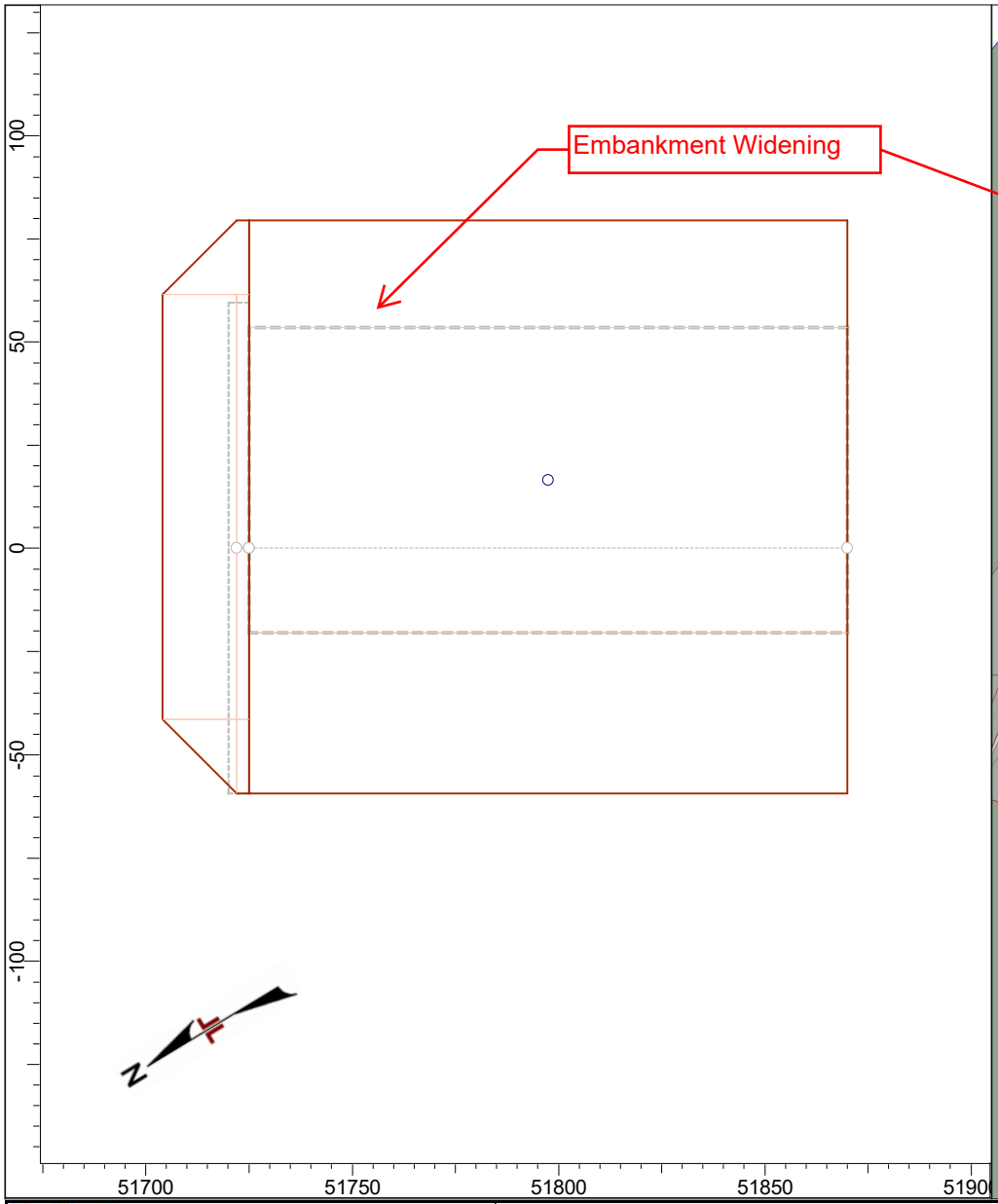
Analysis Methodology	
Analysis Type	Embankment Settlement
Project Name	I-95 Bridge Replacement over Bagshaw Swamp
Location	Jasper County
SCDOT Project ID	P030260
Location of Analysis	End Bridge Approach Embankment
Geometry	Bridge plans and profiles and roadway cross sections dated 6/3/2021
Soil Profile	See Exhibit C-3 for soil profile and parameters.
Settlement Analysis Method	Settlement analysis was performed using Settle3 Version 5.008. Since the soil profile is comprised of sand-like and clay-like strata, settlement was analyzed following guidelines for immediate settlement, primary consolidation and secondary consolidation from SCDOT GDM Section 17.8 to Section 17.10. Compressibility of the hard sandy silt layer has been neglected in the analysis because of age it being overconsolidated. Soil profile and parameters can be found in Exhibit C-3. For settlement analysis, soil strata begin at the Alluvium from Elevation 16 ft. Above Elevation 16 ft, the existing and new embankments have been placed as embankment loads of unit weight 120 pcf.
Design Notes	• Stress increase from 14 ft of fill is 0.9 ksf • Settlements essentially complete in about 4 months after widening. Settlements after that is in the order of less than an inch.

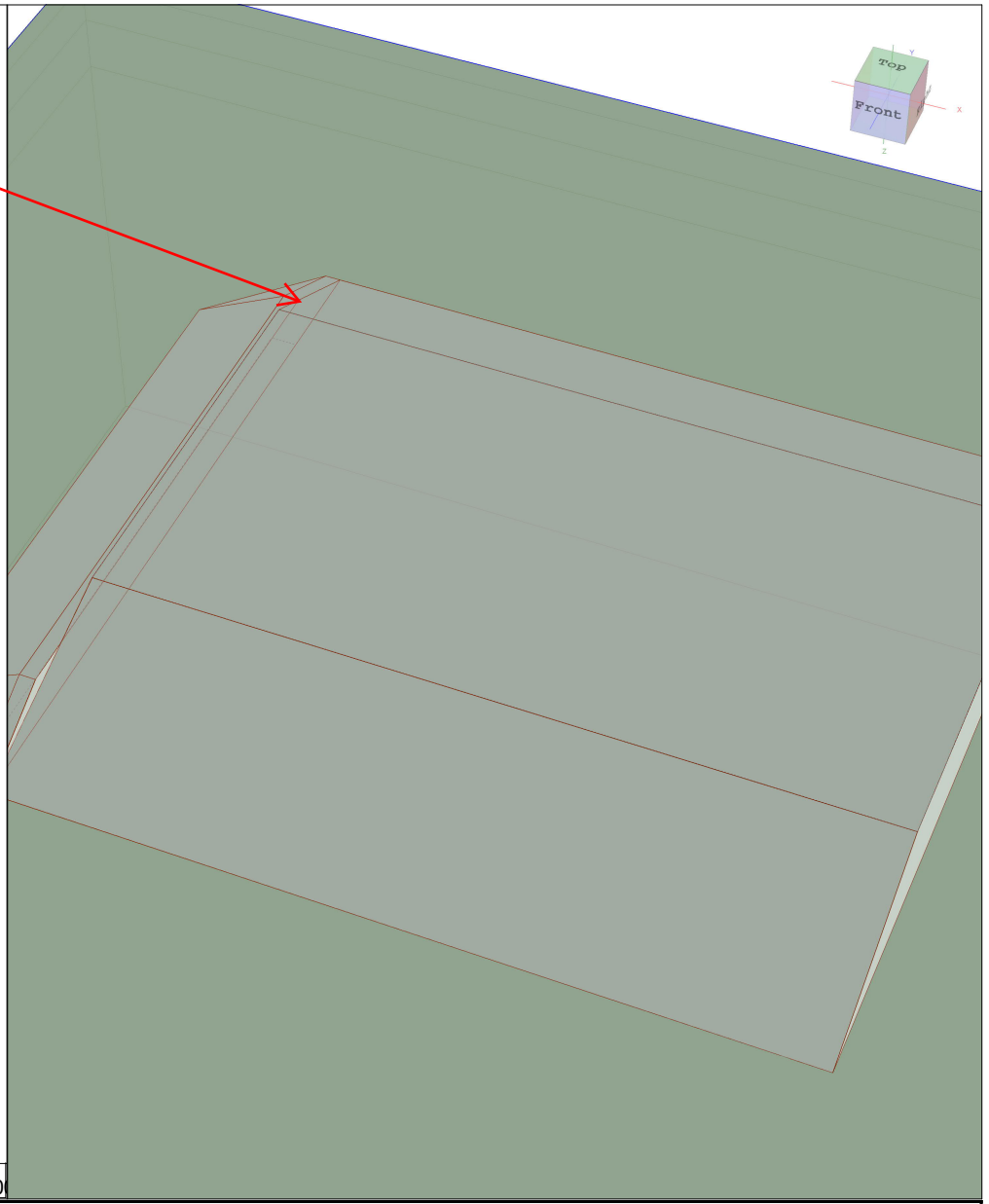




Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp End Bridge.s3z

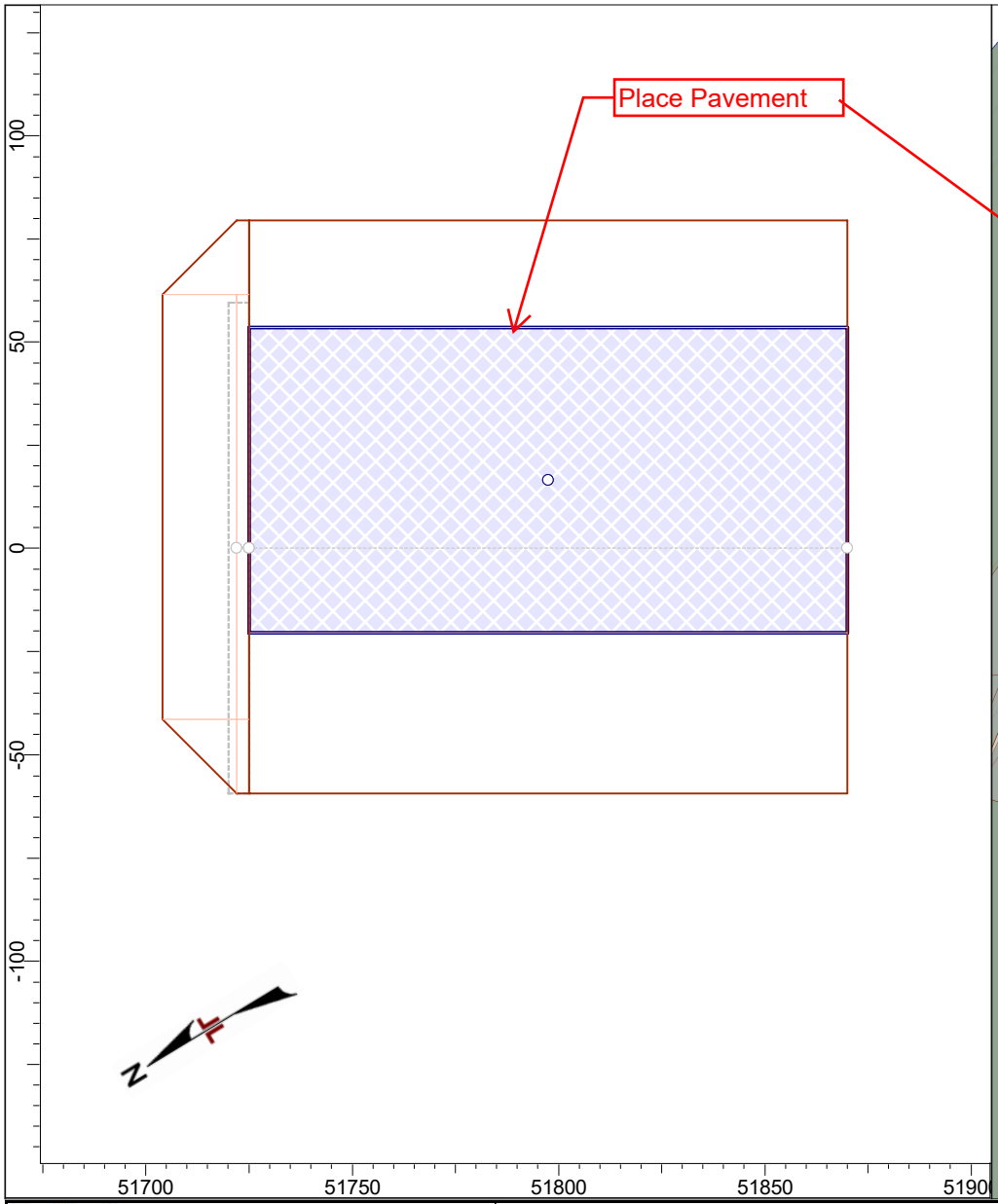
SETTLE3 5.008

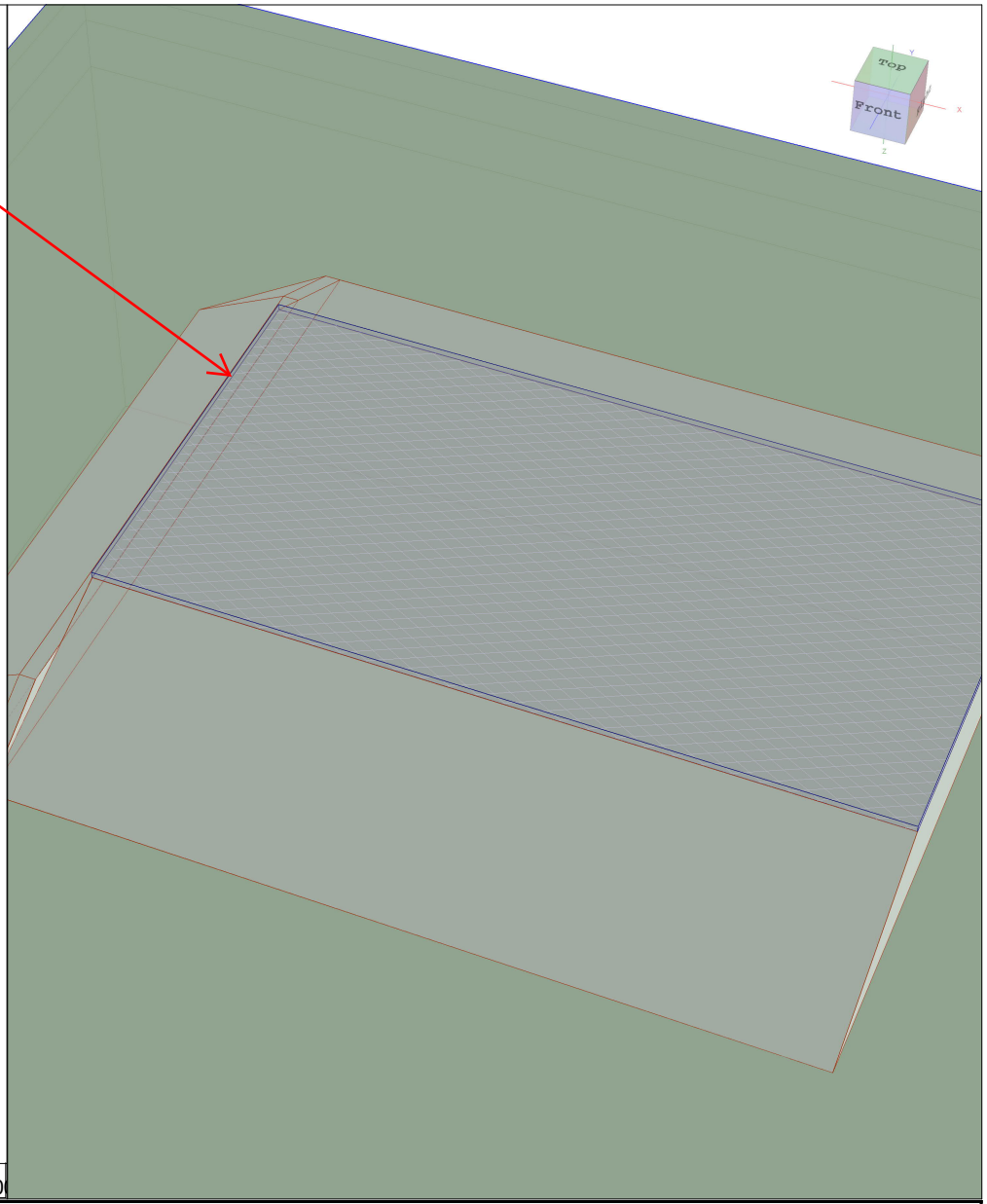




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	Drawn By	A.Fekrat	*Company* Terracon
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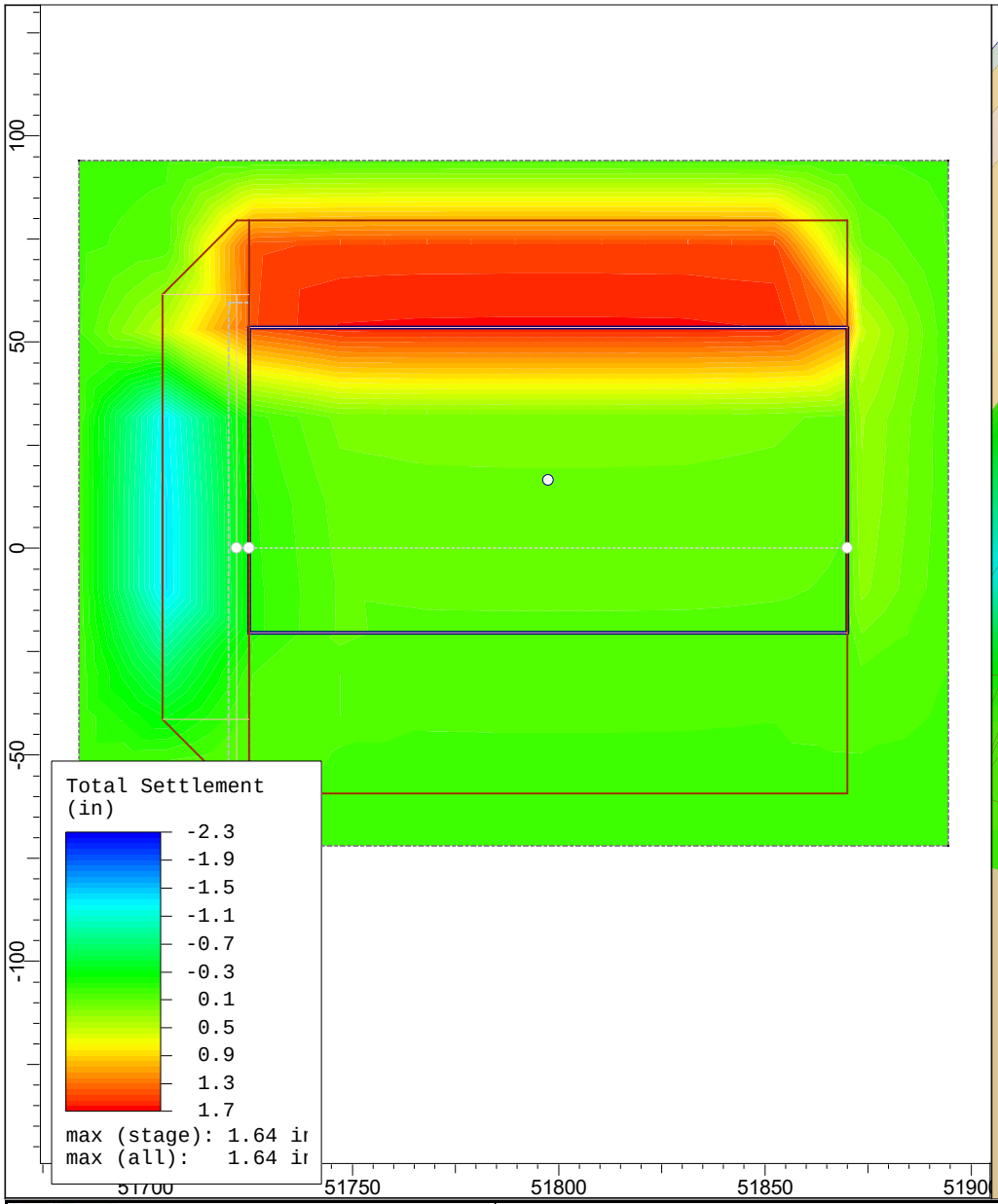
SETTLE3 5.008

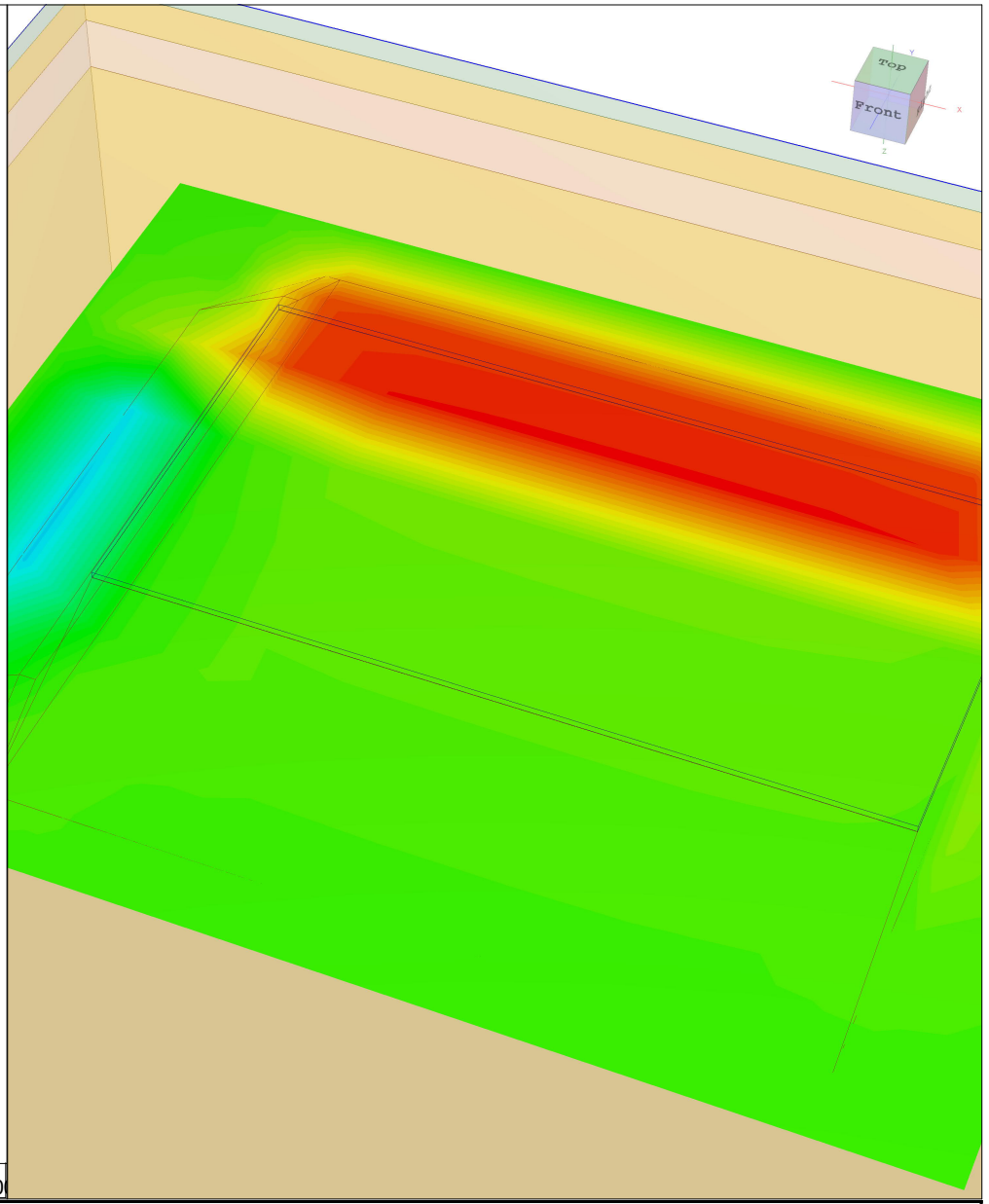




Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp End Bridge.s3z

SETTLE3 5.008





Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By A.Fekrat	*Company*	Terracon
	Date 7/30/2021, 3:10:26 PM	*File Name*	Bagshaw Swamp End Bridge.s3z

SETTLE3 5.008

END BRIDGE SETTLEMENT ANALYSIS

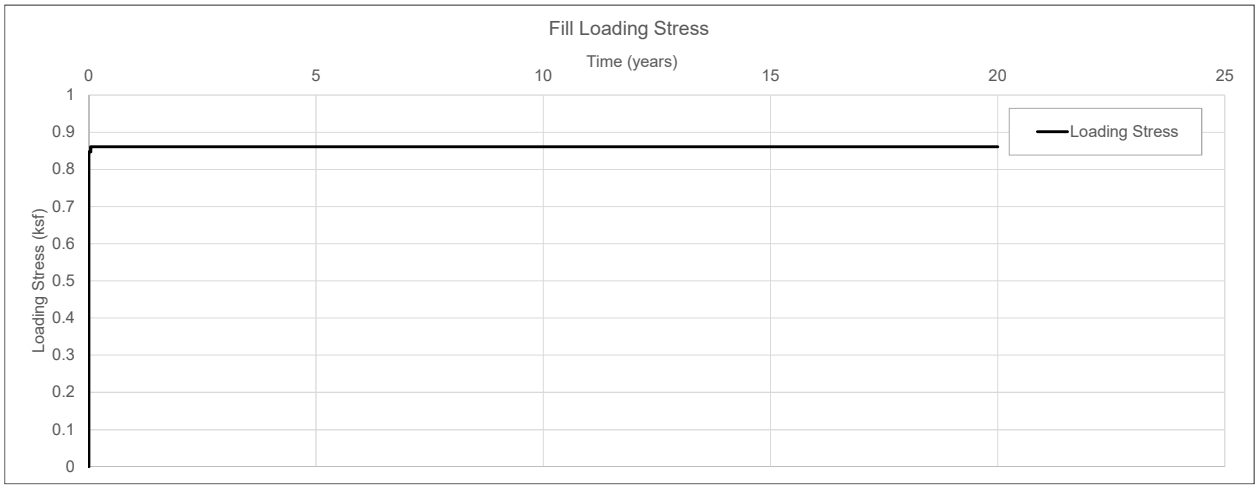
I-95 Bridge Replacement over Bagshaw Swamp

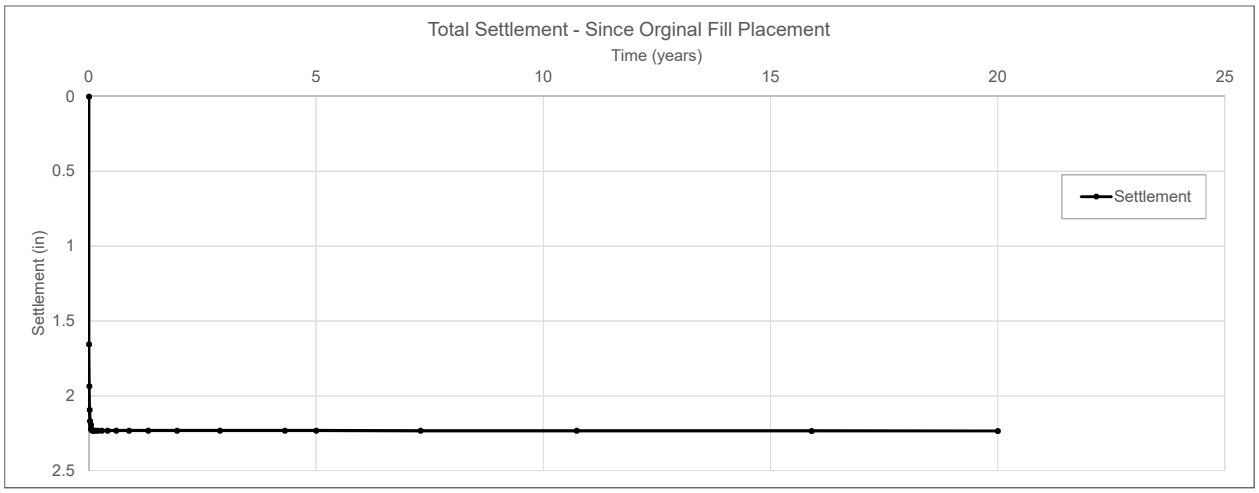
				Total			Post-Pavement		
Stage	Time (years)	Time (months)	Loading Stress (ksf)	Calculated Consolidation (in)	Calculated Secondary Settlement (in)	Calculated Total Settlement (in)	Calculated Consolidation (in)	Calculated Secondary Settlement (in)	Calculated Total Settlement (in)
3	0.00	0.00	0.00	0.00	0.00	0.0			
	0.00	0.04	0.85	1.22	0.00	1.7			
	0.01	0.10	0.85	1.51	0.00	1.9			
	0.02	0.19	0.85	1.66	0.00	2.1			
	0.03	0.32	0.85	1.74	0.00	2.2			
4	0.04	0.50	0.85	1.76	0.00	2.2	0.00	0.00	0.00
	0.05	0.54	0.86	1.77	0.00	2.2	0.01	0.00	0.02
	0.05	0.60	0.86	1.78	0.00	2.2	0.01	0.00	0.03
	0.06	0.69	0.86	1.78	0.00	2.2	0.02	0.00	0.03
	0.07	0.82	0.86	1.78	0.00	2.2	0.02	0.00	0.04
	0.08	1.02	0.86	1.78	0.00	2.2	0.02	0.00	0.04
	0.11	1.31	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	0.15	1.76	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	0.20	2.42	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	0.29	3.43	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	0.41	4.93	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	0.60	7.18	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	0.88	10.56	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	1.30	15.63	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	1.94	23.23	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	2.89	34.63	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	4.31	51.74	0.86	1.79	0.00	2.2	0.02	0.00	0.04
5	5.00	60.00	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	7.30	87.54	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	10.74	128.85	0.86	1.79	0.00	2.2	0.02	0.00	0.04
	15.90	190.82	0.86	1.79	0.00	2.2	0.02	0.00	0.04
6	20.00	240.00	0.86	1.79	0.00	2.2	0.02	0.00	0.04

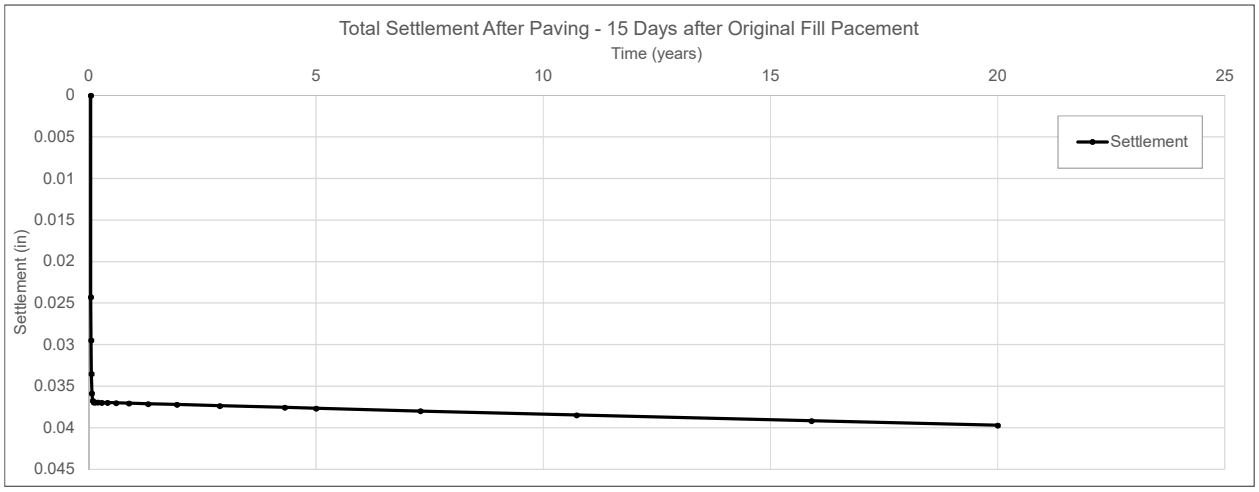
Construction Stage	Description	Time (years)	Time (months)	Time since Intervention (years)	Time since Intervention (months)
1	Placement of Existing Embankment	0	0		
2	Allow Sufficient Time (100 years): Reference Stage	100	1200		
3	Embankment Widening	100.0	1200	0	0
4	Pavement (15 Days After)	100.04	1200.5	0.04	0.5
5	Post-Construction 5 Years After	105	1260	5	60
6	Post-Construction 20 Years After	120	1440	20	240

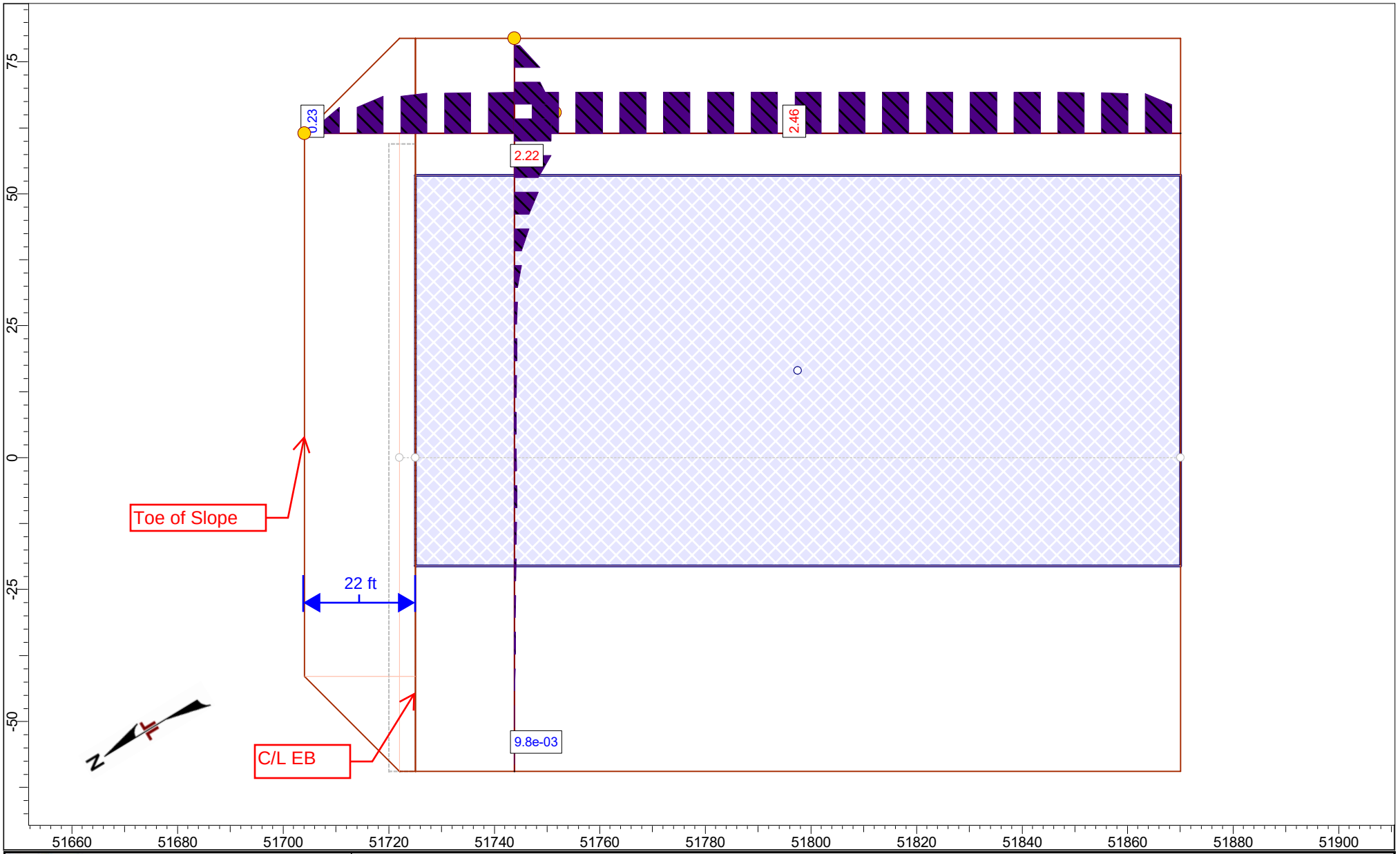
END BRIDGE SETTLEMENT ANALYSIS

I-95 Bridge Replacement over Bagshaw Swamp





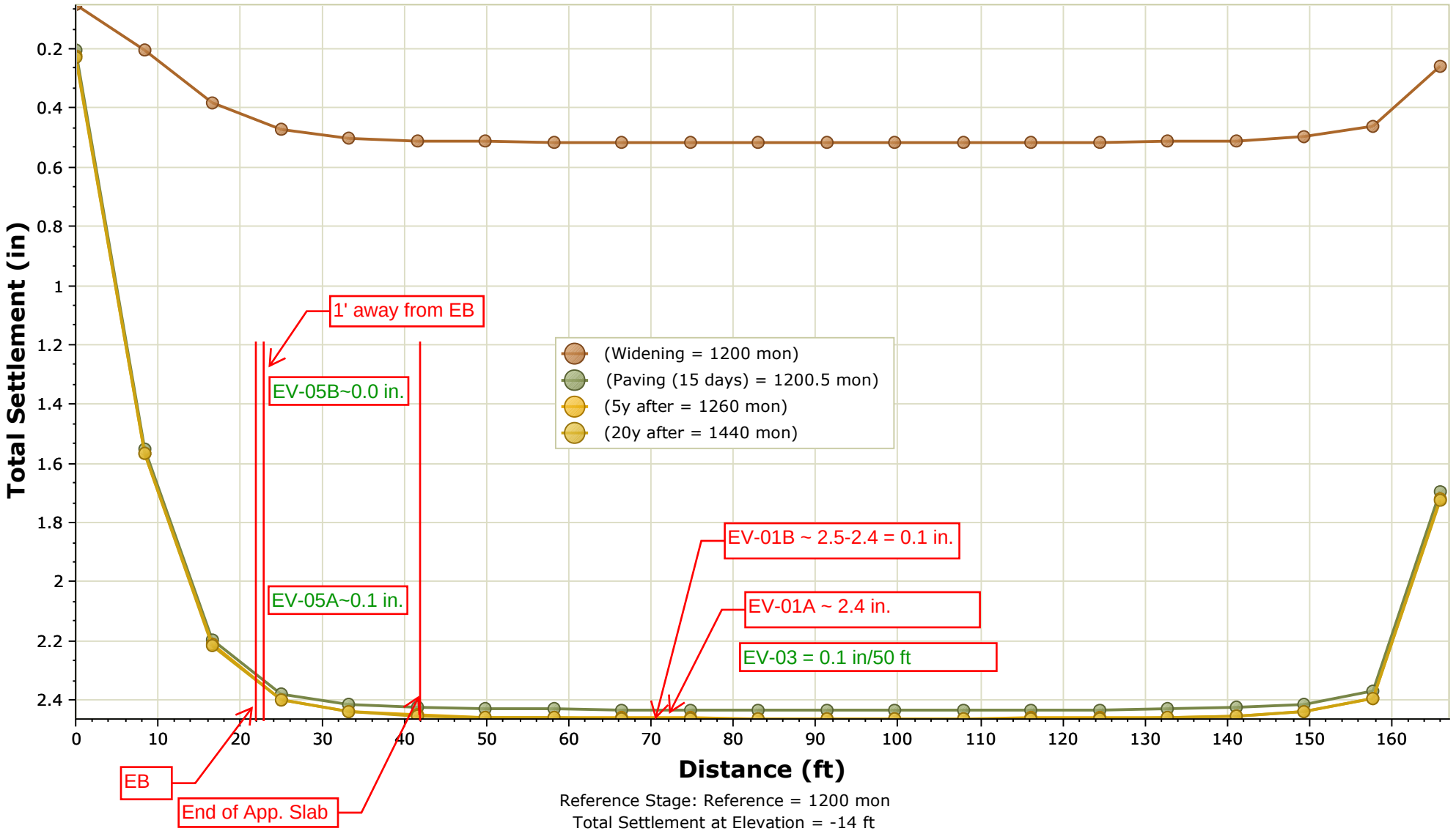




Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By	A.Fekrat	*Company* Terracon
	Date	7/30/2021, 3:10:26 PM	*File Name* Bagshaw Swamp End Bridge.s3z

SETTLE3 5.008

Distance vs. Total Settlement (Longitudinal)

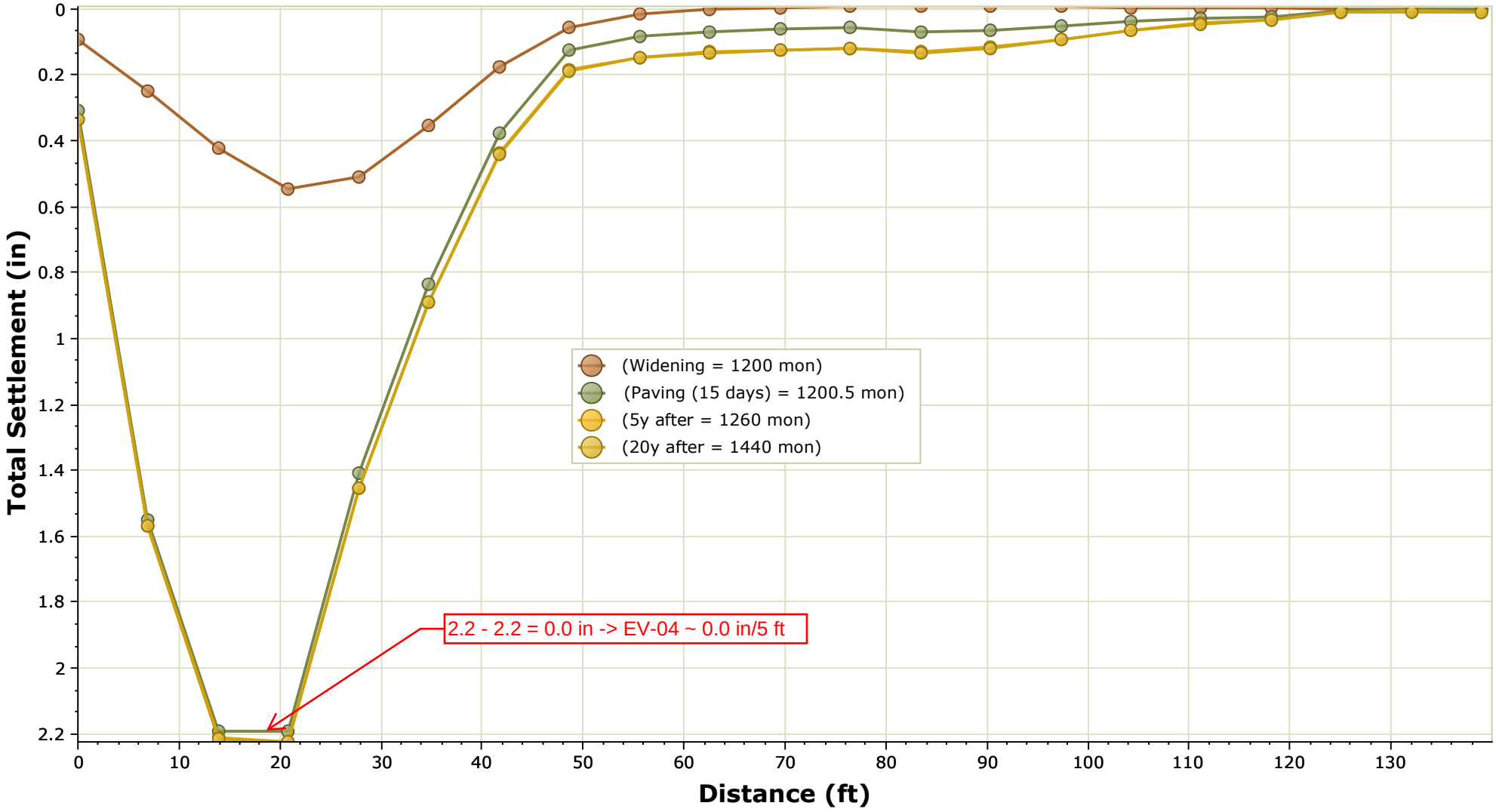


Reference Stage: Reference = 1200 mon
Total Settlement at Elevation = -14 ft

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By	A.Fekrat	Company: Terracon
	Date	7/30/2021, 3:10:26 PM, updated 10/5/2021	File Name: Bagshaw Swamp End Bridge-updated.s3z

SETTLE3 5.008

Distance vs. Total Settlement (Transverse)

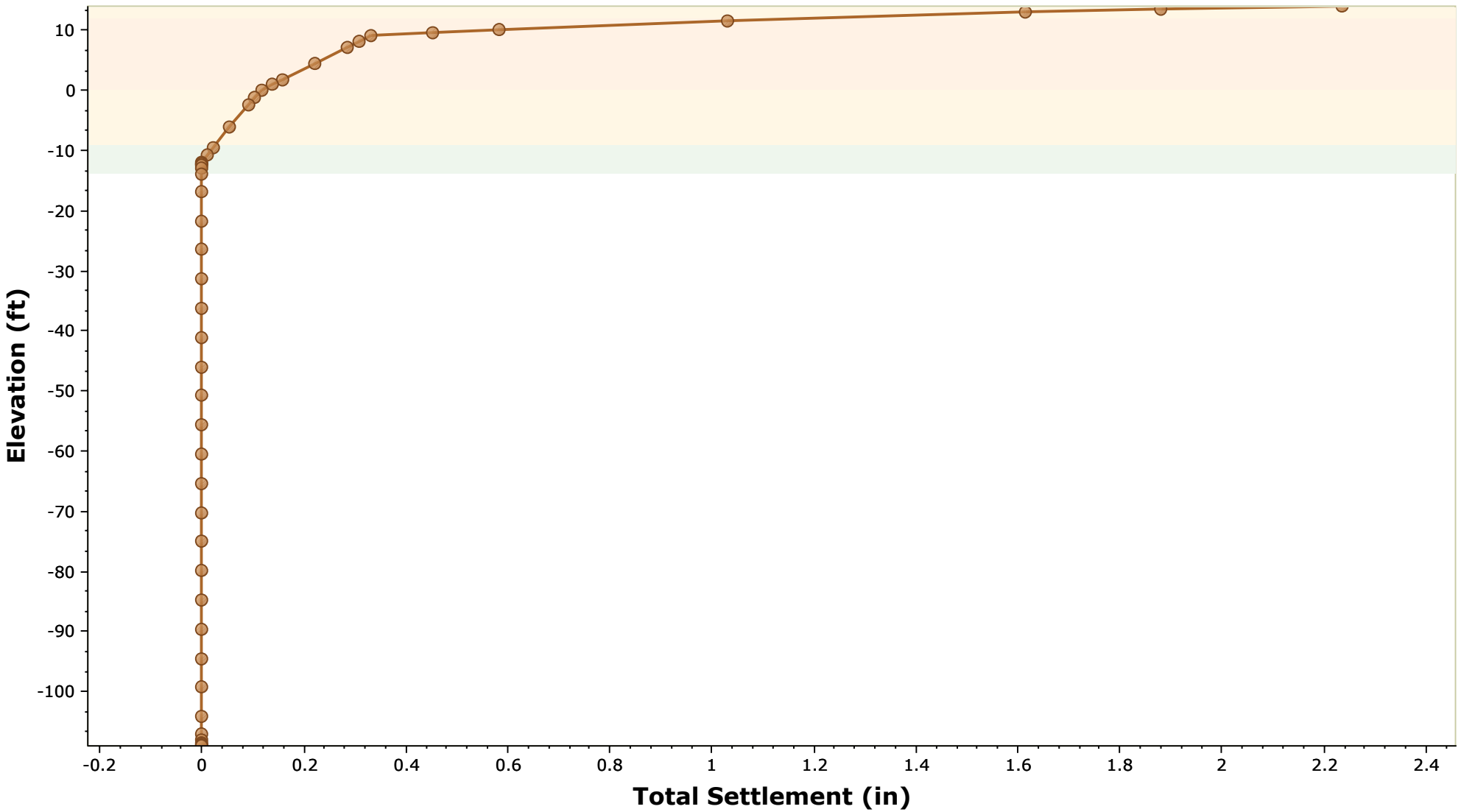


Reference Stage: Reference = 1200 mon
Total Settlement at Elevation = -14 ft

Terracon	*Project*	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By A.Fekrat	*Company*	Terracon
	Date 7/30/2021, 3:10:26 PM, updated 10/5/2021	*File Name*	Bagshaw Swamp End Bridge-updated.s3z

SETTLE3 5.008

Total Settlement vs. Elevation

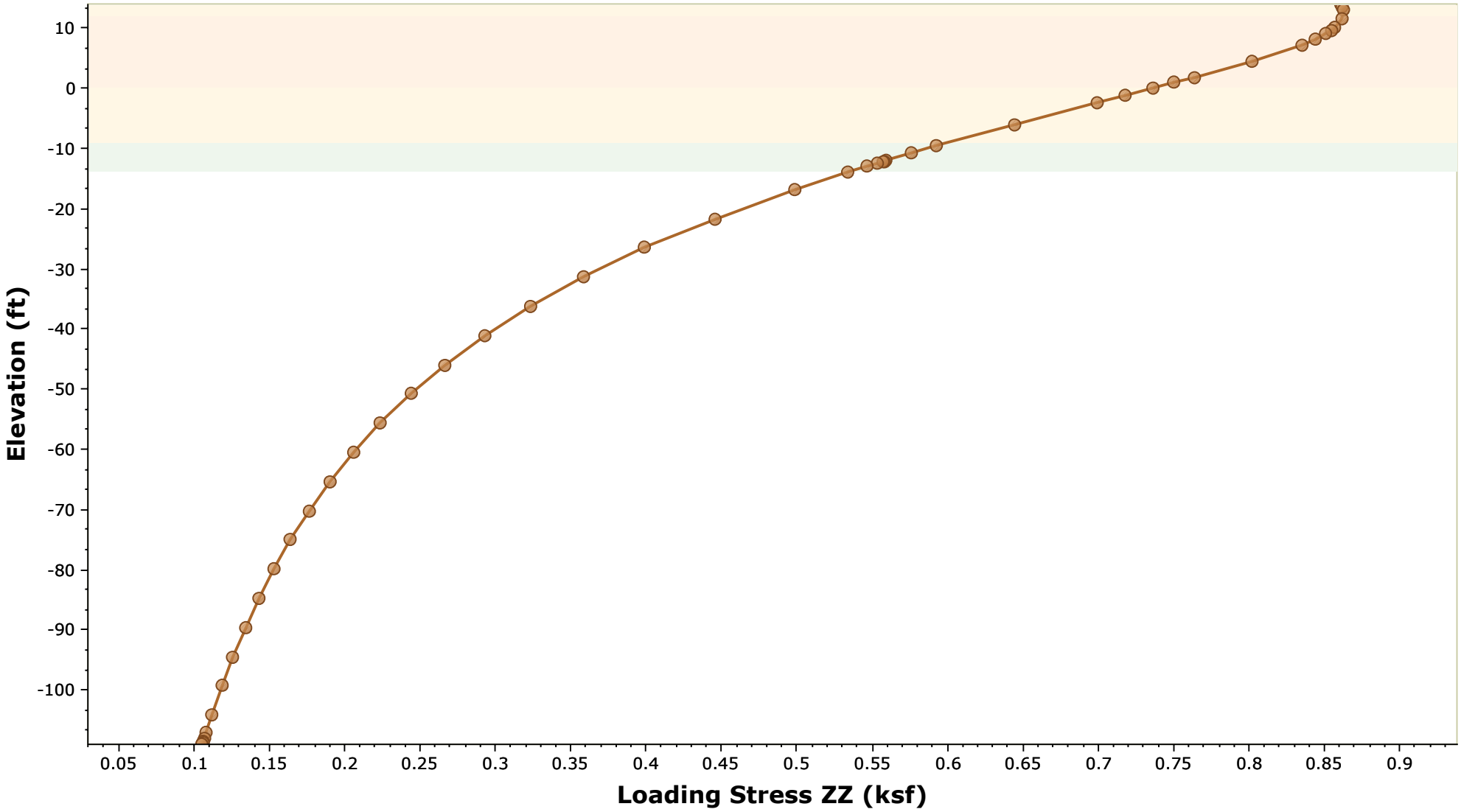


Reference Stage: Reference = 1200 mon

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By	A.Fekrat	Company: Terracon
	Date	7/30/2021, 3:10:26 PM, updated 10/5/2021	File Name: Bagshaw Swamp End Bridge-updated.s3z

SETTLE3 5.008

Loading Stress ZZ vs. Elevation



Reference Stage: Reference = 1200 mon

Terracon	Project	I-95 Bridge Replacement over Bagshaw Swamp	
	Analysis Description	Settlement - End Bridge Bagshaw Swamp	
	Drawn By	A.Fekrat	Company: Terracon
	Date	7/30/2021, 3:10:26 PM, updated 10/5/2021	File Name: Bagshaw Swamp End Bridge-updated.s3z

SETTLE3 5.008

Settle3 Analysis Information
I-95 Bridge Replacement over Bagshaw Swamp

Project Settings

Document Name	Bagshaw Swamp End Bridge-updated.s3z
Project Title	I-95 Bridge Replacement over Bagshaw Swamp
Analysis	Settlement - End Bridge Bagshaw Swamp
Author	A.Fekrat
Company	Terracon
Date Created	7/30/2021, 3:10:26 PM, updated 10/5/2021
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	months
Permeability Units	feet/year
Minimum settlement ratio for subgrade modulus	0.9

Use average properties to calculate layered stresses

Improve consolidation accuracy

Ignore negative effective stresses in settlement calculations

Stage Settings

Stage #	Name	Time [months]
1	Existing	0
2	Reference	1200
3	Widening	1200
4	Paving (15 days)	1200.5
5	5y after	1260
6	20y after	1440

Results (relative to Stage: Reference = 1200 mon)

Time taken to compute: 5.37379 seconds

Stage: Existing = 0 mon

Data Type	Minimum	Maximum
Total Settlement [in]	-2.25231	0
Total Consolidation Settlement [in]	-2.25231	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	-2.25231	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	0	0
Loading Stress XX [ksf]	0	0
Loading Stress YY [ksf]	0	0
Effective Stress ZZ [ksf]	-1.57104	0
Effective Stress XX [ksf]	-1.57104	4.28034e-08
Effective Stress YY [ksf]	-1.57104	4.28034e-08
Total Stress ZZ [ksf]	-4.28034e-08	3.55271e-15
Total Stress XX [ksf]	-3.55271e-15	3.55271e-15

Total Stress YY [ksf]	-3.55271e-15	7.10543e-15
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.0659605	0
Pore Water Pressure [ksf]	-4.28034e-08	1.57104
Excess Pore Water Pressure [ksf]	-4.28034e-08	1.57104
Degree of Consolidation [%]	-100	0
Pre-consolidation Stress [ksf]	-1.55716	0
Over-consolidation Ratio	0	392.23
Void Ratio	0	0.110484
Permeability [ft/y]	0	0
Coefficient of Consolidation [ft^2/y]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	-100	0
Undrained Shear Strength	-0.188672	0

Stage: Reference = 1200 mon

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	0	0
Loading Stress XX [ksf]	0	0
Loading Stress YY [ksf]	0	0
Effective Stress ZZ [ksf]	0	0
Effective Stress XX [ksf]	0	0
Effective Stress YY [ksf]	0	0
Total Stress ZZ [ksf]	0	0
Total Stress XX [ksf]	0	0
Total Stress YY [ksf]	0	0
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0
Pore Water Pressure [ksf]	0	0
Excess Pore Water Pressure [ksf]	0	0
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0	0
Over-consolidation Ratio	0	0
Void Ratio	0	0
Permeability [ft/y]	0	0
Coefficient of Consolidation [ft^2/y]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0

Stage: Widening = 1200 mon

Data Type	Minimum	Maximum
Total Settlement [in]	-0.258438	0.545939
Total Consolidation Settlement [in]	-6.245e-16	6.66134e-16
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	-6.245e-16	6.66134e-16
Immediate Settlement [in]	-0.258438	0.545939
Secondary Settlement [in]	0	0

Loading Stress ZZ [ksf]	-0.600019	1.20008
Loading Stress XX [ksf]	-0.755474	1.32108
Loading Stress YY [ksf]	-0.762655	1.99649
Effective Stress ZZ [ksf]	-8.88178e-16	8.88178e-16
Effective Stress XX [ksf]	-0.755474	1.32108
Effective Stress YY [ksf]	-0.762655	1.99649
Total Stress ZZ [ksf]	-0.600019	1.20008
Total Stress XX [ksf]	-1.26401	2.15964
Total Stress YY [ksf]	-1.16774	3.09483
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.00133242	0.00271083
Pore Water Pressure [ksf]	-0.600019	1.20008
Excess Pore Water Pressure [ksf]	-0.600019	1.20008
Degree of Consolidation [%]	-99.7792	1.42109e-14
Pre-consolidation Stress [ksf]	0	1.77636e-15
Over-consolidation Ratio	-1.98952e-12	2.27374e-12
Void Ratio	-0.00446506	0.00223181
Permeability [ft/y]	0	0
Coefficient of Consolidation [ft^2/y]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	-100	44.2437
Undrained Shear Strength	-2.22045e-16	2.22045e-16

Stage: Paving (15 days) = 1200.5 mon

Data Type	Minimum	Maximum
Total Settlement [in]	-1.37471	2.4331
Total Consolidation Settlement [in]	-1.12413	1.894
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	-1.12413	1.894
Immediate Settlement [in]	-0.25058	0.585597
Secondary Settlement [in]	0	0.0204836
Loading Stress ZZ [ksf]	-0.596233	1.26971
Loading Stress XX [ksf]	-0.745153	1.33426
Loading Stress YY [ksf]	-0.751003	2.01911
Effective Stress ZZ [ksf]	-0.600019	1.20008
Effective Stress XX [ksf]	-1.25053	2.15798
Effective Stress YY [ksf]	-1.13914	3.11744
Total Stress ZZ [ksf]	-0.596233	1.26971
Total Stress XX [ksf]	-1.24901	2.2228
Total Stress YY [ksf]	-1.14069	3.1594
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	2.49123
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	3.93016
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	16.5428
Total Strain	-0.033713	0.0629616
Pore Water Pressure [ksf]	-0.00352805	0.137326
Excess Pore Water Pressure [ksf]	-0.00352805	0.137326
Degree of Consolidation [%]	-93.6355	1.42109e-14
Pre-consolidation Stress [ksf]	0	1.06252
Over-consolidation Ratio	-388.436	82.8662
Void Ratio	-0.105461	0.0564693
Permeability [ft/y]	0	0
Coefficient of Consolidation [ft^2/y]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	-100	0
Undrained Shear Strength	-0.0733187	0.137187

Stage: 5y after = 1260 mon

Data Type	Minimum	Maximum
Total Settlement [in]	-1.36346	2.46115
Total Consolidation Settlement [in]	-1.11635	1.92103
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	-1.11635	1.92103
Immediate Settlement [in]	-0.25058	0.585597
Secondary Settlement [in]	0	0.021225
Loading Stress ZZ [ksf]	-0.596233	1.26971
Loading Stress XX [ksf]	-0.745153	1.33426
Loading Stress YY [ksf]	-0.751003	2.01911
Effective Stress ZZ [ksf]	-0.596233	1.26971
Effective Stress XX [ksf]	-1.24901	2.2228
Effective Stress YY [ksf]	-1.14069	3.1594
Total Stress ZZ [ksf]	-0.596233	1.26971
Total Stress XX [ksf]	-1.24901	2.2228
Total Stress YY [ksf]	-1.14069	3.1594
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0.649673
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	3.93016
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0.940333
Total Strain	-0.0329538	0.0633151
Pore Water Pressure [ksf]	0	0
Excess Pore Water Pressure [ksf]	-8.02864e-26	8.17667e-26
Degree of Consolidation [%]	-1.42109e-14	1.42109e-14
Pre-consolidation Stress [ksf]	0	1.13755
Over-consolidation Ratio	-388.564	78.2062
Void Ratio	-0.106053	0.0551976
Permeability [ft/y]	0	0
Coefficient of Consolidation [ft^2/y]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-0.0733187	0.141839

Stage: 20y after = 1440 mon

Data Type	Minimum	Maximum
Total Settlement [in]	-1.36146	2.4632
Total Consolidation Settlement [in]	-1.11635	1.92103
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	-1.11635	1.92103
Immediate Settlement [in]	-0.25058	0.585597
Secondary Settlement [in]	0	0.0232716
Loading Stress ZZ [ksf]	-0.596233	1.26971
Loading Stress XX [ksf]	-0.745153	1.33426
Loading Stress YY [ksf]	-0.751003	2.01911
Effective Stress ZZ [ksf]	-0.596233	1.26971
Effective Stress XX [ksf]	-1.24901	2.2228
Effective Stress YY [ksf]	-1.14069	3.1594
Total Stress ZZ [ksf]	-0.596233	1.26971
Total Stress XX [ksf]	-1.24901	2.2228
Total Stress YY [ksf]	-1.14069	3.1594
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0.648166
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	3.93016
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0.940333
Total Strain	-0.0329201	0.0633502
Pore Water Pressure [ksf]	0	0
Excess Pore Water Pressure [ksf]	-8.09267e-26	8.19069e-26
Degree of Consolidation [%]	-1.42109e-14	1.42109e-14
Pre-consolidation Stress [ksf]	0	1.13755

Over-consolidation Ratio	-388.564	78.2062
Void Ratio	-0.106112	0.0551412
Permeability [ft/y]	0	0
Coefficient of Consolidation [ft^2/y]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-0.0733187	0.141839

Loads

1. Rectangular Load: "Rectangular Load 1"

Length	145 ft
Width	74 ft
Rotation angle	0 degrees
Load Type	Flexible
Area of Load	10730 ft^2
Load	0.14 ksf

Advanced Staging

Stage	Load Factor	Depth [ft]
Existing = 0 mon	0	-27
Reference = 1200 mon	0	-27
Widening = 1200 mon	0	-27
Paving (15 days) = 1200.5 mon	1	-27
5y after = 1260 mon	1	-27
20y after = 1440 mon	1	-27

Coordinates

X [ft]	Y [ft]
51725	-20.5
51870	-20.5
51870	53.5
51725	53.5

Embankments

1. Embankment: "Embankment Load 1"

Label	Embankment Load 1
Center Line	(51725, 0) to (51870, 0)
Near End Angle	90 degrees
Far End Angle	90 degrees
Number of Layers	1
Base Width	119

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	Existing = 0 mon	0	26.5651	13	0.12	18.4349	0

2. Embankment: "Embankment Load 2"

Label	Embankment Load 2
Center Line	(51720, 0) to (51725, 0)

Near End Angle	26.565 degrees
Far End Angle	90 degrees
Number of Layers	1
Base Width	119

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	Existing = 0 mon	0	26.5651	13	0.12	18.4349	0

3. Embankment: "Embankment Load 3"

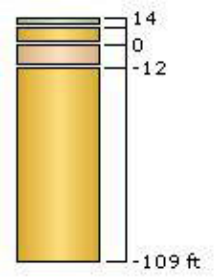
Label	Embankment Load 3
Center Line	(51722, 0) to (51725, 0)
Near End Angle	26.565 degrees
Far End Angle	90 degrees
Number of Layers	1
Base Width	119

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft^3)	Right Angle (deg)	Right Bench Width (ft)
1	Widening = 1200 mon	0	26.5651	9	0.12	26.5651	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	Sandy Clay	5	-14	No
2	Very loose Sand	9	-9	No
3	Medium Dense Sand	12	0	No
4	Hard Sandy Silt	97	12	No



Soil Properties

Property	Sandy Clay	Medium Dense Sand	Hard Sandy Silt	Very loose Sand
Color				
Unit Weight [kips/ft^3]	0.125	0.12	0.115	0.1
Saturated Unit Weight [kips/ft^3]	0.13	0.125	0.12	0.105
K0	1	0.41	1	0.53
Immediate Settlement	Enabled	Enabled	Disabled	Enabled
Es [ksf]	450	800	-	400
Esur [ksf]	450	800	-	400
Primary Consolidation	Enabled	Disabled	Disabled	Disabled
Material Type	Non-Linear			

Cc	0.373	-	-	-
Cr	0.056	-	-	-
e0	0.675	-	-	-
Pc [ksf]	6.7	-	-	-
Cv [ft^2/y]	131	-	-	-
Cvr [ft^2/y]	512	-	-	-
B-bar	1	-	-	-
Secondary Consolidation	Mesri	Disabled	Disabled	Disabled
Ca/Cc	0.017	-	-	-
Undrained Su A [kips/ft2]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1

Groundwater

Groundwater method Piezometric Lines
Water Unit Weight 0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	-14 ft

Query Points

Point #	Query Point Name	(X,Y) Location	Number of Divisions
1	Maximum Response	51751.5, 65.384	Auto: 49

Query Lines

Line #	Query Line Name	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	Longitudinal	51704, 61.5	51870, 61.5	20	Auto: 49
2	Transverse	51743.8, 79.5	51743.8, -59.5	20	Auto: 49

Field Point Grid

Number of points 125
Expansion Factor 2

Grid Coordinates

X [ft]	Y [ft]
51942.5	152
51942.5	-132
51631.5	-132
51631.5	152

EXHIBIT C-10: PERFORMANCE LIMITS

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Location:	Bridge
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT File:	P030260
Date:	10/6/2021

Table 10-12, Embankment (Pavement) Performance Limits

Minimum Design Life: 20 Years

Location	Deformation ID No.	Service Limit State Performance Limit Description	Calculated Settlement	Performance Limit (PL)	Remarks
Begin Bridge (Sta. 514+50 to Sta. 515+95)	EV-01A	Max. Total Settlement along PG[1] Pre-Pave	2.4 in	NL	Meet PL
	EV-01B	Max. Total Settlement along PG[1] Post Pave[2]	0.1 in	3 in	Meet PL
	EV-03	Max. Long. Diff. Settl. along PG Post Pave	0.1 in/50 ft	1.0 in/50 ft	Meet PL
End Bridge (Sta. 517+25 to Sta. 518+70)	EV-01A	Max. Total Settlement along PG Pre-Pave	2.4 in	NL	Meet PL
	EV-01B	Max. Total Settlement along PG Post Pave	0.1 in	3 in	Meet PL
	EV-03	Max. Long. Diff. Settl. along PG Post Pave	0.1 in/50 ft	1.0 in/50 ft	Meet PL

[1]The longitudinal location of EV-01 shall be noted (EV-01 is reported approximately 50 feet away from End Bent)

[2]Design life of 20 years shall be used.

NL = No Limit; however EV-01A shall be reported.

PG = Profile Grade

Total Settlement = Settlement from Elastic Compression + Primary Consolidation + Secondary Compression

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Location:	Bridge
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT File:	P030260
Date:	10/6/2021

Table 10-13, Embankment Widening Performance Limits

Minimum Design Life: 20 Years

Location	Deformation ID No.	Service Limit State Performance Limit Description	Calculated Settlement	Performance Limit (PL)	Remarks
Begin Bridge	EV-04	Max. Vert. Diff. Settl. transverse to APG[1] Post-Pave	0.1 in/5 ft	0.2 in/5 ft	Meet PL
End Bridge	EV-04	Max. Vert. Diff. Settl. transverse to APG[1] Post-Pave	0.0 in/5 ft	0.2 in/5 ft	Meet PL

1. APG = Adjusted Profile Grade

Differential Settlement reported between the existing embankment and the new widened embankment.

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Location:	Bridge
Terracon Project No.:	EN205030
Computed By:	A. Fekrat
Checked By:	K. Scott
SCDOT File:	P029263
Date:	10/6/2021

Table 10-14, Bridge/Embankment Transition Settlement Performance Limits

Minimum Design Life: 20 Years

Location	Deformation ID No.	Service Limit State Performance Limit Description	Calculated Settlement	Approach Slab Length (ft)	Performance Limit (PL)	Remarks
Begin Bridge	EV-05A	δ_V btw EB and end of AS Post Pave - 20 yrs	0.2 in.	20	0.05 x L_{slab} = 1. in.	Meet PL
	EV-05B	δ_V btw EB and 1' away Post Pave - 20 yrs	0.1 in	NA	0.5 in.	Meet PL
End Bridge	EV-05A	δ_V btw EB and end of AS Post Pave - 20 yrs	0.1 in.	20	0.05 x L_{slab} = 1. in.	Meet PL
	EV-05B	δ_V btw EB and 1' away Post Pave - 20 yrs	0.0 in	NA	0.5 in.	Meet PL

EV-05A = Maximum Differential Settlement (δ_V) between the bridge End Bent and the end of the Approach Slab after the roadway has been paved at the end of the pavement design life (20 years).
EV-05B = Maximum Differential Settlement (δ_V) between the bridge End Bent and a point 1 foot from either the "begin" or "end" of bridge after the roadway has been paved at the end of the pavement design life (20 years).
EB = End Bent; AS = Approach Slab

Project:	I-95 Bridge Replacement over Bagshaw Swamp
Location:	Bridge
Terracon Project No.:	EN175299
Computed By:	A. Fekrat
Checked By:	D. Corley
SCDOT File:	P030260
Date:	10/6/2021

Table 10-15, Bridge/Embankment Tranistion Settlement Performance Limit
Bridge Operational Classification (OC): I

Location	Deformation ID No.	EE I Limit State PL Description	Design EQ	Calculated Settlement*	Slab Length (ft)	Performance Limit		Remarks
Begin Bridge	EV-05A	Max. Vert. Diff. Settl. Btw EB and End of AS	FEE	2.1 in.	20	0.200 Lslab =	4. in.	Meet PL
			SEE	2.9 in.	20	0.400 Lslab =	8. in.	Meet PL
	EV-05B	Max. Diff. Settl. (δ_V) btw EB and 1' away	FEE	0.5 in.	NA	2 in.		Meet PL
			SEE	2.9 in.	NA	8 in.		Meet PL
End Bridge	EV-05A	Max. Vert. Diff. Settl. Btw EB and End of AS	FEE	2.4 in.	20	0.200 Lslab =	4. in.	Meet PL
			SEE	1.3 in.	20	0.400 Lslab =	8. in.	Meet PL
	EV-05B	Max. Diff. Settl. (δ_V) btw EB and 1' away	FEE	0.1 in.	NA	2 in.		Meet PL
			SEE	1.8 in.	NA	8 in.		Meet PL

NL = No limit; low probability of collapse; anticipated displacement shall be reported and considered by the design team
EB = End Bent; AS = Approach Slab
* For begin Bridge, differential settlement between Borings BS-STB14 and BS-STB15 has been compared. See Exhibit C-2 SSL.
*For End Bridge, differential settlement between Borings BS-STB11 and BS-STB10 has been compared. See Exhibit C-2 SSL.

APPENDIX D – PLAN NOTES AND SPECIAL PROVISIONS

BRIDGE PLAN NOTES

Driven Pile Installation

Place the following notes on the plans for End Bents and Interior Bents:

The installation of the driven piles shall be conducted in accordance with Section 711 Driven Pile Foundations section of the *SCDOT 2007 Standard Specifications for Highway Construction*. Notes included in these plans are in addition to the requirements of the Standard Specifications.

Description	End Bent 1 EE I	End Bent 5 EE I
Factored Design Load	410 kips	415 kips
Geotechnical Resistance Factor	1.00	1.00
Nominal Resistance	410 kips	415 kips
Resistance from: Design Flood Scourable Soils Soils undergoing static downdrag	NA	NA
Resistance from Liquefiable Soils	194 kips	194 kips
Required Driving Resistance	604 kips	609 kips

The required minimum tip elevation to achieve critical penetration for the HP14x89 piles at End Bent 1 is -65.6 feet and at End Bent 5 is -66.6 feet NAVD 88.

Description	Interior Bent 2 EE I	Interior Bent 3 EE I	Interior Bent 4 EE I
Factored Design Load	90 kips	50 kips	100 kips
Geotechnical Resistance Factor	1.00	1.00	1.00
Nominal Resistance	325 kips	328 kips	325 kips
Resistance from: Design Flood Scourable Soils Soils undergoing static downdrag	NA	NA	NA
Resistance from Liquefiable Soils	287 kips	278 kips	285 kips
Required Driving Resistance	612 kips	606 kips	610 kips

The required minimum tip elevation to achieve critical penetration for the PSC 20-inch Concrete Piles with Points at Interior Bents 2, 3 and 4 is -28 feet NAVD 88.

Install steel HP “stinger” section to the PSC pile tip to be protruded 2’-6” and embedded into the PSC pile a minimum 6 feet.

Drive all piles such that both the required driving resistance and minimum tip elevation shall be satisfied. Any scenario where either the required driving resistance or the minimum pile tip elevation is not achieved shall be approved by the Geotechnical Engineer.

Each pile is to be installed in one continuous operation. Include details of any anticipated temporary driving discontinuances including anticipated time intervals in the Pile Installation Plan.

Level 1 – SCDOT has elected to not monitor the site; therefore, no Earth-borne Vibration Monitoring is required.

The following estimated parameters are recommended for performing a drivability analysis for End Bents and Interior Bents.

Estimated Pile Drivability Analysis Parameters	
Description	**End Bent 1 and End Bent 5**
Skin Quake (QS)	0.10 in
Toe Quake (QT)	0.10 in
Skin Damping (SD)	0.15 s/ft
Toe Damping (TD)	0.15 s/ft
% Skin Friction for End Bents	100 %
Distribution Shape	Variable
Estimated Driving Resistance	607.4 and 614 kips
Pile Penetration for End Bents	100%
Hammer Energy Range	110 to 130 ft-kips

Distribution Shape varies with depth.
End Bents 1 and 5: 0 at surface to 0.5 at 6.4 ft, 1.2 at 6.4 ft to 1.2 at 12.4 ft, 0.7 at 12.4 ft to 0.8 at 21.4 ft, 0.4 at 21.4 ft to 2.8 at 33.4 ft, 1.5 at 33.4 ft to 1.5 at 101.4 ft

Estimated Pile Drivability Analysis Parameters			
Description	**Interior Bent 2**	**Interior Bent 3**	**Interior Bent 4**
Skin Quake (QS)	0.10 in	0.10 in	0.10 in
Toe Quake (QT)	0.10 in	0.10 in	0.10 in
Skin Damping (SD)	0.15 s/ft	0.15 s/ft	0.15 s/ft
Toe Damping (TD)	0.15 s/ft	0.15 s/ft	0.15 s/ft
% Skin Friction for End Bents	82%	83%	82%
Distribution Shape	Variable	Variable	Variable
Estimated Driving Resistance	611.6 kips	605.9 kips	609.6 kips
Pile Penetration for End Bents	89%	85%	87%
Hammer Energy Range	80 to 100 ft-kips	80 to 100 ft-kips	80 to 100 ft-kips

Estimated Pile Drivability Analysis Parameters			
Description	**Interior Bent 2**	**Interior Bent 3**	**Interior Bent 4**
Distribution Shape varies with depth. Interior Bent 2: 0 at surface to 0.5 at 7.0 ft, 1.2 at 7.0 ft to 1.2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft, 2.1 at 22.0 ft to 2.8 at 34.0 ft , 2.2 at 34.0 ft to 2.2 at 102.0 ft Interior Bent 3: 0 at surface to 1.2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft, 2.1 at 22.0 ft to 2.8 at 34.0 ft , 2.2 at 34.0 ft to 2.2 at 102.0 ft Interior Bent 4: 0 at surface to 0.5 at 7.0 ft, 1,2 at 7.0 ft to 1,2 at 13.0 ft, 0.7 at 13.0 ft to 0.8 at 22.0 ft , 2.1 at 22 ft to 2.8 at 34 ft, 2.2 at 34.0 ft to 2.2 at 102.0 ft			

A pile hammer having the rated energy as indicated above is considered suitable for driven pile installation. However, final hammer approval is based on a wave equation analysis that accurately reflects the Contractor's proposed driving system.

The dynamic pile test shall consist of testing production piles. The test piles shall be monitored using the Pile Driving Analyzer (PDA) and the CAPWAP analysis shall be performed to verify the pile capacity. A minimum of 10 piles shall be tested. An additional PDA equipment setup to measure the pile capacity during pile driving restrike (approximately one inch or 10 to 20 hammer blows) shall occur between three and seven days after initial pile driving. The following locations have been selected for dynamic tests:

- End Bent 1: Piles 1, 6
- Interior Bent 2: Piles 2, 7
- Interior Bent 3: Piles 3,8
- Interior Bent 4: Piles 4, 9
- End Bent 5: Piles 1, 5

The location and number of test piles may be altered by the Geotechnical Engineer or the SCDOT based on results of the test pile program.

Temporary Shoring

Temporary shoring may be required for maintenance of traffic during construction. Use buoyant unit weights in computations for soils below the water level. Designer shall determine appropriate water level and consider all unbalanced water forces in design and confirm soil profile and parameters are appropriate for the final wall configuration and location. Design shall accommodate live loading. Use the following soil strength parameters for determining earth pressure coefficients. The following earth pressures can be used for the fill and existing materials:

Earth Pressures at Begin Bridge and End Bridge

Soil Type	**Elevation** (ft, NAVD88)	**C** (psf)	**Phi** (°)	**Earth Pressure Coefficient**			**Total Unit Weight** (pcf)
				Active	**Passive**	**At-Rest**	
Fill	28 - 23	58	29	0.28	3.44	0.52	120
	23 - 20	--	36	0.26	3.85	0.41	120

Soil Type	Elevation (ft, NAVD88)	C (psf)	Phi (°)	Earth Pressure Coefficient			Total Unit Weight (pcf)
				Active	Passive	At-Rest	
	20 - 15	--	30	0.33	3.00	0.50	120
Alluvium	15 - 9	1,200	--	1.00	1.00	1.00	125
	9 - 0	--	28	0.36	2.77	0.53	100
	0 - -12	--	36	0.26	3.85	0.41	120
	below -12	3,500	--	1.00	1.00	1.00	115

1. Ground water elevation is approx. Elev. 15 feet NAVD 88.
2. Unit weight of water = 62.4 pcf is used to calculate pressures below the ground water elevation.

ROAD PLAN NOTES

Place the following notes on the roadway plans:

Site preparation shall proceed according to the SCDOT procedures outlined in the Standard Specifications for Highway Construction 2007.

Embankment Fill Material

All roadway fill material shall meet the Borrow Excavation requirements on Section 203.2.1.8 of SCDOT Standard Specifications for Highway Construction 2007.

General Embankment Construction

- All roadway fill material will meet the Borrow Excavation requirements on Section 203.2.1.8 of *SCDOT 2007 Standard Specifications for Highway Construction* and the requirements outlined in the Borrow Materials section of the plan notes.
- Borrow will be placed in accordance with Section 205 of the *SCDOT 2007 Standard Specifications for Highway Construction*.
- Borrow placed on existing slopes will be benched and compacted in accordance with Section 205.4.4 of the *SCDOT 2007 Standard Specifications for Highway Construction*.

Bid Items and Quantities

Item No.	Pay Item	Pay Unit
7110200	Prestressed Concrete Piling – 20” Sq.	LF
7110201	Pile Buildup Preparation	EA
7110205	Prestressed Index Piling – 20” Sq.	LF

7112230	Steel H Bearing Piling – 20” Sq	LF
7112232	Steel H Bearing Index Pile – HP14x89	LF