I-5986B Final Pavement Design Recommendations Report Addendum
I-95 Widening MM 69 to MM 82
Johnston and Harnett Counties
S&ME Project No. 623517048

PREPARED FOR:

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April 27, 2021

Michael Baker International
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Cary, NC 27518

Attention: Mr. Mickie Wing

Reference: **I-5986B Final Pavement Design Recommendations Report Addendum**
I-95 Widening
Johnston, Harnett Counties
S&ME Project No. 623517048
PE Firm License No. F-0176

Dear Mr. Wing:

The purpose of this report is to provide pavement design recommendations to the design team for the subject I-5986B project. The information contained in this report pertains to the pavements for the roadway widening of I-95 as well as the widening and realignments of ramps, loops and Y-lines within the project limits, which begin at approximate mile marker 69, just south of Bud Hawkins Rd. and end just north of the interchange of I-95 and I-40 (Approximate mile marker 81). The Y-lines included are part of previous TIP numbers I-5878 and I-5883 in addition to I-5986B. This addendum is to combine previous submittals and incorporates comments by Michael Baker International. It is to be noted that if additional Y-line alignments, service roads, driveways, or any other alignment changes are proposed as part of I-5986B project, S&ME will have to review and submit an addendum to this report. The revision is based on comments from NCDOT and Michael Baker International on March 19, 2021. Our services are being performed in general accordance with the approved scope of services in the Master Agreement for Subcontracted Technical Services between S&ME, Inc. and Michael Baker International dated February 13, 2017 for Task 3.

Sincerely,

S&ME, Inc.

Stewart Laney, PE
Senior Project Manager

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Appendices

1.0 Project Overview

The project consists of widening and rehabilitation of the existing 4-6 lane roadway section of I-95 to an 8 lane roadway section from approximate MM 69 to approximate MM 81, located in Harnett and Johnston Counties, North Carolina. Included in the project are the interchanges and Y-lines along the approximately 10-mile long I-95 corridor. The following table presents how the project has been divided for the purposes of the pavement recommendations:

Table 1.1

Route	Begin Station	End Station	New Location Y/N	Number of Lanes	Curb & Gutter	Pavement Design life
-L- I-95*	80+00	1452+20.87	Yes	6	No	30
-Y14- SR 1793 (West) (Spring Branch Rd.)	10+00	24+66	No	2	Yes	20
-Y14- SR 1793 (East) (Pope Rd.)	27+42	46+81.23	No	2	No	20
Ramps at –Y14- SR 1798	Varies		Yes	1	No	30
-Y15- US 421 (West)	10+00	21+85	No	4	Yes	30
-Y15- US 421 (East)	21+85	57+96.55	No	4	No	30
Ramps at –Y15- US 421	Varies		Yes	1	No	30
-Y16- SR 1808 (Jonesboro Rd.)	10+00	49+21.99	Yes	2	No	20
Ramps at –Y16- SR 1808	Varies		Yes	1	No	30
-Y17- SR 1709 (Hodges Chapel Rd.)	10+00	45+56.91	No	2	No	20
Ramps at –Y17- SR 1709	Varies		Yes	1	No	30
-Y18- NC 50/NC 242 (East Main St.)	10+00	45+44.03	No	2	Yes	30
Ramps at –Y18- NC 50/NC 242	Varies		Yes	1	No	30
I-5878						
-SR9A- New Alignment (Interstate Drive)	10+12.00	93+04.22	Yes	2	No	20
-SR9- Elm Street Ext.	10+00	93+04.64	Yes	2	No	20
-SR11- Stoney Run Drive	-	-	Yes	2	No	20
-SR12- Old State Hwy 55 E	-	-	Yes	2	No	20
-SR18- Jackson Road	-	-	Yes	2	No	20
-Y25- Sampson Road	-	-	Yes	2	No	20

-Y25A- E Broad Street	-	-	Yes	2	No	20
-DR1 & DR1A- New Alignment (Bud Hawkins Rd)	-	-	Yes	2	No	20
-NBCD & SBCD- Y 14 Ramps	-	-	Yes	2	No	20
-Y14RAA- New Roundabout on Spring Branch Rd	10+00.00	13+95.84	Yes/No	2	Yes	20
-Y14RAB- New Roundabout on Pope Rd	10+00.00	13+61.28	Yes/No	2	Yes	20
-DR10- New Location	10+24.70	12+00.00	Yes	2	No	20
-Y24- Bud Hawkins Road	13+59.60	49+82.28	Yes	2	No	20
I-5883						
-SR13- Jerry Carr Road	10+00.00	59+58.54	Yes	2	No	20
-SR14- Saddlebred Road/ Rooms to Go Way	-	-	Yes	2	No	20
-SR15- George Perry Lee Road	10+13.43	98+25.00	Yes	2	No	20
-SR16- Sadler Road	10+00.00	85+93.68	Yes	2	No	20
-SR17- Robin Hood Road	10+09.89	65+97.99	Yes	2	No	20
-Y26- New Alignment (George Perry Lee Road)	10+11.21	30+84.53	Yes	2	No	20
-DR2- New Alignment (Jerry Carr Rd)	10+11.00	12+91.61	Yes	2	No	20
-Y32- Core Rd (Cul-De-Sac)	10+43.60	11+48.60	Yes	2	No	20
I-5986B						
-SR19- SR 1834 Foundation Rd	10+45.00	28+98.68	Yes	2	No	20
-Y18RAA- New Roundabout on NC 50	10+00.00	14+46.11	Yes	2	Yes	30
-Y27- SR1809 Webb Rd	25+77.06	27+84.39	Yes	2	No	20
-Y28- SR1100 Chicopee Rd	15+75.00	31+00.00	Yes	2	No	20
-Y28A- E Brocklyn St	15+60.85	-	Yes	2	No	20
-Y29- SR1204/SR1101 S Market St Cub Rd Connection	20+00.00	35+50.00	Yes/No	2	No	20
-Y29A-SR1101 Cub Rd (New Service Rd)	10+14.04	39+88.01	Yes/No	2	No	20

-Y30-S Walton Dr (NC 242)	19+00.00	24+22.91	Yes	2	Yes	30
-Y33-SR1219 (N Walton Av)	10+50.00	45+65.00	Yes	2	No	20
-Y19RPB- I40 Ramp	26+00.00	30+97.86	Yes	1	No	30
-Y19RPCA- I40 Ramp	10+00.00	18+34.55	Yes	1	No	30

* The existing pavement of I-95 within the project limits has been further divided for the purpose of pavement rehabilitation recommendations.

2.0 Traffic

Traffic data for pavement designs is based on information provided by Michael Baker and NCDOT, more specifically obtained from the Traffic Forecast Diagrams prepared by Atkins, dated November 23, 2016. Pavement designs are based on the AASHTO 93 Interim Guide for Design of Pavement Structures and the NCDOT Pavement Design Procedure (2017). As shown in the table below, the following traffic conditions have been incorporated into our analyses:

Table 2.1

Route	Initial Year ADT 2018	Future Year ADT 2040	Duals %	TTST %	Life	Lanes	Directional Split
-L- I-95	57,000	74,600	7	17	30	6	50
-Y14- SR 1798 (West) (Spring Branch Rd.)	4,100	7,200	4	1	20	2	50
-Y14- SR 1798 (East) (Pope Rd.)	3,600	5,300	4	1	20	2	50
Ramps at –Y14- SR 1798	3,450	7,350	4	3	30	1	100
-Y15- US 421 (West)	19,800	27,400	3	3	30	4	50
-Y15- US 421 (East)	15,500	19,800	3	3	30	4	50
Ramps at –Y15- US 421	4,100	6,250	4	3	30	1	100
-Y16- SR 1808 (Jonesboro Rd.)	6,900	9,100	6	17	20	2	50
Ramps at –Y16- SR 1808	1,450	1,800	6	17	30	1	100
-Y17- SR 1709 (Hodges Chapel Rd.)	3,600	4,900	5	30	20	2	50
Ramps at –Y17- SR 1709	1,350	1,850	5	30	30	1	100
-Y18- NC 50/NC 242 (East Main St.)	13,600	20,400	3	3	30	2	50
Ramps at –Y18- NC 50/NC 242	3,850	6,300	3	4	30	1	100

I-5878							
-SR9A- New Alignment (Interstate Drive)	500	700	8	1	20	2	50
-SR9- Elm Street Ext.	1,400	1,900	3	1	20	2	50
-SR11- Stoney Run Drive	600	900	10	7	20	2	50
-SR12- Old State Hwy 55 E	1,900	2,300	3	2	20	2	50
-SR18- Jackson Road	1,500	2,200	5	1	20	2	50
-Y25- Sampson Road	2,400	3,700	2	1	20	2	50
-Y25A- E Broad Street	700	900	10	7	20	2	50
-DR1 & DR1A- New Alignment (Bud Hawkins Rd)	300	500	5	1	20	2	50
-NBCD & SBCD- Y 14 Ramps	3,450	7,350	4	3	20	2	50
-Y14RAA- New Roundabout on Spring Branch Rd	4,100	7,200	4	1	20	2	100
-Y14RAB- New Roundabout on Pope Rd	3,600	5,300	4	1	20	2	100
-DR10- New Location	500	800	10	3	20	2	50
-Y24- Bud Hawkins Road	500	900	8	13	20	2	50
I-5883							
-SR13- Jerry Carr Road	100	200	10	1	20	2	50
-SR14- Saddlebred Road/ Rooms to Go Way	2,000	2,400	5	4	20	2	50
-SR15- George Perry Lee Road	700	900	7	10	20	2	50
-SR16- Sadler Road	2,200	2,600	5	9	20	2	50
-SR17- Robin Hood Road	600	700	5	15	20	2	50
-Y26- New Alignment (George Perry Lee Road)	700	900	7	10	20	2	50
-DR2- New Alignment (Jerry Carr Rd)	100	200	10	1	20	2	50
-Y32- Core Rd (Cul-De-Sac)	100	200	10	1	20	2	50
I-5986B							
-Y29- SR1204/SR1101 S Market St Cub Rd Connection *	700	1,000	2	5	20	2	50

-Y29A-SR1101 Cub Rd (New Service Rd) *	100	200	2	1	20	2	50
-Y30-S Walton Dr (NC 242)	4,900	7,500	5	5	30	2	50
-Y33-SR1219 (N Walton Av)	850	950	5	5	20	2	50
-Y19RPCA- I-40 Ramp	14,200	23,700	3	5	30	1	100
-Y19RPB- I-40 Ramp	12,000	19,900	3	5	30	1	100
-Y18RAA- apron	10,400	15,400	3	4	30	2	100
-SR19- SR 1834 Foundation Rd	100	200	2	1	20	2	50
-Y18RAA- New Roundabout on NC50	10,400	15,400	3	4	30	2	100
-Y27- SR1809 Webb Rd	600	700	5	15	20	2	50
-Y28- SR1100 Chicopee Rd	1,800	2,500	3	3	20	2	50
-Y28A- E Brocklyn St	200	300	6	1	20	2	50

*Traffic data for -Y29- and Y-29A- was not available. We have assumed ADT and truck percentages similar to neighboring Y-lines. Note that pavement thickness can be modified if needed when traffic data is available.

3.0 Soil Conditions

Existing geotechnical conditions along the project alignment are based on the Preliminary Roadway Geotechnical Engineering Report (PRGER) prepared by S&ME which will be submitted at a later date. During this evaluation, asphalt coring was performed at twenty-six locations (26) (C-1 through C-26) and subgrade tests were performed at twenty-one (21) locations along the existing I-95 alignment. Subgrade underneath the pavement structure was evaluated by Kessler Dynamic Cone Penetrometer Testing (KDCP). Falling weight deflectometer testing was done and deflection data used to back calculate subgrade modulus values and CBR.

3.1 Dynamic Cone Penetrometer Testing

The subgrade was evaluated by Kessler Dynamic Cone Penetrometer Testing (KDCP). The KDCP is driven into the subgrade soils by dropping a Dual-Mass Hammer form a height of 22.6 inches. The depth of cone penetration is measures at selected penetration of hammer drop intervals and the soil shear strength is reported in terms of DCP index. The DCP index is used to estimate weighted average field California Bearing Ratio (CBR) values. The following table shows the testing that has been performed:

Table 3.1

Test ID	I-95 Approx. Station	Direction	Location	Offset (ft)	Asphalt Thickness (in.)	Base Thickness (in.)	Base Type	Weighted Average CBR
C-1	908+59	NB	OSS	4.8	7.0	-	-	34
C-2	950+90	NB	OSS	6.0	7.0	-	-	30

C-3	1038+19	NB	OSS	5.5	11.5	-	-	42
C-4	1122+19	NB	OSS	4.8	8.0	-	-	27
C-5	1254+62	NB	OSS	5.0	10.75	-	-	38
C-6	1323+56	NB	OSS	5.4	11.0	-	-	47
C-7	1347+73	NB	OSS	4.7	16.0	-	-	No Kessler
C-8	1362+58	NB	OSS	5.6	17.0	-	-	No Kessler
C-9	1382+97	NB	OSS	7.0	8.0	-	-	No Kessler
C-10	1405+76	NB	OSS	5.0	6.75	-	-	33
C-11	1236+35	NB	OSL	2.1	13.5	-	-	76
C-12	1070+06	NB	OSL	2.0	6.5	9.0 Concrete	Econocrete	No Kessler
C-12-1	1070+06	NB	OSL	2.8	18.5	-	-	No Kessler
C-13	1432+26	SB	OSS	6.5	6.0	-	-	61
C-14	1375+37	SB	OSS	4.5	13.75	-	-	31
C-15	1340+86	SB	OSS	6.2	14.0	-	-	46
C-16	1316+18	SB	OSS	5.6	11.0	-	-	23
C-17	1299+78	SB	OSS	6.2	10.0	-	-	40
C-18	1247+37	SB	OSS	6.5	7.0	-	-	62
C-19	1141+06	SB	OSS	7.5	8.75	-	-	37
C-20	950+68	SB	OSS	6.8	9.0	-	-	31
C-21	926+49	SB	OSS	5.5	8.75	-	-	41
C-22	904+92	SB	OSS	5.0	9.25	-	-	26
C-23	-	SB	OSL	4.5	6.5	9.0 Concrete	Econocrete	No Kessler
C-24	1290+13	SB	OSL	2.2	14.5	-	-	47
C-25	1136+72	SB	OSL	3.0	12.5	-	-	63
C-26	1391+76	SB	OSL	4.3	14.5	-	-	22

3.2 Falling Weight Deflectometer Testing

Falling weight deflectometer (FWD) testing was performed in the outside wheel path of the outside travel lane in both the north and southbound directions. Testing was done at approximately every 250 feet, as 208 tests were conducted in the southbound direction, and 204 tests were done in the northbound direction of I-95. Two seating drops were done followed by two loading drops targeting approximately 9,000 pounds in accordance with NCDOT procedures. Subgrade characteristics were found through back-calculation of the FWD deflection data.

Backcalculated subgrade modulus values were above 10,000 psi for all tested locations in both directions; a value of 10,000 psi is considered adequate for subgrade strength per NCDOT. In addition, backcalculated subgrade moduli values were used to calculate the in-situ CBR values using the empirical equation: Mr = 2,555 * (CBR Value) ^ 0.64, as recommended by AASHTO in NCHRP Project 1-37A and by the NCDOT Pavement Design Procedure (2017). The data is summarized below in Table 3.2.

Table 3.2

I-95 Tested Section (Approx. Stations)	Direction	Minimum Subgrade Modulus psi	Maximum Subgrade Modulus psi	Average Subgrade Modulus psi	Standard Deviation %	Average In-Situ CBR
Sta. 896+43 to Sta. 1405+82	NB	15,269	57,886	31,933	24.9	53.12
Sta. 1435+99 to Sta. 894+53	SB	15,299	63,653	32,187	27.0	54.01

3.3 Previous Projects Data

S&ME has recently conducted pavement design investigation projects for NCDOT for three interchanges included in the current I-5986B project limits. These projects were as follows: I-5877 (I-95 at SR 1811 and SR 1001), I-5878 (I-95 at US 421 and SR 1793), and I-5883 (I-95 at SR 1808 and SR 1709). As part of the investigation and reporting for these projects we obtained pavement core data along the I-95 travel lanes, outside and inside shoulders, as well as acceleration lanes. Pavement and Subgrade Inventory submittals for the above mentioned projects are available and information from them could be included in future submittals. Core information for the inside and outside travel lanes is presented in the table below:

Table 3.3

Test ID	Project	I-95 Approx. Station	Direction	Location	Offset (ft)	Asphalt Thickness (in.)	Base Thick-ness (in.)	Base Type	Core Condition
C-1	I-5877	845+76	NB	OSL	2.2	15.0	-	-	Good condition, separated at 8” depth
C-2	I-5877	897+77	NB	OSL	1.6	13.75	-	-	Top 3” debonded, separated at 8-9” depth
C-3	I-5877	801+80	SB	OSL	1.6	13.25	-	-	Good condition

C-4	I-5877	872+79	SB	OSL	1.9	14.0	-	-	Some stripping at 6-8” depth
C-5	I-5878	1012+63	NB	ISL	3.0	11.5	-	-	Some stripping at 7” depth
C-6	I-5878	1026+88	NB	OSL	3.0	13.0	6.0	Drainage sand	Stripping at 8-9” depth
C-7	I-5878	950+80	SB	OSL	4.3	13.0	-	-	Top 3” debonded, stripping at 7-8” depth
C-8	I-5878	984+55	SB	ISL	2.2	14.25	-	-	Stripping at 7” depth
C-9	I-5883	1117+63	NB	OSL	3.2	13.0	6.0	Drainage sand	Good condition
C-10	I-5883	1223+63	NB	OSL	1.5	13.5	6.0	Drainage sand	Good condition, begin stripping at 5-6” depth
C-11	I-5883	1080+63	SB	OSL	2.6	13.0	6.0	Drainage sand	Moderate stripping at 5-7” depth
C-12	I-5883	1185+63	SB	OSL	3.2	13.0	6.0	Drainage sand	Moderate stripping at 4-7” depth

3.4 Existing Pavement Conditions

Existing pavement distress along the project were evaluated at the time of testing. In Johnston County, the pavement along the travel lanes exhibits minimal distress consisting of occasional low severity transverse cracking. The travel lanes and 3-6 feet of the outside shoulder pavement have been resurfaced with an open graded friction asphalt course (OGFAC). Outside shoulder pavement exhibited low to moderate severity transverse and occasional low severity longitudinal cracking. In Harnett County, no visual distresses were observed due to recent resurfacing along both the travel lanes and shoulder pavements.

3.5 Ground Penetrating Radar Survey

S&ME performed a supplemental exploration of the existing pavements that included a GPR survey. GPR survey was performed along the existing mainline travel lanes and outside shoulders. GPR is an electromagnetic method that detects interfaces between subsurface materials with differing dielectric constants. The transmitter radiates electromagnetic waves into the earth from an antenna moving across the ground surface. Electromagnetic waves are reflected back to the receiver by interfaces between materials with differing dielectric constants. The intensity

of the reflected signal is a function of the contrast in the dielectric constant at the interface, the conductivity of the material that the wave is traveling through, and the frequency of the signal. Asphalt cores were also performed to complement the GPR survey and help calibrate the GPR data. Core results and the plots of the GPR data are attached to this letter for you review. The core and GRP data have been used to determine the in place pavement layer thicknesses along the project alignment.

The GPR survey conducted in the travel lanes suggested the presence of two distinctive pavement sections within the project limits, in both the northbound and the southbound directions; a full-depth asphalt section, built on subgrade (from approximate MM 71 to approximate MM 79.3), and a composite pavement section (asphalt on concrete), built on econocrete/ABC base (from approximate MM 79.3 to approximate MM 81). GPR results were confirmed by the core samples. An example of the GPR scan as well as the full survey GPR plot along the existing outside lanes can be found in Appendix II.

3.6 Falling Weight Deflectometer Testing

Falling Weight Deflectometer (FWD) testing was conducted in the outside wheel path of the outside travel lane in both the southbound and northbound directions of I-95 between MM 71 and MM 81. Load and temperature corrected FWD deflections were used to calculate a 15-year overlay design using the AASHTO 93 Interim Guide for Design of Pavement Structures and the NCDOT Pavement Design Procedure (2017). Deflection and overlay results can be seen in the table below:

Table 3.4

I-95 Tested Section (Approx. Station)	Direction	Minimum Deflection mils	Maximum Deflection mils	Average Deflection mils	Standard Deviation %	Required Overlay in
Sta. 1318+05 to Sta. 894+53 Composite pavement	SB	2.13	5.07	3.37	22.8	**0.0”**
Sta. 1435+99 to Sta. 1320+55 Full-depth asphalt	SB	4.03	9.51	6.10	17.0	**0.0 - 1.5”**
Sta. 896+43 to Sta. 1314+92 Composite pavement	NB	2.44	6.21	3.97	22.7	**0.0”**
Sta. 1317+42 to Sta. 1405+82 Full-depth asphalt	NB	3.17	8.94	5.72	18.4	**0.0”**

It is to be noted that deflection limit was set to satisfy a-15 year overlay design requirement, as target deflection limit was 8.31 mils. By this requirement, in the southbound direction FWD testing suggested that structural overlay is required at 7 out of the tested 208 locations, or 3.4% of the tested locations. In the northbound direction, deflection analysis showed that structural overlay is required at 2 of the tested 204 location, or 0.98%.

3.7 I-5877 Additional Falling Weight Deflectometer Testing

Additional Falling Weight Deflectometer (FWD) testing was conducted within the I-5877 project limits in the outside wheel path of the outside travel lane in both the southbound and northbound directions, from approximate station 785+25 to approximate station 949+00 on December 19 and 20, 2018. Load and temperature corrected FWD deflections were used to calculate a 15-year overlay design using the AASHTO 93 Interim Guide for Design of Pavement Structures and the NCDOT Pavement Design Procedure (2017). Deflection and overlay results can be seen in the table below:

Table 3.5

I-95 Tested Section	Direction	Minimum Deflection mils	Maximum Deflection mils	Average Deflection mils	Standard Deviation %	Required Overlay in
Approx. Sta. 949+00 to Approx. Sta. 785+50	SB	4.23	9.61	5.58	15.8	**0.0”**
Approx. Sta. 785+25 Approx. Sta. 940+00	NB	3.78	8.43	5.51	17.9	**0.0”**

Similarly to the I-5986B section, the deflection limit was set to satisfy a-15 year overlay design requirement, and the target deflection limit was 8.31 mils. By this requirement, in the southbound direction FWD testing suggested that structural overlay is required at 1 out of the tested 57 locations, or 1.8% of the tested locations. In the northbound direction, deflection analysis showed that structural overlay is required at 1 of the tested 56 locations, or 1.8% of the tested locations.

3.8 Pavement Coring

Coring was conducted in the outside travel lane in both directions of I-95. Core data is presented below:

Table 3.6

Test ID	I-95 Approx. Station	Direction	Location	Offset (ft)	Asphalt Thickness (in.)	Concrete Thickness (in.)	Base Type	Core Description and Condition
C-11	1236+35	NB	OSL	2.1	13.5	-	-	Fair-good condition, separation at 6.5” depth 1.75” of surface, 4.5” intermediate courses, and 7.25” of base mixes
C-12	1070+06	NB	OSL	2.0	6.5	9.0	Econocrete	Fair condition, asphalt disintegrated from about 3” depth to the top of concrete

								1.0” OGFAC, 1.75” of surface, about 2.5” intermediate courses, and 9.0” of concrete

Test ID	I-95 Approx. Station	Direction	Location	Offset (ft)	Asphalt Thickness (in.)	Concrete Thickness (in.)	Base Type	Core Description and Condition
C-12-1	1070+06	NB	OSL	2.8	18.5	-	-	-
C-23	-	SB	OSL	4.5	6.5	9.0	Econocrete	-
C-24	1290+13	SB	OSL	2.2	14.5	-	-	Fair-good condition, stripping & separation at 7.0” depth 0.75” OGFAC, 1.5” of surface, 6.0” intermediate courses, and 5.75” of base mixes
C-25	1136+72	SB	OSL	3.0	12.5	-	-	Fair-good condition, stripping & separation at 4.25” depth 2.0” of surface, 6.0” intermediate courses, and 4.5” of base mixes
C-26	1391+76	SB	OSL	4.3	14.5	-	-	-

4.0 Pavement Design Recommendations

Provided project information and the data and analyses from our pavement evaluation were used for the below pavement recommendations for roadway widening, as well as rehabilitation of the existing pavement.

4.1 I-95 Widening Design

Based on the provided traffic information, our preliminary alternate designs and feedback from NCDOT, we have recommended a full-depth asphalt widening pavement section. Calculations were done in accordance with AASHTO 93 Interim Design of Pavement Structures and the NCDOT Pavement Design Procedure (2017).

Table 4.1

Alignment	Open Graded Friction Course OGFAC	Surface Course In.	Intermediate Course In.	Base Course In.	ABC In.	Subgrade Stabilization Yes/No
-L- I-95 Outside Widening	* Type FC-1 Modified	3.0" S9.5D	4.0" I19.0C	11.0" B25.0C	-	No
-L- I-95 Inside Widening	* Type FC-1 Modified	3.0" S9.5D	4.0" I19.0C	11.0" B25.0C	-	No

*Open graded friction asphalt course (OGFAC) could be applied based on roadway longitudinal profile and typical section. OGFAC thickness was not included in the calculation of the required structural pavement design.

4.2 Existing I-95 Pavement

Based on the existing pavement condition, FWD, coring and Kessler DCP data, the table below presents our recommendations for the existing I-95 travel lanes pavement. Both the outside and inside shoulder pavements will have to be removed and replaced with the full-depth pavement section recommended in Table 5.1 for the final alignment configuration due to insufficient pavement thickness. Existing Shoulder pavements will be evaluated further as part of the temporary pavements needed for the project construction staging, and report will be submitted separately.

Table 4.2

Alignment	Direction	Recommendations for Existing Travel Lanes
Johnston County Section Sta. 1425+12 to Sta. 1270+94	SB	Mill the existing OGFAC, place 1.5" S9.5D surface course
Harnett County Section 1270+94 to 894+53	SB	Overlay the existing travel lanes pavement with 1.5" S9.5D, surface course
Johnston County Section Sta. 1270+94 to 1425+12	NB	Mill the existing OGFAC, place 1.5" S9.5D surface course
Harnett County Section 894+53 to 1270+94	NB	Overlay the existing travel lanes pavement with 1.5" S9.5D, surface course

The analyses and recommendations submitted herein are based, in part, upon the data provided to S&ME by NCDOT, and Michael Baker International, and information obtained from S&ME explorations. In the event that any changes in the design, design parameters, project data, and estimated traffic are planned, the conclusions and recommendations contained in this report will not be valid unless the changes are reviewed and conclusions modified or verified in writing.

4.3 Y-Lines Pavement Design

Table 4.4 Y-Lines

Alignment	Surface Course In.	Intermediate Course In.	Base Course In.	ABC In.	Subgrade Stabilization Yes/No
-Y14- SR 1793 (West) (Spring Branch Rd.)	3.0" S9.5C	4.0" I19.0C	4.0" B25.0C	-	No
-Y14- SR 1793 (East) (Pope Rd.)	3.0" S9.5C	-	4.5" B25.0C	-	No
Ramps at –Y14- SR 1798	3.0" S9.5C	4.0" I19.0C	-	8.0"	No
-Y15- US 421 (West)	3.0" S9.5C	4.0" I19.0C	4.0" B25.0C	-	No
-Y15- US 421 (East)	3.0" S9.5C	4.0" I19.0C	4.0" B25.0C	-	No
Ramps at –Y15- US 421	3.0" S9.5C	4.0" I19.0C	-	8.0"	No
-Y16- SR 1808 (Jonesboro Rd.)	3.0" S9.5C	4.0" I19.0C	4.0" B25.0C	-	No
Ramps at –Y16- SR 1808	3.0" S9.5C	4.0" I19.0C	-	8.0"	No
-Y17- SR 1709 (Hodges Chapel Rd.)	3.0" S9.5C	4.0" I19.0C	4.0" B25.0C	-	No
Ramps at –Y17- SR 1709	3.0" S9.5C	4.0" I19.0C	-	10.0"	No
-Y18- NC 50/NC 242 (East Main St.)	3.0" S9.5C	4.0" I19.0C	4.0" B25.0C	-	No
Ramps at –Y18- NC 50/NC 242	3.0" S9.5C	4.0" I19.0C	-	8.0"	No
I-5878					
-SR9A- New Alignment (Interstate Drive)	3.0" S9.5B	-	-	8.0"	No
-SR9- Elm Street Ext.	3"0 S9.5B	-	-	8.0"	No
-SR11- Stoney Run Drive	3.0" S9.5B	4.0" I19.0C	-	8.0"	No
-SR12- Old State Hwy 55 E	3.0" S9.5B	-	-	8.0"	No
-SR18- Jackson Road	3.0" S9.5B	-	-	8.0"	No
-Y25- Sampson Ave	3.0" S9.5B	4.0" I19.0C	4.0" B25.0C	-	No
-Y25A- E Broad Street	3.0" S9.5B	4.0" I19.0C	4.0" B25.0C	-	No

-DR1 & DR1A- New Alignment (Bud Hawkins Rd)	3.0” S9.5B	4.0” I19.0C	-	8.0”	No
-NBCD & SBCD- Y 14 Ramps	3.0” S9.5C	4.0” I19.0C	-	8.0”	No
-Y14RAA- New Roundabout on Spring Branch Rd	3.0” S9.5C	4.0” I19.0C	-	8.0”	No
-Y14RAB- New Roundabout on Pope Rd	3.0” S9.5C	4.0” I19.0C	-	8.0”	No
-DR10- New Location	3.0” S9.5B	-	4.0” B25.0C	-	No
-Y24- Bud Hawkins Road	3.0” S9.5C	4.0” I19.0C	-	8.0”	No
I-5883					
-SR13- Jerry Carr Road	3.0” S9.5B	-	-	8.0”	No
-SR14- Saddlebred Road/ Rooms to Go Way	3.0” S9.5B	2.5” I19.0C	-	10.0”	No
-SR15- George Perry Lee Road	3.0” S9.5B	-	-	8.0”	No
-SR16- Sadler Road	3.0” S9.5B	2.5” I19.0C	-	8.0”	No
-SR17- Robin Hood Road	3.0” S9.5B	-	-	10.0”	No
-Y26- New Alignment (George Perry Lee Road)	3.0” S9.5B	-	-	8.0”	No
-DR2- New Alignment (Jerry Carr Rd)	3.0” S9.5B	-	-	8.0”	No
-Y32- Core Rd (Cul-De-Sac)	3.0” S9.5B	-	4.0” B25.0C	-	No
-DR3-	3.0” S9.5B	-	-	8.0”	No
-DR4-	3.0” S9.5B	-	-	8.0”	No
I-5986B					
-SR19- SR 1834 Foundation Rd	3.0” S9.5B	-	4.0” B25.0C	-	No
-Y18RAA- New Roundabout on NC50**	3.0” S9.5C	4.0” I19.0C	4.0” B25.0C	8.0”	No
-Y27- SR1809 Webb Rd	3.0” S9.5B	-	-	10.0”	No
-Y28- SR1100 Chicopee Rd	3.0” S9.5B	4.0” I19.0C	-	8.0”	No
-Y28A- E Brocklyn St	3.0” S9.5B	-	-	8.0”	No

-Y29- SR1204/SR1101 S Market St Cub Rd Connection	3.0" S9.5B	-	4.0" B25.0C	-	No
-Y29A-SR1101 Cub Rd (New Service Rd)	3.0" S9.5B	-	4.0" B25.0C	-	No
-Y30-S Walton Dr (NC 242)	3.0" S9.5C	4.0" I19.0C	-	8.0"	No
-Y33-SR1219 (N Walton Av)	3.0" S9.5B	-	4.0" B25.0C	-	No
-Y19RPCA- I40 Ramp	3.0" S9.5C	3.5" I19.0C	5.0" B25.0C	8.0"	No
-Y19RPB- I40 Ramp	3.0" S9.5C	3.5" I19.0C	5.0" B25.0C	8.0"	No

The ABC base could be substituted with an asphalt base course, B25.0C as the thickness of the asphalt base should equal half the thickness of the ABC. Conversely, the where 4 or 5 inches of B25.0C is proposed in the table above, it could be substituted with ABC, as the ABC thickness should be twice the thickness of the black base.

If ABC base is constructed, and asphalt surface course is paved directly on top of the ABC, prime coat must be applied at rate as specified in the NCDOT Standard Specification for Road and Structures.

Overlay all existing pavements of the alignments in the above table with the full amount of the recommended surface course, 3.0" S9.5B. Where milling and resurfacing is required on Y34, Y35, and Y36, resurface with 3.0" S9.5C.

Table 4.5: Concrete Apron

Alignment	Concrete Thickness	Base Thickness	ABC Thickness
-Y14RAA- & -Y14RAB- apron	12" with a 4x4 W5.5xW5.5 wire mesh reinforcement*	-	8 inches
-Y18RAA- apron	12" with a 4x4 W5.5xW5.5 wire mesh reinforcement*	4.0" B25.0C	8 inches

*6x6 W8.5xW8.5 wire mesh reinforcement can be used or heavier.

5.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical and pavement engineering practices for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made.

The analyses and recommendations submitted herein are based, in part, upon the data provided to S&ME by NCDOT, and Michael Baker International, and information obtained from S&ME explorations. In the event that any changes in the design, design parameters, project data, and estimated traffic are planned, the conclusions and

recommendations contained in this report will not be valid unless the changes are reviewed and conclusions modified or verified in writing.

The Consultant should note that the existing pavement structure recommendations have some inherent risk due to variability in the existing pavements and base thickness, as well as seasonal pavement and subgrade conditions. S&ME cannot qualify or warrant the material properties, or the dimensions or existing conditions in their entirety. As such, the Consultant should assess such parameters and the construction contingency risk this poses to the project.

Regardless of the thoroughness of a geophysical study, there is always a possibility that actual conditions may not match the interpretations. GPR survey was conducted at two longitudinal scans, one in each travel; no additional transverse surveys were conducted. The results should be considered accurate only to the degree implied by the methods used and the method's limitations and data coverage. Accordingly, the possibility exists that not all features at a project site have been identified due to asphalt and/or concrete conditions or the occurrence of features outside the lateral limits and below the depth of penetration of the methods used.

We recommend that S&ME be provided the opportunity to review and comment upon the final design plans and specifications.

Appendices

Appendix I – Pavement Design Calculations

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	February 25, 2018
Site:	I-5986B-I-95 Widening
Location:	Harnett County, NC
Project No.:	6235-17-048
Engineer:	VGM

INPUT CELLS

-L- Line

Asphalt

Stone Subbase

Design Criteria

CBR Design Value	9
Fine Grained?	Yes
Resilient Modulus (M_r) (psi)=	10,426
Road Type	Freeway
Design Equivalent (18 kip) Single Axle Loads (ESALs)	66,150,017
20 Year ADT	73,693
30 Year ADT	83,281
Design Life (years)	30
Initial Serviceability	4.2
Terminal Serviceability	2.8
Design Serviceability	1.5
Reliability (%)	95
Standard Normal Deviate (ZR)	-1.645
Standard Deviation	0.45

Required Structural Number **6.40**

Recommended Flexible Pavement Section

				Option 1 - Full-Depth Asphalt		Option 2 - Asphalt with ABC		Option 3 - Asphalt with CTABC		Option 4 - Full-Depth Asphalt w Stab.	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5D	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**4.00**	1.76	**4.00**	1.76	**4.00**	1.76	**3.00**	1.32
	Asphalt Base Course, B25.0C	0.30	-	**11.00**	3.30	**5.50**	1.65	**6.00**	1.80	**10.00**	3.00
	ABC Stone	0.14	1.0			**10.00**	1.40				
	Cement Treated CTABC	0.23	1.0					**8.00**	1.84		
	Lime Stabilized Subgrade	0.13	1.0				1.00				1.00
	Cement Stabilized Subgrade	0.14	1.0								
	CMRB	0.26	1.0								
				Total Structural Number	**6.38**	**Total Structural Number**	**7.13**	**Total Structural Number**	**6.72**	**Total Structural Number**	**6.64**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches				
Asphalt	**18.00**	**12.50**	**13.00**	**16.00**
ABC	**-**	**10.00**	**-**	**-**
CTABC	**-**	**-**	**8.00**	**-**
CMRB	**-**	**-**	**-**	**-**
Stabilization	**-**	**-**	**-**	**-**

ESALs Calculation:

TRAFFIC DATA			
Initial Year:	2018	Projection Year:	2040
Initial Year ADT:	57,000	Proj. Yr. ADT:	74,600
% DUALS:	7	% TTST:	17
		Growth (%):	1.2

DESIGN PARAMETERS			
Construction Year:	2019	Des. Life (Years):	30
Constr. Year ADT:	57,701	30 YEAR ADT=	83,281
DIR %:	50	TERM. SI:	2.75
LANES/DIRECT:	3	LANE DIST:	0.8
Rural/Urban:	R	Freeway/Other:	F
DUAL FACT (flex).:	0.3	TTST FACT (flex):	1.15
DUAL FACT (rig).:	0.30	TTST FACT (rig):	1.6
Contr. Year ADT (Trucks)	13848		
		ADDITIONAL 18K:	0
DAILY 18K (flex):	6,037	TOTAL 18K (flex):	**66,150,017**
(rigid)	8,163	(rigid)	89446038

ADDITIONAL ESAL CALCULATIONS**

TTST		Duals	
Trucks Per Day	0	Trucks Per Day	0
Trucks Per Year	0	Trucks Per Year	0
Years	30	Years	30
Total TTST	0	Total Dual	0
ESALs	0	ESALs	0

ESAL (for Asphalt Pavement)

R (%)	95	-
z_R	-1.65	-
S_0	0.45	-
Δ psi	1.45	-
M_R	10,426	psi
SN	6.40	-
W_{18}	66,870,262	ESALS
$\log_{10} W_{18}$	7.83	
W_{18} (Needed)	66,150,017	ESALS

Design Serviceability Loss = $p_o - p_t$

AASHTO Guide for Design of Pavement Structures, 1993.

Route	Initial Year AADT	Future Year AADT (2040)	Duals %	TTST %	Design Life (Years)	No. of Lanes	Directional Split (%)
L	57,000	74,600	7.0	17.0	30	3	50
L Shoulder	57,000	74,600	7.0	17.0	30	3	50
Y14-SR 1798 (West) (Spring Branch Rd)	4,100	7,200	4.0	1.0	20	1	50
Y14-SR 1798 (East) (Pope Rd)	3,600	5,300	4.0	1.0	20	1	50
Ramps at Y14-SR 1798	3,450	7,350	4.0	3.0	30	1	100
Y15-US 421 (West)	19,800	27,400	3.0	3.0	30	2	50
Y15-US 421 (East)	15,500	19,800	3.0	3.0	30	2	50
Ramps at Y15-US 421	4,100	6,250	4.0	3.0	30	1	100
Y16-SR 1808 (Jonesboro Rd)	6,900	9,300	6.0	17.0	20	1	50
Ramps at Y16-SR 1808	1,450	1,800	6.0	17.0	30	1	100
Y17-SR 1709 (Hodges Chapel Rd)	3,600	4,900	5.0	30.0	20	1	50
Ramps at Y17-SR 1709	1,350	1,850	5.0	30.0	30	1	100
Y18-NC 50/NC 242 (East Main St)	13,600	20,400	3.0	3.0	30	1	50
Ramps at Y18-NC 50/NC 242	3,850	6,300	3.0	4.0	30	1	100

	SURFACE		INTERMEDIATE		BASE						
	DEPTH	TYPE	DEPTH	TYPE	DEPTH	TYPE	ABC	CTABC	STAB[1]	SN Prov	SN Req
L Shoulder	3	S9.5D	4	I19.0C	12	B25.0C	0.0		No	6.68	5.11
Y14-SR 1798 (West) (Spring Branch Rd)	3	S9.5C	4	I19.0C	4	B25.0C	0.0		No	4.28	2.59
Y14-SR 1798 (East) (Pope Rd)	3	S9.5C	0	I19.0C	4.5	B25.0C	0.0		No	2.67	2.49
Ramps at Y14-SR 1798	3	S9.5C	4	I19.0C	0	B25.0C	8.0		No	4.20	3.75
Y15-US 421 (West)	3	S9.5C	4	I19.0C	4	B25.0C	0.0		No	4.28	4.09
Y15-US 421 (East)	3	S9.5C	4	I19.0C	4	B25.0C	0.0		No	4.28	3.89
Ramps at Y15-US 421	3	S9.5C	4	I19.0C	0	B25.0C	8.0		No	4.20	3.68
Y16-SR 1808 (Jonesboro Rd)	3	S9.5C	4	I19.0C	4	B25.0C	0.0		No	4.28	3.85
Ramps at Y16-SR 1808	3	S9.5C	4	I19.0C	0	B25.0C	8.0		No	4.20	3.87
Y17-SR 1709 (Hodges Chapel Rd)	3	S9.5C	4	I19.0C	4	B25.0C	0.0		No	4.28	3.91
Ramps at Y17-SR 1709	3	S9.5C	4	I19.0C	0	B25.0C	10.0		No	4.48	4.22
Y18-NC 50/NC 242 (East Main St)	3	S9.5C	4	I19.0C	4	B25.0C	0.0		No	4.28	3.95
Ramps at Y18-NC 50/NC 242	3	S9.5C	4	I19.0C	0	B25.0C	8.0		No	4.20	3.77

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	November 15, 2018
Site:	I-5878
Location:	Harnett County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	7	7	7	7
Fine Grained?	No	No	No	No
Resilient Modulus (M_r) (psi)=	10,628	10,628	10,628	10,628
Road Type	Secondary	Secondary	Secondary	Secondary
Design Equivalent (18 kip) Single Axle Loads (ESALs)	65,404	234,430	192,654	147,044
20 Year ADT	689	884	2,280	2,162
Design Life (years)	20	20	20	20
Initial Serviceability	4.2	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5	2.5
Design Serviceability	1.7	1.7	1.7	1.7
Reliability (%)	85	85	85	85
Standard Normal Deviate (ZR)	-1.036	-1.036	-1.036	-1.036
Standard Deviation	0.45	0.45	0.45	0.45
Required Structural Number	**1.86**	**2.34**	**2.26**	**2.15**

Recommended Flexible Pavement Section

				SR9A (New, Interstate Dr.)		SR11 (Stoney Run Dr)		SR12 (Old State Hwy 55 E)		SR18 (Jackson Rd/Sampson Ave)	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**-**		**-**		**-**		**4.00**	1.76
	Asphalt Base Course, B25.0C	0.30	-	**-**		**-**		**-**			
	ABC Stone	0.14	1.0	**8.00**	1.12	**8.00**	1.12	**8.00**	1.12	**8.00**	1.12
	Cement Treated CTABC	0.23	1.0								
	Lime Stabilized Subgrade	0.13	1.0								
	Cement Stabilized Subgrade	0.14	1.0								
				Total Structural Number	**2.44**	**Total Structural Number**	**2.44**	**Total Structural Number**	**2.44**	**Total Structural Number**	**4.20**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches								
Asphalt	**3.00**		**3.00**		**3.00**		**7.00**	
ABC	**8.00**	*	**8.00**	*	**8.00**	*	**8.00**	*
CTABC	**-**		**-**		**-**		**-**	
Stabilization	**-**		**-**		**-**		**-**	

* Use prime coat at rate as required in the NCDOT Standard Specifications for Roads and Structures, 2018.

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	November 15, 2018
Site:	I-5878
Location:	Harnett County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	7	7	7
Fine Grained?	No	No	No
Resilient Modulus (M_r) (psi)=	10,628	10,628	10,628
Road Type	Secondary	Secondary	Secondary
Design Equivalent (18 kip) Single Axle Loads (ESALs)	252,333	31,473	683,695
20 Year ADT	890	489	7,102
Design Life (years)	20	20	20
Initial Serviceability	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5
Design Serviceability	1.7	1.7	1.7
Reliability (%)	85	85	85
Standard Normal Deviate (ZR)	-1.036	-1.036	-1.036
Standard Deviation	0.45	0.45	0.45
Required Structural Number	**2.37**	**1.63**	**2.85**

Recommended Flexible Pavement Section

				Y25A (E Broad St)		DR1 & DR1A (New, Bud Hawkins Rd)		NBCD & SBCD (Y-14 ramps)	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**4.00**	1.76	**4.00**	1.76	**4.00**	1.76
	Asphalt Base Course, B25.0C	0.30	-	**-**		**-**		**4.00**	1.20
	ABC Stone	0.14	1.0	**0.00**	0.00	**8.00**	1.12	**0.00**	0.00
	Cement Treated CTABC	0.23	1.0						
	Lime Stabilized Subgrade	0.13	1.0						
	Cement Stabilized Subgrade	0.14	1.0						
				Total Structural Number	**3.08**	**Total Structural Number**	**4.20**	**Total Structural Number**	**4.28**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches							
Asphalt	**7.00**		**7.00**		**11.00**		
ABC	**-**	*	**8.00**	*	**-**	*	
CTABC	**-**		**-**		**-**		
Stabilization	**-**		**-**		**-**		

* Use prime coat at rate as required in the NCDOT Standard Specifications for Roads and Structures, 2018.

ESALs Calculation:

TRAFFIC DATA			
Initial Year:	2018	Projection Year:	2040
Initial Year ADT:	59,800	Proj. Yr. ADT:	83,400
% DUALS:	7	% TTST:	17
		Growth (%):	1.5

DESIGN PARAMETERS			
Construction Year:	2019	Des. Life (Years):	30
Constr. Year ADT:	60,711	30 YEAR ADT=	95,558
DIR %:	50	TERM. SI:	3
LANES/DIRECT:	4	LANE DIST:	0.8
Rural/Urban:	R	Freeway/Other:	F
DUAL FACT (flex).:	0.3	TTST FACT (flex):	1.15
DUAL FACT (rig).:	0.30	TTST FACT (rig):	1.6
Contr. Year ADT (Trucks)	14571		
		ADDITIONAL 18K:	0
DAILY 18K (flex):	6,653	TOTAL 18K (flex):	**72,897,533**
(rigid)	0	(rigid)	

ADDITIONAL ESAL CALCULATIONS**

TTST		Duals	
Trucks Per Day	0	Trucks Per Day	0
Trucks Per Year	0	Trucks Per Year	0
Years	30	Years	30
Total TTST	0	Total Dual	0
ESALs	0	ESALs	0

ESAL (for Asphalt Pavement)

R (%)	95	-
z_R	-1.65	-
S_0	0.45	-
Δ psi	1.2	-
M_R	10,628	psi
SN	6.85	-
W_{18}	75,513,685	ESALS
$\log_{10} W_{18}$	7.88	
W_{18} (Needed)	72,897,533	ESALS

Design Serviceability Loss = $p_o - p_t$

AASHTO Guide for Design of Pavement Structures, 1993.

Route	Initial Year AADT	Future Year AADT (2040)	Duals %	TTST %	Design Life (Years)	No. of Lanes	Directional Split (%)
SR9A (New, Interstate Dr.)	500	700	8.0	1.0	20	2	50
SR11 (Stoney Run Dr)	600	900	10.0	7.0	20	2	50
SR12 (Old State Hwy 55 E)	1,900	2,300	3.0	2.0	20	2	50
SR18 (Jackson Rd/Sampson Ave)	1,500	2,200	5.0	1.0	20	2	50
Y25A (E Broad St)	700	900	10.0	7.0	20	2	50
DR1 & DR1A (New, Bud Hawkins Rd)	300	500	5.0	1.0	20	2	50
NBCD & SBCD (Y-14 ramps)	3,450	7,350	4.0	3.0	20	2	50
Y14RAA New RAB on Spring Branch Rd	4,100	7,200	4.0	1.0	20	2	100
Y14RAB New RAB on Pope Road	3,600	5,300	4.0	1.0	20	2	100
DR10 New Location	500	800	10.0	3.0	20	2	50
Y25 Sampson Ave	2,400	3,700	2.0	1.0	20	2	50
SR9	1,400	1,900	3.0	1.0	20	2	50
Y24 Bud Hawkins Road	550	900	8.0	13.0	20	2	50

	SURFACE		INTERMEDIATE		BASE			Var.			SURF.	LOAD		
	DEPTH	TYPE	DEPTH	TYPE	DEPTH	TYPE	ABC	ABC:	CTABC	STAB[1]	TYPE[2]	LEVEL[3]	SN Prov	SN Req
SR9A (New, Interstate Dr.)	3	S9.5B	0	I19.0C	0	B25.0C	8.0			No			2.44	1.86
SR11 (Stoney Run Dr)	3	S9.5B	4	I19.0C	0	B25.0C	8.0			No			4.20	2.34
SR12 (Old State Hwy 55 E)	3	S9.5B	0	I19.0C	0	B25.0C	8.0			No			2.44	2.26
SR18 (Jackson Rd/Sampson Ave)	3	S9.5B	4	I19.0C	0	B25.0C	8.0			No			4.20	2.15
Y25A (E Broad St)	3	S9.5B	4	I19.0C	4	B25.0C	0.0			No			4.28	2.37
DR1 & DR1A (New, Bud Hawkins Rd)	3	S9.5B	4	I19.0C	0	B25.0C	8.0			No			4.20	1.63
NBCD & SBCD (Y-14 ramps)	3	S9.5C	4	I19.0C	0	B25.0C	0.0			No			3.08	2.85
Y14RAA New RAB on Spring Branch Rd	3	S9.5C	4	I19.0C	0	B25.0C	8.0			No			4.20	2.92
Y14RAB New RAB on Pope Road	3	S9.5C	4	I19.0C	0	B25.0C	8.0			No			4.20	2.80
DR10 New Location	3	S9.5B	0	I19.0C	4	B25.0C	0.0			No			2.52	2.08
Y25 Sampson Ave	3	S9.5B	4	I19.0C	4	B25.0C	0.0			No			4.28	2.17
SR9	3	S9.5B	0	I19.0C	0	B25.0C	8.0			No			2.44	2.01
Y24 Bud Hawkins Road	3	S9.5B	0	I19.0C	0	B25.0C	10.0			No			2.72	2.51

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	November 15, 2018
Site:	I-5883
Location:	Harnett County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	7	7	7	7
Fine Grained?	No	No	No	No
Resilient Modulus (M_r) (psi)=	10,628	10,628	10,628	10,628
Road Type	Secondary	Secondary	Secondary	Secondary
Design Equivalent (18 kip) Single Axle Loads (ESALs)	18,668	382,143	303,323	790,886
20 Year ADT	194	2,380	890	2,580
Design Life (years)	20	20	20	20
Initial Serviceability	4.2	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5	2.5
Design Serviceability	1.7	1.7	1.7	1.7
Reliability (%)	85	85	85	85
Standard Normal Deviate (ZR)	-1.036	-1.036	-1.036	-1.036
Standard Deviation	0.45	0.45	0.45	0.45
Required Structural Number	**1.48**	**2.56**	**2.45**	**2.93**

Recommended Flexible Pavement Section

				SR 13 (Jerry Carr Rd)		SR 14 (Saddlebred Rd/ Rooms to Go Way)		SR 15 (George Perry Lee Rd)		SR 16 (Sadler Rd)	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**-**		**-**		**-**		**2.50**	1.10
	Asphalt Base Course, B25.0C	0.30	-	**-**		**-**		**-**		**0.00**	0.00
	ABC Stone	0.14	1.0	**8.00**	1.12	**10.00**	1.40	**8.00**	1.12	**8.00**	1.12
	Cement Treated CTABC	0.23	1.0								
	Lime Stabilized Subgrade	0.13	1.0								
	Cement Stabilized Subgrade	0.14	1.0								
				Total Structural Number	**2.44**	**Total Structural Number**	**2.72**	**Total Structural Number**	**2.44**	**Total Structural Number**	**3.54**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches								
Asphalt	**3.00**		**3.00**		**3.00**		**5.50**	
ABC	**8.00**	*	**10.00**	*	**8.00**	*	**8.00**	*
CTABC	**-**		**-**		**-**		**-**	
Stabilization	**-**		**-**		**-**		**-**	

* Use prime coat at rate as required in the NCDOT Standard Specifications for Roads and Structures, 2018.

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	November 15, 2018
Site:	I-5883
Location:	Harnett County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	7	7	7	7
Fine Grained?	No	No	No	No
Resilient Modulus (M_r) (psi)=	10,628	10,628	10,628	10,628
Road Type	Secondary	Secondary	Secondary	Secondary
Design Equivalent (18 kip) Single Axle Loads (ESALs)	335,810	303,323	382,143	18,668
20 Year ADT	695	890	2,380	194
Design Life (years)	20	20	20	20
Initial Serviceability	4.2	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5	2.5
Design Serviceability	1.7	1.7	1.7	1.7
Reliability (%)	85	85	85	85
Standard Normal Deviate (ZR)	-1.036	-1.036	-1.036	-1.036
Standard Deviation	0.45	0.45	0.45	0.45
Required Structural Number	**2.50**	**2.45**	**2.56**	**1.48**

Recommended Flexible Pavement Section

				SR 17 (Robin Hood Rd)		Y26 (New, George Perry Lee Rd)		Y32 (New, Saddlebred Rd)		DR2 (New, Jerry Carr)	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**-**		**-**		**-**		**-**	
	Asphalt Base Course, B25.0C	0.30	-	**-**		**-**		**0.00**	0.00	**0.00**	0.00
	ABC Stone	0.14	1.0	**10.00**	1.40	**8.00**	1.12	**10.00**	1.40	**8.00**	1.12
	Cement Treated CTABC	0.23	1.0								
	Lime Stabilized Subgrade	0.13	1.0								
	Cement Stabilized Subgrade	0.14	1.0								
				Total Structural Number	**2.72**	**Total Structural Number**	**2.44**	**Total Structural Number**	**2.72**	**Total Structural Number**	**2.44**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches								
Asphalt	**3.00**		**3.00**		**3.00**		**3.00**	
ABC	**10.00**	*	**8.00**	*	**10.00**	*	**8.00**	*
CTABC	**-**		**-**		**-**		**-**	
Stabilization	**-**		**-**		**-**		**-**	

* Use prime coat at rate as required in the NCDOT Standard Specifications for Roads and Structures, 2018.

ESALs Calculation:

TRAFFIC DATA			
Initial Year:	2018	Projection Year:	2040
Initial Year ADT:	59,800	Proj. Yr. ADT:	83,400
% DUALS:	7	% TTST:	17
		Growth (%):	1.5

DESIGN PARAMETERS			
Construction Year:	2019	Des. Life (Years):	30
Constr. Year ADT:	60,711	30 YEAR ADT=	95,558
DIR %:	50	TERM. SI:	3
LANES/DIRECT:	4	LANE DIST:	0.8
Rural/Urban:	R	Freeway/Other:	F
DUAL FACT (flex).:	0.3	TTST FACT (flex):	1.15
DUAL FACT (rig).:	0.30	TTST FACT (rig):	1.6
Contr. Year ADT (Trucks)	14571		
		ADDITIONAL 18K:	0
DAILY 18K (flex):	6,653	TOTAL 18K (flex):	**72,897,533**
(rigid)	0	(rigid)	

ADDITIONAL ESAL CALCULATIONS**

TTST		Duals	
Trucks Per Day	0	Trucks Per Day	0
Trucks Per Year	0	Trucks Per Year	0
Years	30	Years	30
Total TTST	0	Total Dual	0
ESALs	0	ESALs	0

ESAL (for Asphalt Pavement)

R (%)	95	-
z_R	-1.65	-
S_0	0.45	-
Δ psi	1.2	-
M_R	10,628	psi
SN	6.85	-
W_{18}	75,513,685	ESALS
$\log_{10} W_{18}$	7.88	
W_{18} (Needed)	72,897,533	ESALS

Design Serviceability Loss = $p_o - p_t$

AASHTO Guide for Design of Pavement Structures, 1993.

Route	Initial Year AADT	Future Year AADT (2040)	Duals %	TTST %	Design Life (Years)	No. of Lanes	Directional Split (%)
SR 13 (Jerry Carr Rd)	100	200	10.0	1.0	20	2	50
SR 14 (Saddlebred Rd/ Rooms to Go Way)	2,000	2,400	5.0	4.0	20	2	50
SR 15 (George Perry Lee Rd)	700	900	7.0	10.0	20	2	50
SR 16 (Sadler Rd)	2,200	2,600	5.0	9.0	20	2	50
SR 17 (Robin Hood Rd)	600	700	5.0	15.0	20	2	50
Y26 (New, George Perry Lee Rd)	700	900	7.0	10.0	20	2	50
DR2 (New, Jerry Carr Rd)	100	200	10.0	1.0	20	2	50
Y32 Core Rd (Cul de Sac)	100	200	10.0	1.0	20	2	50

	SURFACE		INTERMEDIATE		BASE			Var.			SURF.	LOAD		
	DEPTH	TYPE	DEPTH	TYPE	DEPTH	TYPE	ABC	ABC:	CTABC	STAB[1]	TYPE[2]	LEVEL[3]	SN Prov	SN Req
SR 13 (Jerry Carr Rd)	3	S9.5B	0	I19.0C	0	B25.0C	8.0			No			2.44	1.48
SR 14 (Saddlebred Rd/ Rooms to Go Way)	3	S9.5B	2.5	I19.0C	0	B25.0C	10.0			No			3.82	2.56
SR 15 (George Perry Lee Rd)	3	S9.5B	0	I19.0C	0	B25.0C	8.0			No			2.44	2.45
SR 16 (Sadler Rd)	3	S9.5B	2.5	I19.0C	0	B25.0C	8.0			No			3.54	2.93
SR 17 (Robin Hood Rd)	3	S9.5B	0	I19.0C	0	B25.0C	10.0			No			2.72	2.50
Y26 (New, George Perry Lee Rd)	3	S9.5B	0	I19.0C	0	B25.0C	8.0			No			2.44	2.45
DR2 (New, Jerry Carr Rd)	3	S9.5B	0	I19.0C	0	B25.0C	8.0			No			2.44	1.48
Y32 Core Rd (Cul de Sac)	3	S9.5B	0	I19.0C	4	B25.0C	0.0			No			2.52	1.48

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	September 9, 2019
Site:	I-5986B-I-95 Widening
Location:	Harnett and Johnston County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	9	9	9	9
Fine Grained?	Yes	Yes	Yes	Yes
Resilient Modulus (M_r) (psi)=	10,426	10,426	10,426	10,426
Road Type	Secondary	Secondary	Secondary	Secondary
Design Equivalent (18 kip) Single Axle Loads (ESALs)	862,677	689,577	136,168	20,743
20 Year ADT	7,018	5,208	0	0
Design Life (years)	20	20	783	194
Initial Serviceability	4.2	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5	2.5
Design Serviceability	1.7	1.7	1.7	1.7
Reliability (%)	85	85	85	85
Standard Normal Deviate (ZR)	-1.036	-1.036	-1.036	-1.036
Standard Deviation	0.45	0.45	0.45	0.45
Required Structural Number	**3.00**	**2.87**	**2.14**	**1.52**

Recommended Flexible Pavement Section

				Y14RAA-New Roundabout on Spring Branch Rd		Y14RAB-New Roundabout on Pope Rd		DR10-New Location		Y32-Core Rd (Cul De Sac)	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**4.00**	1.76	**4.00**	1.76	**0.00**	0.00	**0.00**	0.00
	Asphalt Base Course, B25.0C	0.30	-	**0.00**	0.00	**0.00**	0.00	**4.00**	1.20	**4.00**	1.20
	ABC Stone	0.14	1.0	**8.00**	1.12	**8.00**	1.12	**0.00**	0.00	**0.00**	0.00
	Cement Treated CTABC	0.23	1.0								
	Lime Stabilized Subgrade	0.13	1.0								
	Cement Stabilized Subgrade	0.14	1.0								
				Total Structural Number	**4.20**	**Total Structural Number**	**4.20**	**Total Structural Number**	**2.52**	**Total Structural Number**	**2.52**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches							
Asphalt	**7.00**		**7.00**		**7.00**		**7.00**	
ABC	**8.00**	1.12	**8.00**		**-**		**-**	
CTABC	**-**		**-**		**-**		**-**	
Stabilization	**-**		**-**		**-**		**-**	

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	September 9, 2019
Site:	I-5986B-I-95 Widening
Location:	Harnett and Johnston County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	9	9	9	9
Fine Grained?	Yes	Yes	Yes	Yes
Resilient Modulus (M_r) (psi)=	10,426	10,426	10,426	10,426
Road Type	Secondary	Primary	Freeway	Freeway
Design Equivalent (18 kip) Single Axle Loads (ESALs)	8,140	4,368,148	7,573,184	8,992,430
20 Year ADT	194	15,128	19,448	`
Design Life (years)	20	30	30	30
Initial Serviceability	4.2	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5	3.0
Design Serviceability	1.7	1.7	1.7	1.2
Reliability (%)	85	90	95	95
Standard Normal Deviate (ZR)	-1.036	-1.282	-1.645	-1.645
Standard Deviation	0.45	0.45	0.45	0.45
Required Structural Number	**1.27**	**4.64**	**5.39**	**5.53**

Recommended Flexible Pavement Section

				SR19-SR1834 (Foundation Rd)		Y18RAA-New Roundabout on NC50		Y19RPB-I40 Ramp		Y19RPCA-I40 Ramp	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**0.00**	0.00	**4.00**	1.76	**3.50**	1.54	**3.50**	1.54
	Asphalt Base Course, B25.0C	0.30	-	**4.00**	1.20	**4.00**	1.20	**5.00**	1.50	**5.00**	1.50
	ABC Stone	0.14	1.0	**0.00**	0.00	**8.00**	1.12	**8.00**	1.12	**8.00**	1.12
	Cement Treated CTABC	0.23	1.0								
	Lime Stabilized Subgrade	0.13	1.0								
	Cement Stabilized Subgrade	0.14	1.0								
				Total Structural Number	**2.52**	**Total Structural Number**	**5.40**	**Total Structural Number**	**5.48**	**Total Structural Number**	**5.48**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches				
Asphalt	**7.00**		**11.00**	**11.50**	**11.50**
ABC	**-**	-	**8.00**	**8.00**	**8.00**
CTABC	**-**		**-**	**-**	**-**
Stabilization	**-**		**-**	**-**	**-**

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	September 9, 2019
Site:	I-5986B-I-95 Widening
Location:	Harnett and Johnston County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	9	9	9	9
Fine Grained?	Yes	Yes	Yes	Yes
Resilient Modulus (M_r) (psi)=	10,426	10,426	10,426	10,426
Road Type	Secondary	Secondary	Secondary	Secondary
Design Equivalent (18 kip) Single Axle Loads (ESALs)	373,122	291,636	24,743	164,208
20 Year ADT	695	2,463	295	984
Design Life (years)	20	20	20	20
Initial Serviceability	4.2	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5	2.5
Design Serviceability	1.7	1.7	1.7	1.7
Reliability (%)	85	85	85	85
Standard Normal Deviate (ZR)	-1.036	-1.036	-1.036	-1.036
Standard Deviation	0.45	0.45	0.45	0.45
Required Structural Number	**2.57**	**2.45**	**1.57**	**2.21**

Recommended Flexible Pavement Section

				Y27-SR1809 (Webb Rd)		Y28-SR1100 (Chicopee Rd)		Y28A-E Brocklyn St		Y29-SR1204/SR1101 (S Maket St/ Cub Rd Connection)	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**0.00**	0.00	**4.00**	1.76	**0.00**	0.00	**0.00**	0.00
	Asphalt Base Course, B25.0C	0.30	-	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**4.00**	1.20
	ABC Stone	0.14	1.0	**10.00**	1.40	**8.00**	1.12	**8.00**	1.12	**0.00**	0.00
	Cement Treated CTABC	0.23	1.0								
	Lime Stabilized Subgrade	0.13	1.0								
	Cement Stabilized Subgrade	0.14	1.0								
				Total Structural Number	**2.72**	**Total Structural Number**	**4.20**	**Total Structural Number**	**2.44**	**Total Structural Number**	**2.52**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches							
Asphalt	**3.00**		**7.00**		**3.00**		**7.00**
ABC	**10.00**	1.4	**8.00**		**8.00**		**-**
CTABC	**-**		**-**		**-**		**-**
Stabilization	**-**		**-**		**-**		**-**

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project Information

Date:	September 9, 2019
Site:	I-5986B-I-95 Widening
Location:	Harnett and Johnston County, NC
Project No.:	6235-17-048
Engineer:	vgm

INPUT CELLS

Asphalt

ABC

Design Criteria

CBR Design Value	9	9	9
Fine Grained?	Yes	Yes	Yes
Resilient Modulus (M_r) (psi)=	10,426	10,426	10,426
Road Type	Secondary	Primary	Secondary
Design Equivalent (18 kip) Single Axle Loads (ESALs)	8,140	1,392,532	205,223
20 Year ADT	194	7,356	945
Design Life (years)	20	30	20
Initial Serviceability	4.2	4.2	4.2
Terminal Serviceability	2.5	2.5	2.5
Design Serviceability	1.7	1.7	1.7
Reliability (%)	85	90	85
Standard Normal Deviate (ZR)	-1.036	-1.282	-1.036
Standard Deviation	0.45	0.45	0.45
Required Structural Number	**1.27**	**3.80**	**2.30**

Recommended Flexible Pavement Section

				Y29A-SR1101 Cub Rd (New Service Rd)		Y30-S Walton Dr (NC 242)		Y33-SR1219 (N Walton Av)	
		SN / inch	Drainage Coefficient	Thickness (inches)	SN	Thickness (inches)	SN	Thickness (inches)	SN
	Asphalt Surface Course, S9.5B	0.44	-	**3.00**	1.32	**3.00**	1.32	**3.00**	1.32
	Asphalt Intermediate Course, I19.0C	0.44	-	**0.00**	0.00	**4.00**	1.76	**0.00**	0.00
	Asphalt Base Course, B25.0C	0.30	-	**4.00**	1.20	**0.00**	0.00	**4.00**	1.20
	ABC Stone	0.14	1.0	**0.00**	0.00	**8.00**	1.12	**0.00**	0.00
	Cement Treated CTABC	0.23	1.0						
	Lime Stabilized Subgrade	0.13	1.0						
	Cement Stabilized Subgrade	0.14	1.0						
				Total Structural Number	**2.52**	**Total Structural Number**	**4.20**	**Total Structural Number**	**2.52**

AASHTO Guide for Design of Pavement Structures, 1993.

Thickness, inches					
Asphalt	**7.00**		**7.00**	**7.00**	
ABC	**-**	-	**8.00**	**-**	
CTABC	**-**		**-**	**-**	
Stabilization	**-**		**-**	**-**	

ESALs Calculation:

TRAFFIC DATA			
Initial Year:	2018	Projection Year:	2040
Initial Year ADT:	64,100	Proj. Yr. ADT:	92,900
% DUALS:	5	% TTST:	13
		Growth (%):	1.7

DESIGN PARAMETERS			
Construction Year:	2019	Des. Life (Years):	30
Constr. Year ADT:	65,190	30 YEAR ADT=	108,129
DIR %:	50	TERM. SI:	3
LANES/DIRECT:	3	LANE DIST:	0.8
Rural/Urban:	R	Freeway/Other:	F
DUAL FACT (flex).:	0.3	TTST FACT (flex):	1.15
DUAL FACT (rig).:	0.30	TTST FACT (rig):	1.6
Contr. Year ADT (Trucks)	11734		
		ADDITIONAL 18K:	0
DAILY 18K (flex):	5,584	TOTAL 18K (flex):	**61,182,129**
(rigid)	7,561	(rigid)	82846596

ADDITIONAL ESAL CALCULATIONS**

TTST		Duals	
Trucks Per Day	0	Trucks Per Day	0
Trucks Per Year	0	Trucks Per Year	0
Years	30	Years	30
Total TTST	0	Total Dual	0
ESALs	0	ESALs	0

ESAL (for Asphalt Pavement)

R (%)	95	-
z_R	-1.65	-
S_0	0.45	-
Δ psi	1.2	-
M_R	10,426	psi
SN	6.75	-
W_{18}	64,551,258	ESALS
$\log_{10} W_{18}$	7.81	
W_{18} (Needed)	61,182,129	ESALS

Design Serviceability Loss = $p_o - p_t$

AASHTO Guide for Design of Pavement Structures, 1993.

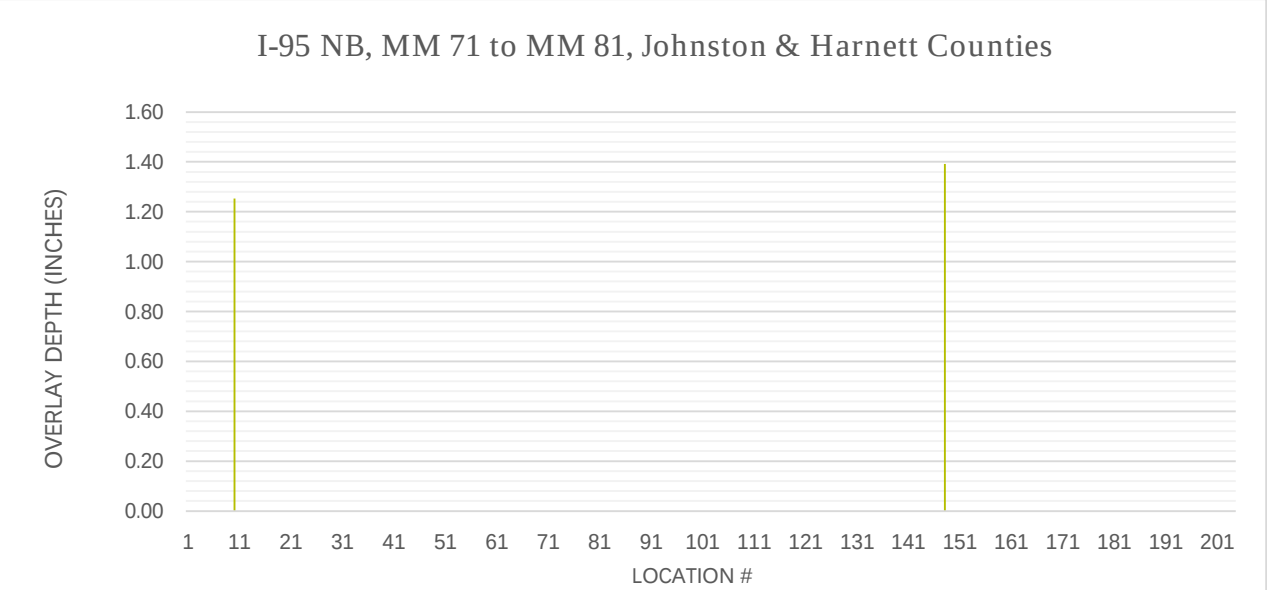
Pavement Design (Y-Lines)

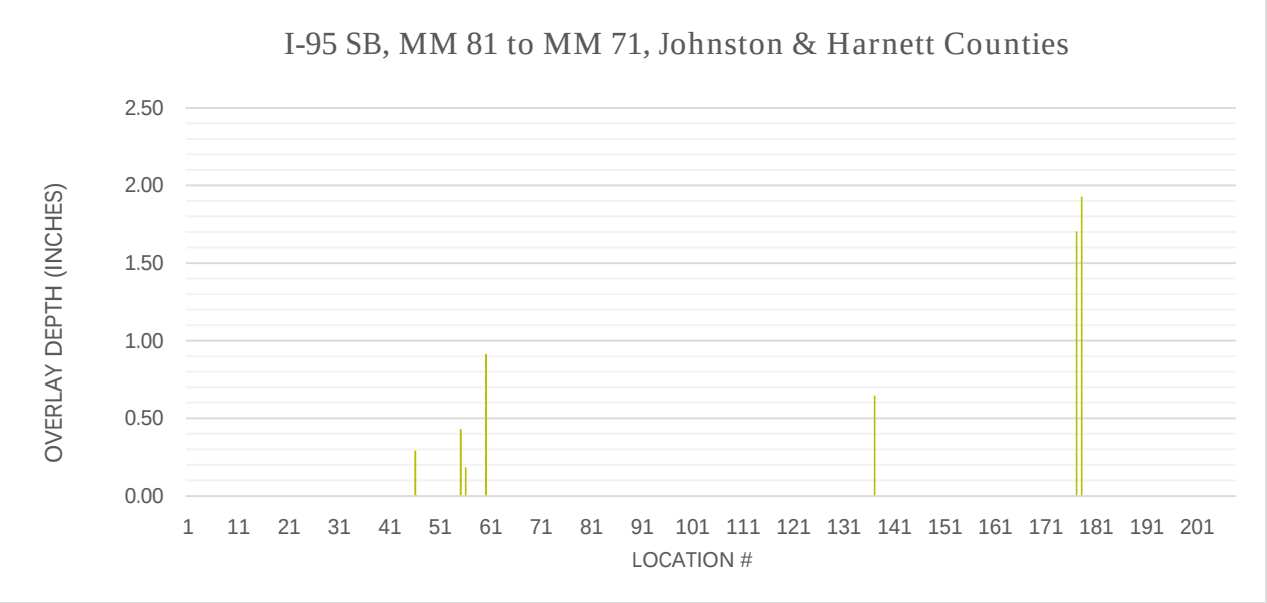
	Init. Year	Fut. Year		Const. YR=	2019																		
				MR (psi)=	10,426																		
LINES	2018	2040	% DU	%TT	Life	Realiab.	S Error	Initial SI	Term SI	ural/Urbar	Road	No. Lanes	Dir, %	Add. ESAL's	Lane Dist	ESAL's	20 Yrs ESAL	20 Yrs AA	SN Rqd	% grth	Frw/Oth	Ru/Urb	Flex Dual Fact	TTST Fact
Y14RAA-New Roundabout on Spring Branch Rd	4,100	7,200	4	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	100	0	1	862,677	862,677	7018	3.00	2.6	O	R	0.3	0.95
Y14RAB-New Roundabout on Pope Rd	3,600	5,300	4	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	100	0	1	689,577	689,577	5208	2.87	1.8	O	R	0.3	0.95
DR10-New Location	500	800	10	3.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	136,168	136,168	783	2.14	2.1	O	R	0.3	0.95
Y32-Core Rd (Cul De Sac)	100	200	10	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	20,743	20,743	194	1.52	3.2	O	R	0.3	0.95
SR19-SR1834 (Foundation Rd)	100	200	2	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	8,140	8,140	194	1.27	3.2	O	R	0.3	0.95
Y18RAA-New Roundabout on NC50	10,400	15,400	3	4.0	30	90	0.45	4.20	2.50	Rural	Primary	1	100	0	1	7,211,185	4,368,148	15128	4.64	1.8	O	R	0.3	0.95
Y19RPB-I40 Ramp	12,000	19,900	3	5.0	30	95	0.45	4.20	2.50	Rural	Freeway	1	100	0	1	12,884,002	7,573,184	19448	5.39	2.3	F	R	0.3	1.15
Y19RPCA-I40 Ramp	14,200	23,700	3	5.0	30	95	0.45	4.20	2.50	Rural	Freeway	1	100	0	1	15,325,118	8,992,430	23155	5.53	2.3	F	R	0.3	1.15
Y27-SR1809 (Webb Rd)	600	700	5	15.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	373,122	373,122	695	2.57	0.7	O	R	0.3	0.95
Y28-SR1100 (Chicopee Rd)	1,800	2,500	3	3.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	291,636	291,636	2463	2.45	1.5	O	R	0.3	0.95
Y28A-E Brocklyn St	200	300	6	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	24,743	24,743	295	1.57	1.8	O	R	0.3	0.95
Y29-SR1204/SR1101 (S Maket St/ Cub Rd Connection)	700	1,000	2	5.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	164,208	164,208	984	2.21	1.6	O	R	0.3	0.95
Y29A-SR1101 Cub Rd (New Service Rd)	100	200	2.0	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	8,140	8,140	194	1.27	3.2	O	R	0.3	0.95
Y30-S Walton Dr (NC 242)	4,900	7,500	5.0	5.0	30	90	0.45	4.20	2.50	Rural	Primary	1	50	0	1	2,318,915	1,392,532	7356	3.80	1.9	O	R	0.3	0.95
Y33-SR1219 (N Walton Av)	850	950	5.0	5.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	205,223	205,223	945	2.30	0.5	O	R	0.3	0.95
DR3	100	200	10.0	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	20,743	20,743	194	1.52	3.2	O	R	0.3	0.95
DR4	100	200	10.0	1.0	20	85	0.45	4.20	2.50	Rural	Secondary	1	50	0	1	20,743	20,743	194	1.52	3.2	O	R	0.3	0.95

Route	Initial Year AADT	Future Year AADT (2040)	Duals %	TTST %	Design Life (Years)	No. of Lanes	Directional Split (%)
Y14RAA-New Roundabout on Spring Branch Rd	4,100	7,200	4.0	1.0	20	1	100
Y14RAB-New Roundabout on Pope Rd	3,600	5,300	4.0	1.0	20	1	100
DR10-New Location	500	800	10.0	3.0	20	1	50
Y32-Core Rd (Cul De Sac)	100	200	10.0	1.0	20	1	50
SR19-SR1834 (Foundation Rd)	100	200	2.0	1.0	20	1	50
Y18RAA-New Roundabout on NC50	10,400	15,400	3.0	4.0	30	1	100
Y19RPB-I40 Ramp	12,000	19,900	3.0	5.0	30	1	100
Y19RPCA-I40 Ramp	14,200	23,700	3.0	5.0	30	1	100
Y27-SR1809 (Webb Rd)	600	700	5.0	15.0	20	1	50
Y28-SR1100 (Chicopee Rd)	1,800	2,500	3.0	3.0	20	1	50
Y28A-E Brocklyn St	200	300	6.0	1.0	20	1	50
Y29-SR1204/SR1101 (S Maket St/ Cub Rd Connection)	700	1,000	2.0	5.0	20	1	50
Y29A-SR1101 Cub Rd (New Service Rd)	100	200	2.0	1.0	20	1	50
Y30-S Walton Dr (NC 242)	4,900	7,500	5.0	5.0	30	1	50
Y33-SR1219 (N Walton Av)	850	950	5.0	5.0	20	1	50
DR3	100	200	10.0	1.0	20	1	50
DR4	100	200	10.0	1.0	20	1	50

	SURFACE		INTERMEDIATE		BASE						
	DEPTH	TYPE	DEPTH	TYPE	DEPTH	TYPE	ABC	CTABC	STAB[1]	SN Prov	SN Req
Y14RAA-New Roundabout on Spring Branch Rd	3	S9.5B	4	I19.0C	0	B25.0C	8.0		No	4.20	3.00
Y14RAB-New Roundabout on Pope Rd	3	S9.5B	4	I19.0C	0	B25.0C	8.0		No	4.20	2.87
DR10-New Location	3	S9.5B	0	I19.0C	4	B25.0C	0.0		No	2.52	2.14
Y32-Core Rd (Cul De Sac)	3	S9.5B	0	I19.0C	4	B25.0C	0.0		No	2.52	1.52
SR19-SR1834 (Foundation Rd)	3	S9.5B	0	I19.0C	4	B25.0C	0.0		No	2.52	1.27
Y18RAA-New Roundabout on NC50	3	S9.5C	4	I19.0C	4	B25.0C	8.0		No	5.40	4.64
Y19RPB-I40 Ramp	3	S9.5C	3.5	I19.0C	5	B25.0C	8.0		No	5.48	5.39
Y19RPCA-I40 Ramp	3	S9.5C	3.5	I19.0C	5	B25.0C	8.0		No	5.48	5.53
Y27-SR1809 (Webb Rd)	3	S9.5B	0	I19.0C	0	B25.0C	10.0		No	2.72	2.57
Y28-SR1100 (Chicopee Rd)	3	S9.5B	4	I19.0C	0	B25.0C	8.0		No	4.20	2.45
Y28A-E Brocklyn St	3	S9.5B	0	I19.0C	0	B25.0C	8.0		No	2.44	1.57
Y29-SR1204/SR1101 (S Maket St/ Cub Rd Connection)	3	S9.5B	0	I19.0C	4	B25.0C	0.0		No	2.52	2.21
Y29A-SR1101 Cub Rd (New Service Rd)	3	S9.5B	0	I19.0C	4	B25.0C	0.0		No	2.52	1.27
Y30-S Walton Dr (NC 242)	3	S9.5C	4	I19.0C	0	B25.0C	8.0		No	4.20	3.80
Y33-SR1219 (N Walton Av)	3	S9.5B	0	I19.0C	4	B25.0C	0.0		No	2.52	2.30

Appendix II– FWD Analyses


I-95 NB, MM 71 to MM 81, Johnston & Harnett Counties
OVERLAY DEPTH (INCHES)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1 11 21 31 41 51 61 71 81 91 101 111 121 131 141 151 161 171 181 191 201
LOCATION #


I-95 SB, MM 81 to MM 71, Johnston & Harnett Counties
OVERLAY DEPTH (INCHES)
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2.00
1.50
1.00
0.50
0.00
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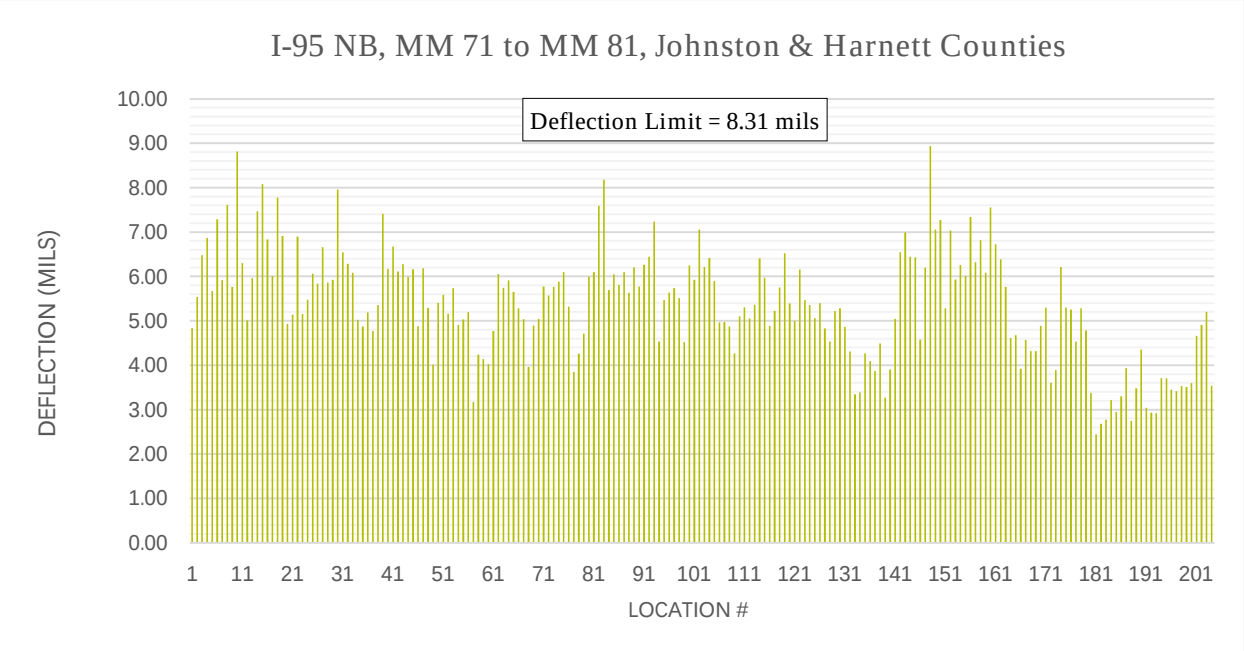
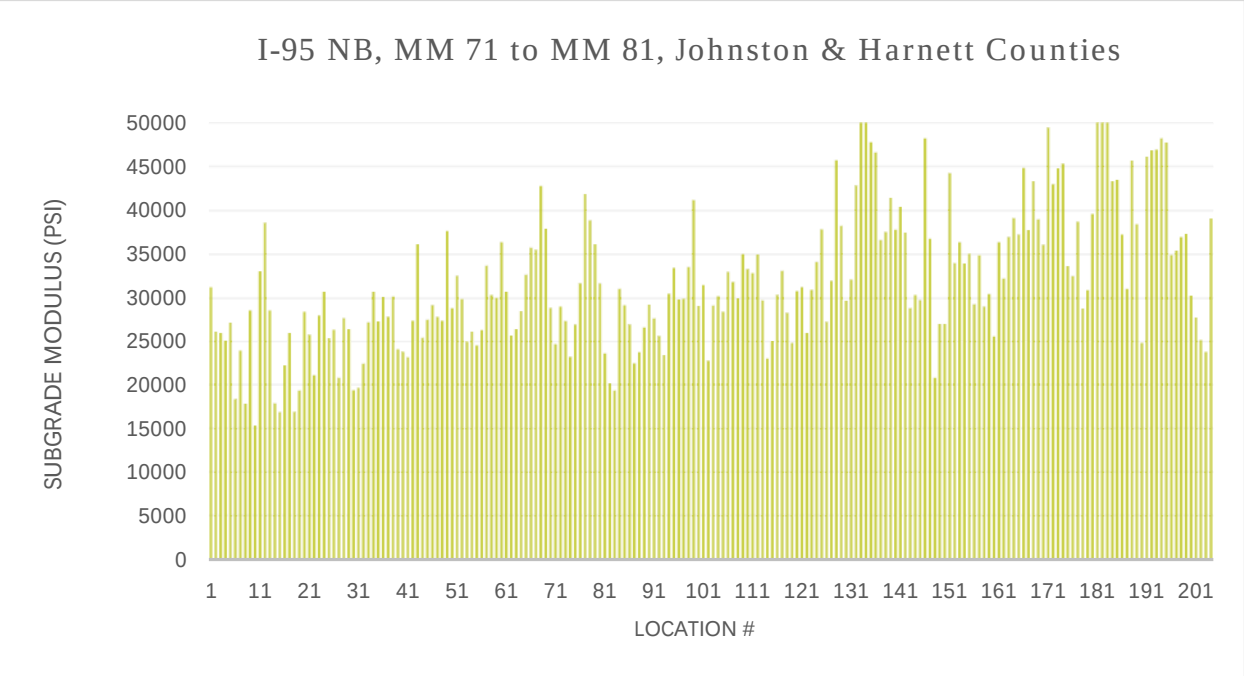
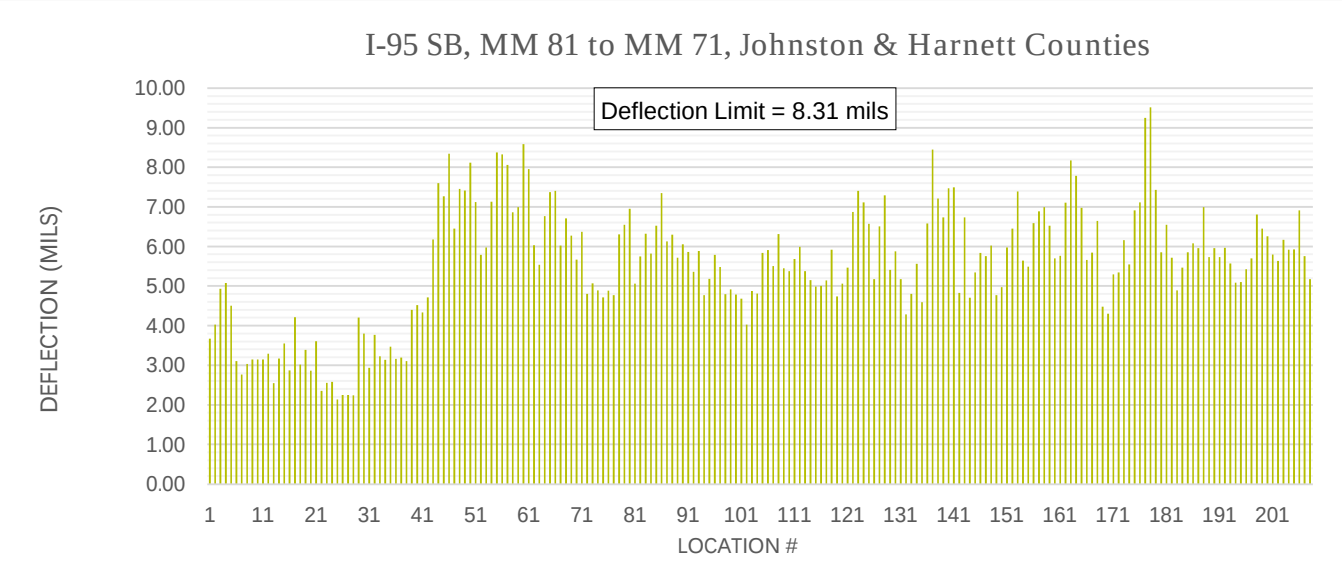
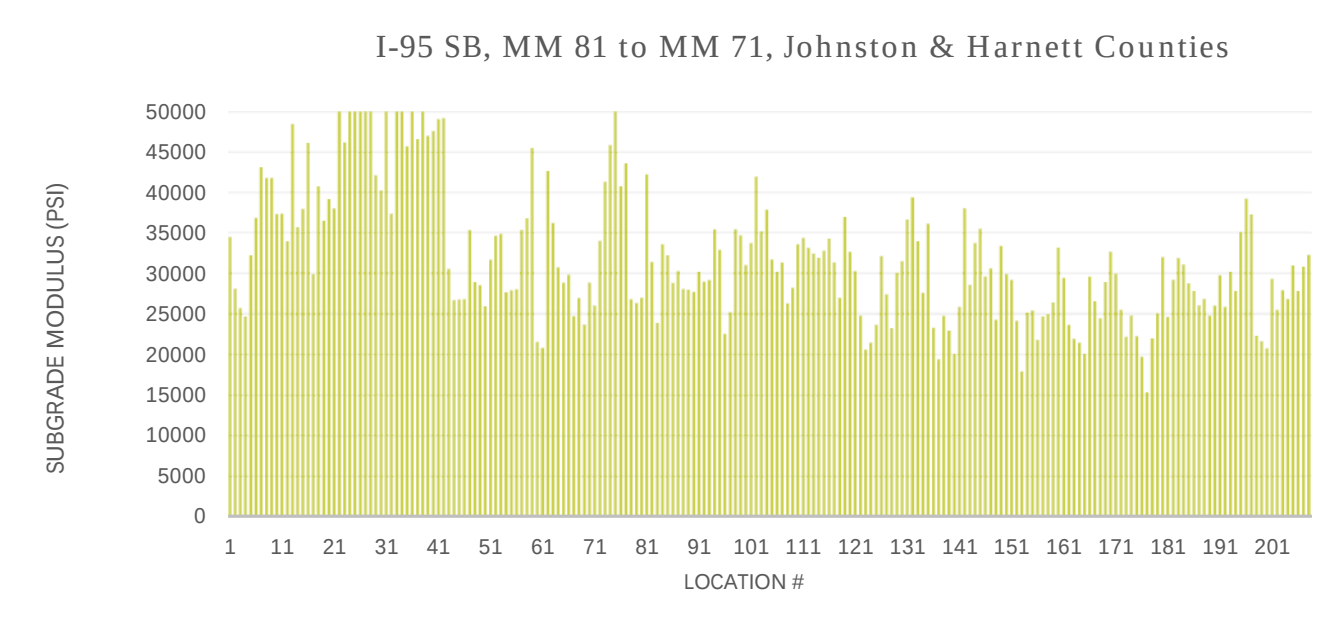
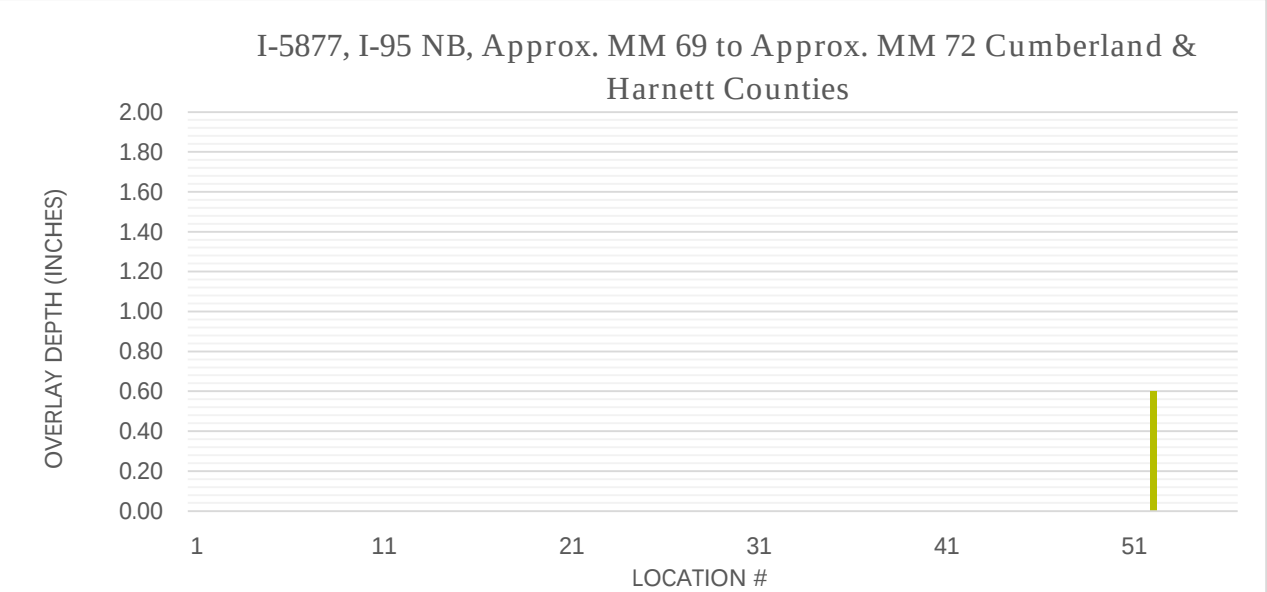
LOCATION #

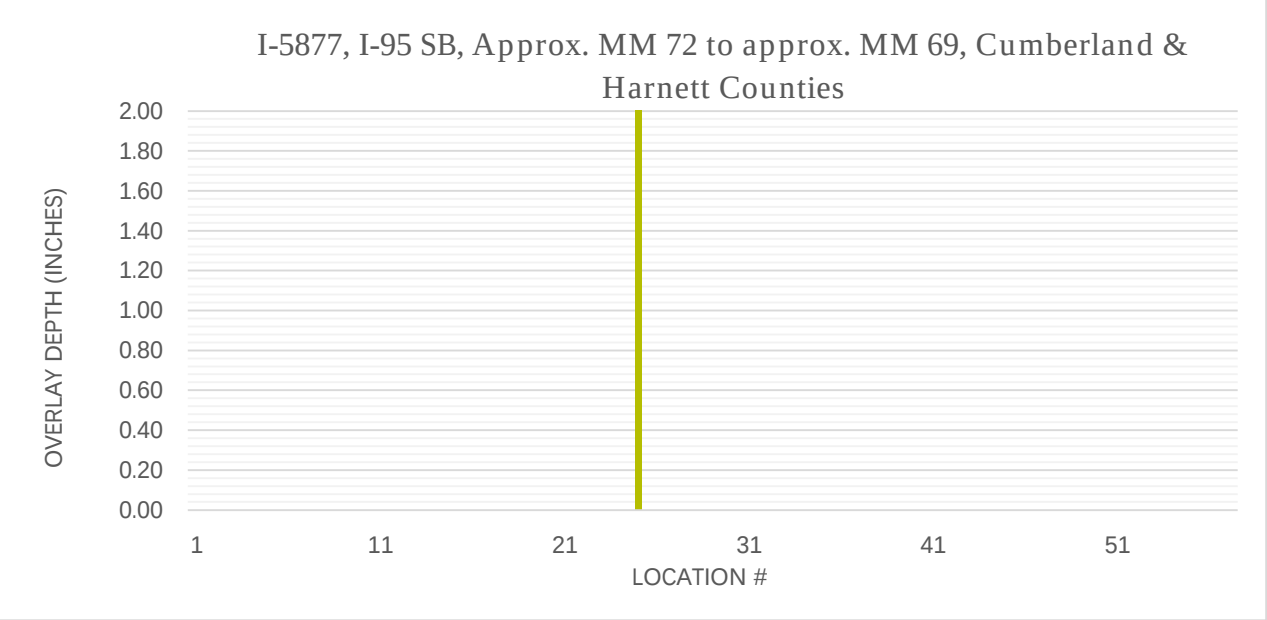

I-95 NB, MM 71 to MM 81, Johnston & Harnett Counties
Deflection Limit = 8.31 mils
DEFLECTION (MILS)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1 11 21 31 41 51 61 71 81 91 101 111 121 131 141 151 161 171 181 191 201
LOCATION #

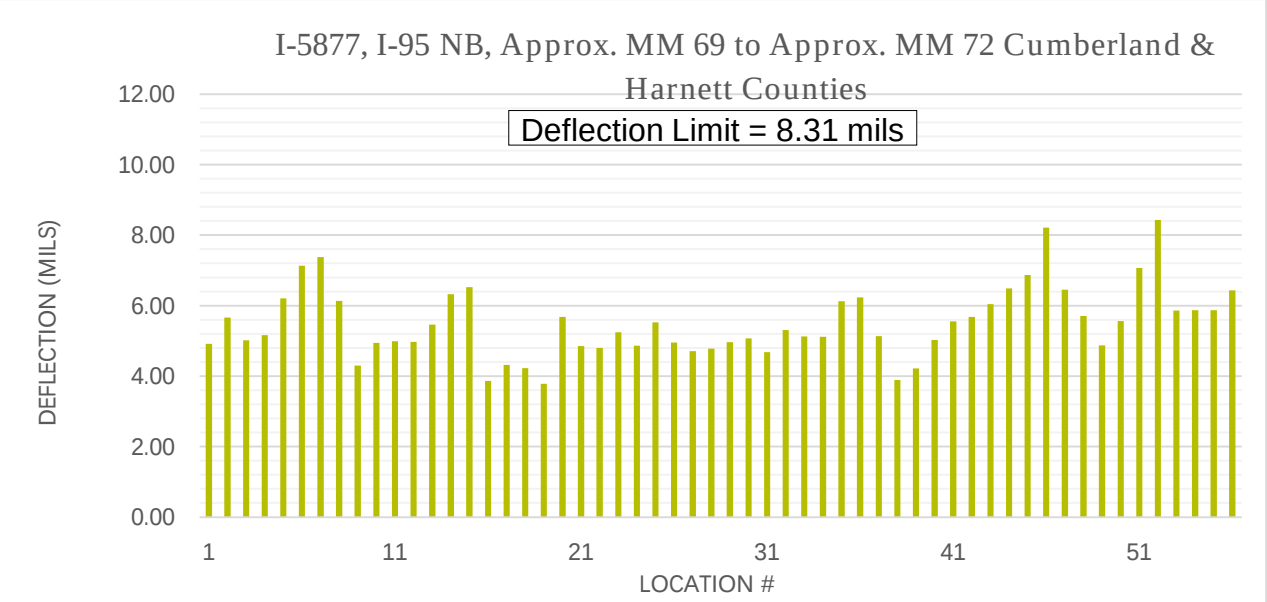

I-95 NB, MM 71 to MM 81, Johnston & Harnett Counties
SUBGRADE MODULUS (PSI)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1 11 21 31 41 51 61 71 81 91 101 111 121 131 141 151 161 171 181 191 201
LOCATION #

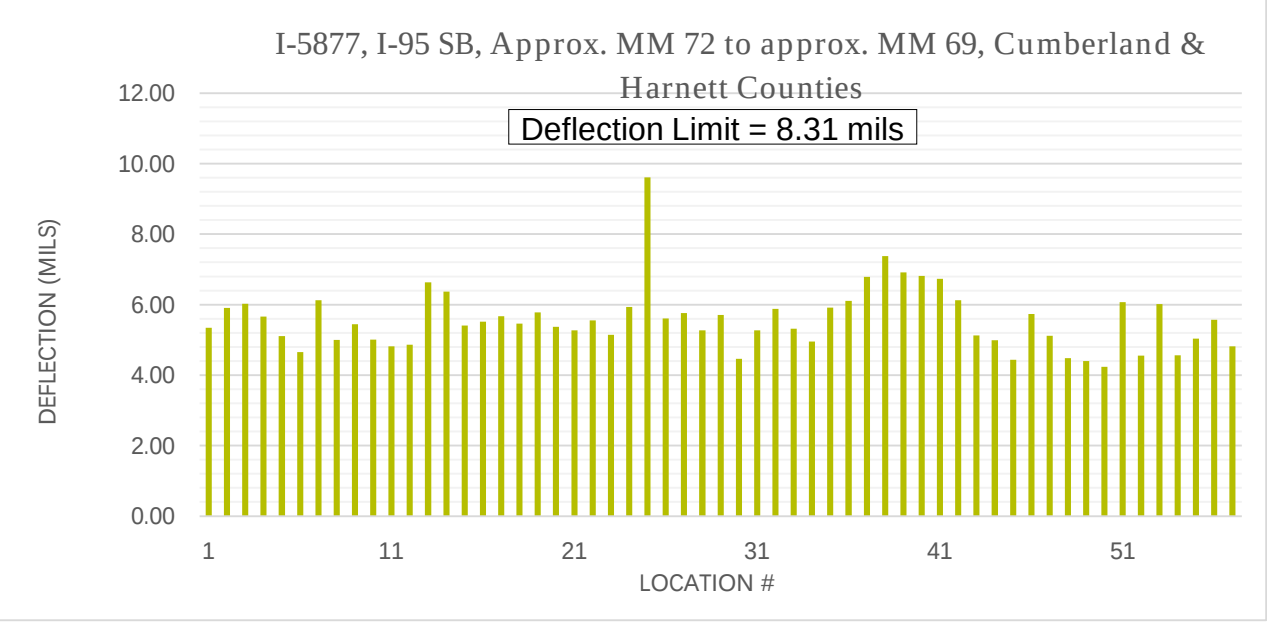

I-95 SB, MM 81 to MM 71, Johnston & Harnett Counties
Deflection Limit = 8.31 mils
DEFLECTION (MILS)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1 11 21 31 41 51 61 71 81 91 101 111 121 131 141 151 161 171 181 191 201
LOCATION #


I-95 SB, MM 81 to MM 71, Johnston & Harnett Counties
SUBGRADE MODULUS (PSI)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1 11 21 31 41 51 61 71 81 91 101 111 121 131 141 151 161 171 181 191 201
LOCATION #

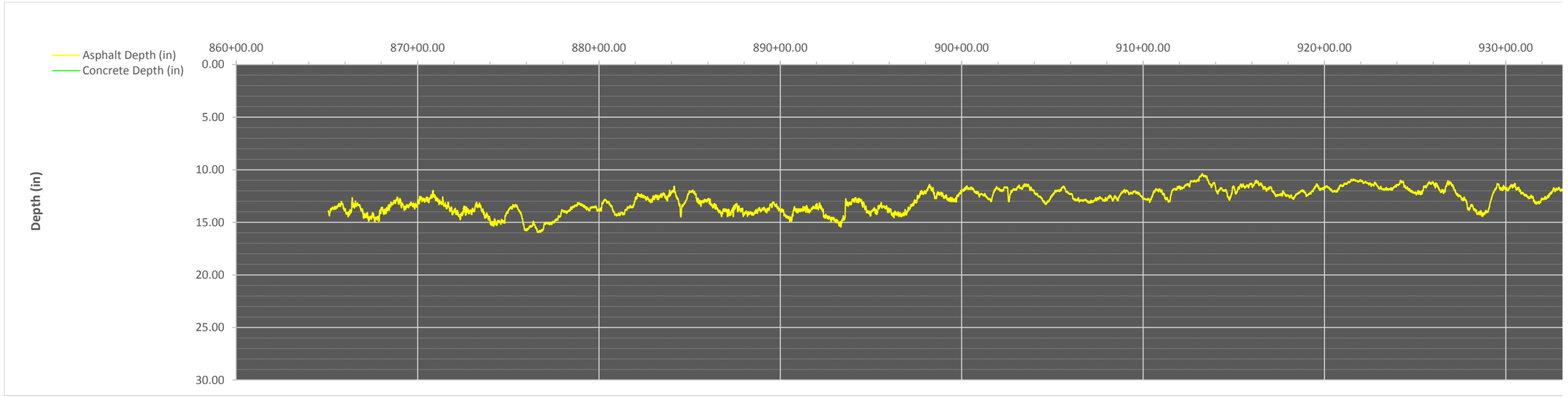

I-5877, I-95 NB, Approx. MM 69 to Approx. MM 72 Cumberland & Harnett Counties
OVERLAY DEPTH (INCHES)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
11
21
31
41
51
LOCATION #

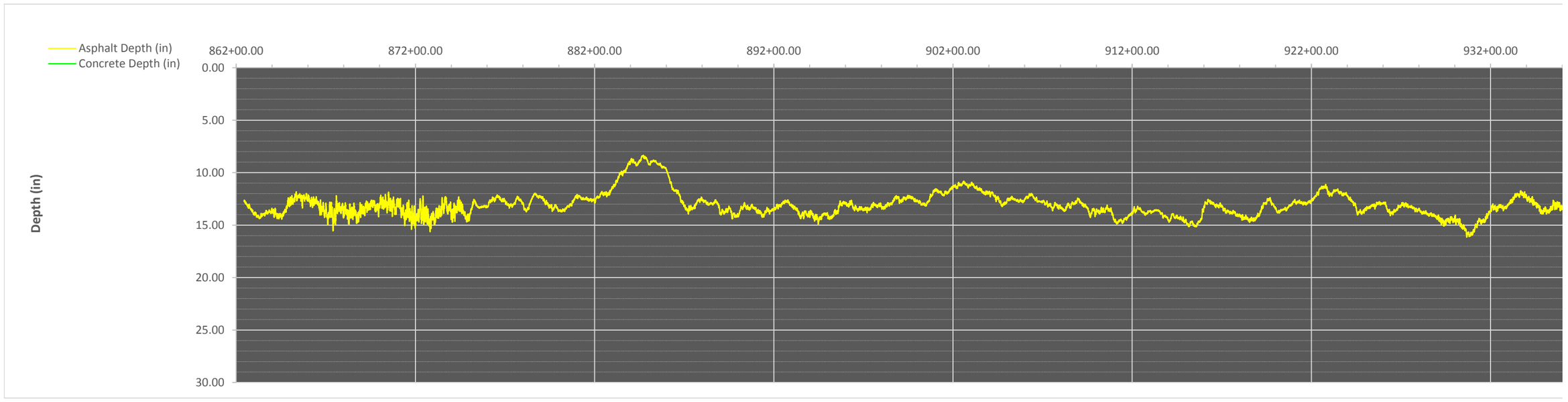

I-5877, I-95 SB, Approx. MM 72 to approx. MM 69, Cumberland & Harnett Counties
OVERLAY DEPTH (INCHES)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
11
21
31
41
51
LOCATION #

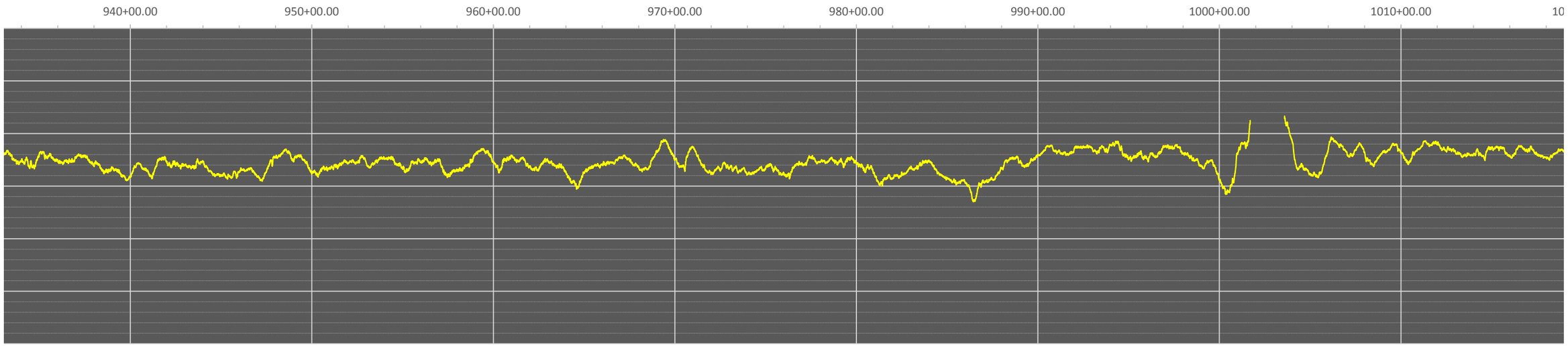

I-5877, I-95 NB, Approx. MM 69 to Approx. MM 72 Cumberland & Harnett Counties
Deflection Limit = 8.31 mils
DEFLECTION (MILS)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1
11
21
31
41
51
LOCATION #

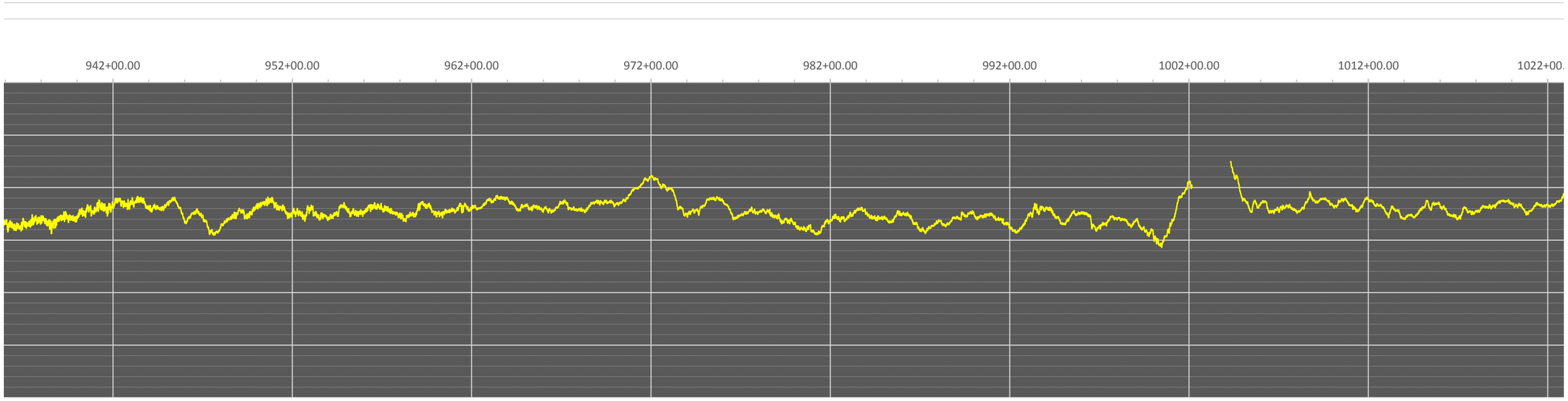

I-5877, I-95 SB, Approx. MM 72 to approx. MM 69, Cumberland & Harnett Counties
Deflection Limit = 8.31 mils
DEFLECTION (MILS)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1
11
21
31
41
51
LOCATION #

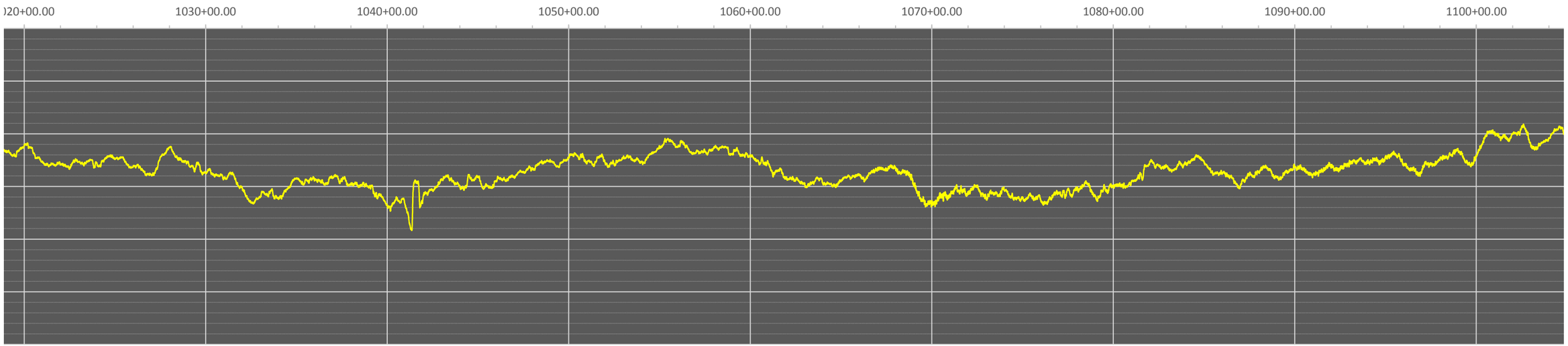
Appendix III – GPR Survey Results

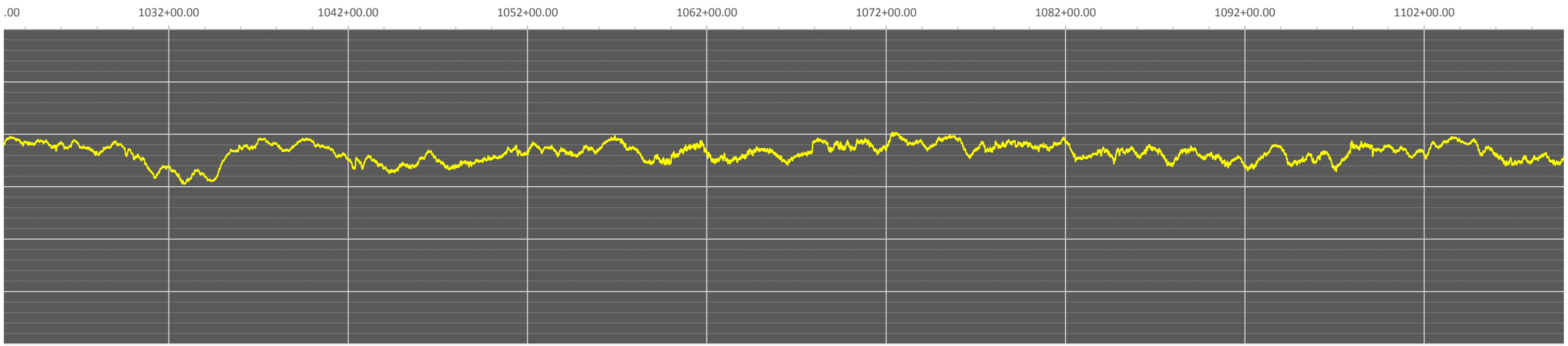

Asphalt Depth (in)
Concrete Depth (in)
860+00.00
870+00.00
880+00.00
890+00.00
900+00.00
910+00.00
920+00.00
930+00.00
Depth (in)
0.00
5.00
10.00
15.00
20.00
25.00
30.00


Asphalt Depth (in)
Concrete Depth (in)
862+00.00
872+00.00
882+00.00
892+00.00
902+00.00
912+00.00
922+00.00
932+00.00
Depth (in)
0.00
5.00
10.00
15.00
20.00
25.00
30.00

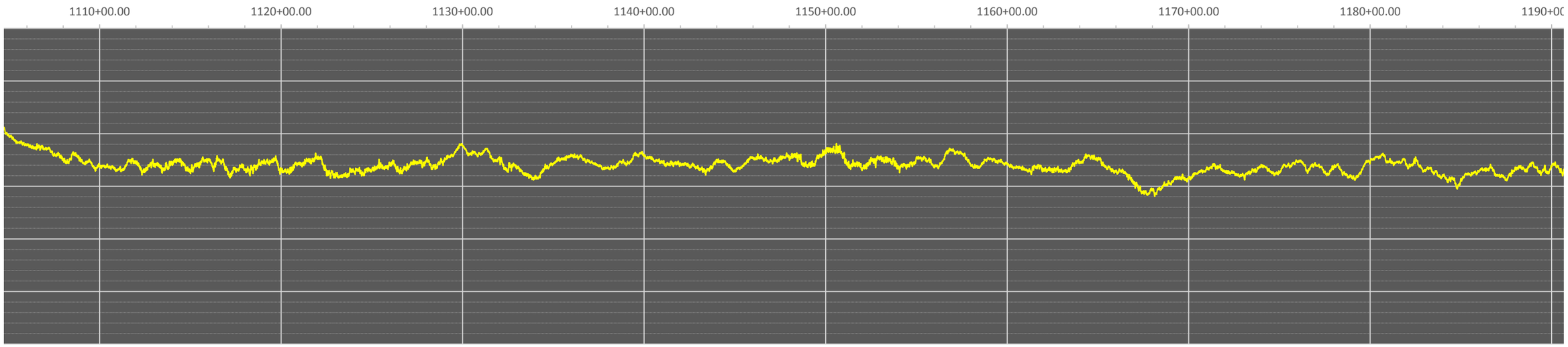

940+00.00
950+00.00
960+00.00
970+00.00
980+00.00
990+00.00
1000+00.00
1010+00.00
10


942+00.00
952+00.00
962+00.00
972+00.00
982+00.00
992+00.00
1002+00.00
1012+00.00
1022+00.

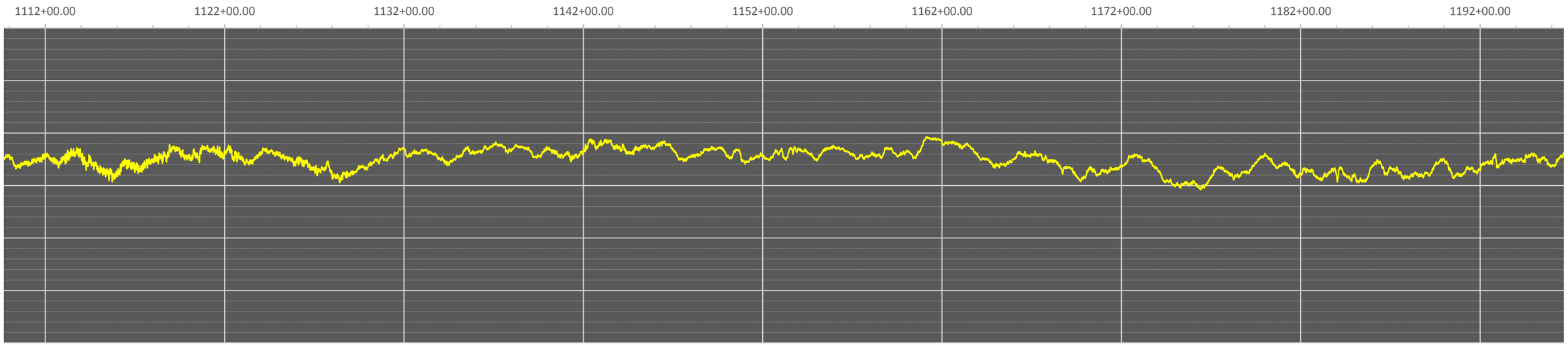

020+00.00
1030+00.00
1040+00.00
1050+00.00
1060+00.00
1070+00.00
1080+00.00
1090+00.00
1100+00.00

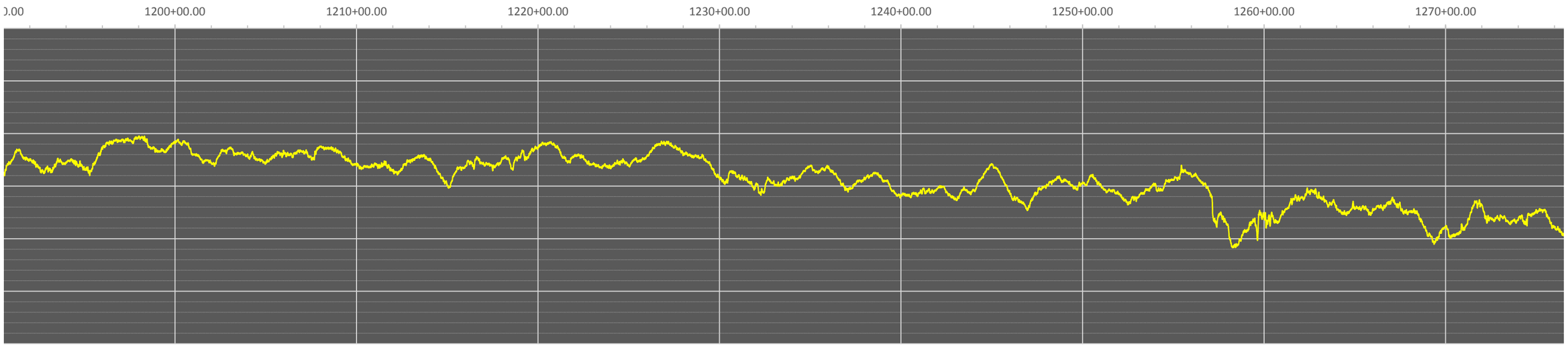

.00
1032+00.00
1042+00.00
1052+00.00
1062+00.00
1072+00.00
1082+00.00
1092+00.00
1102+00.00

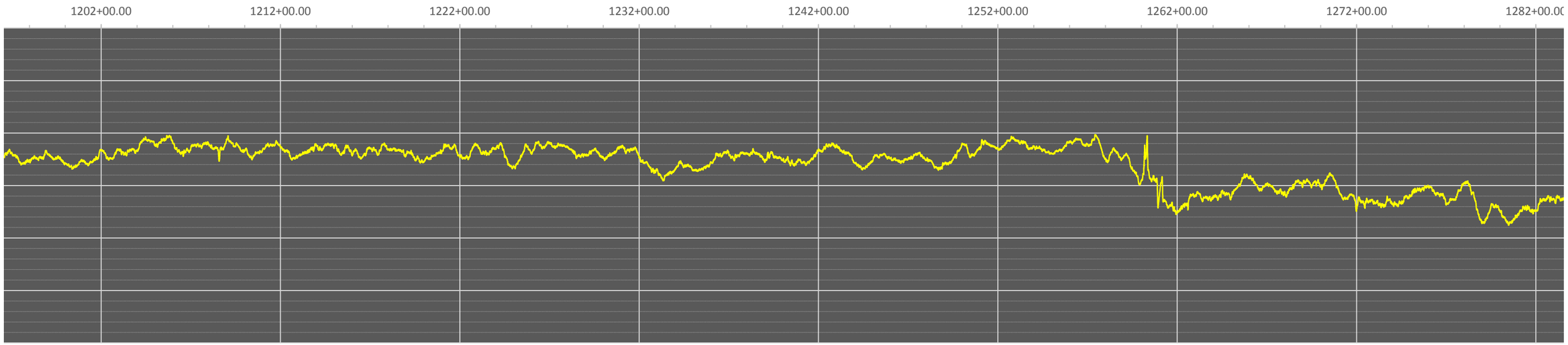
I-95 NB Right Travel Lane

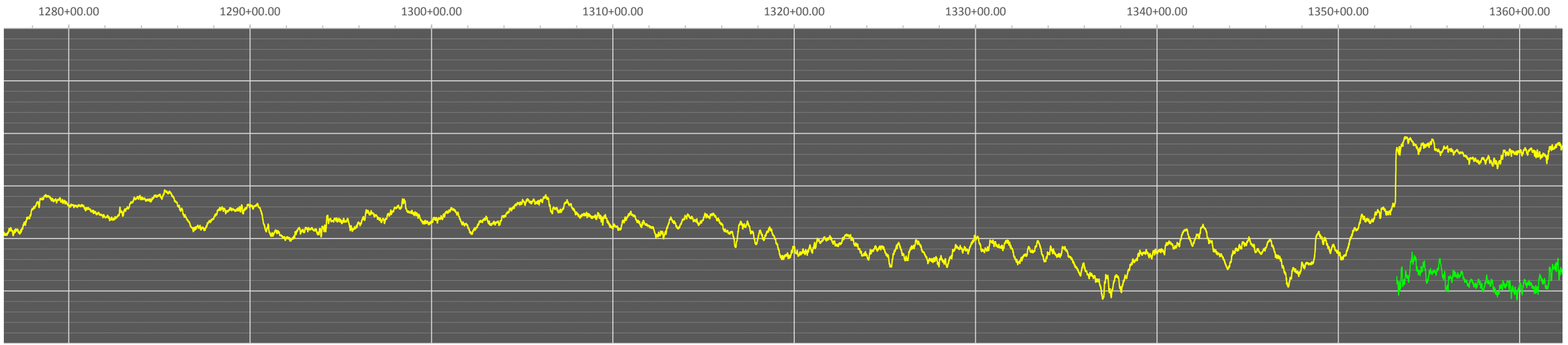


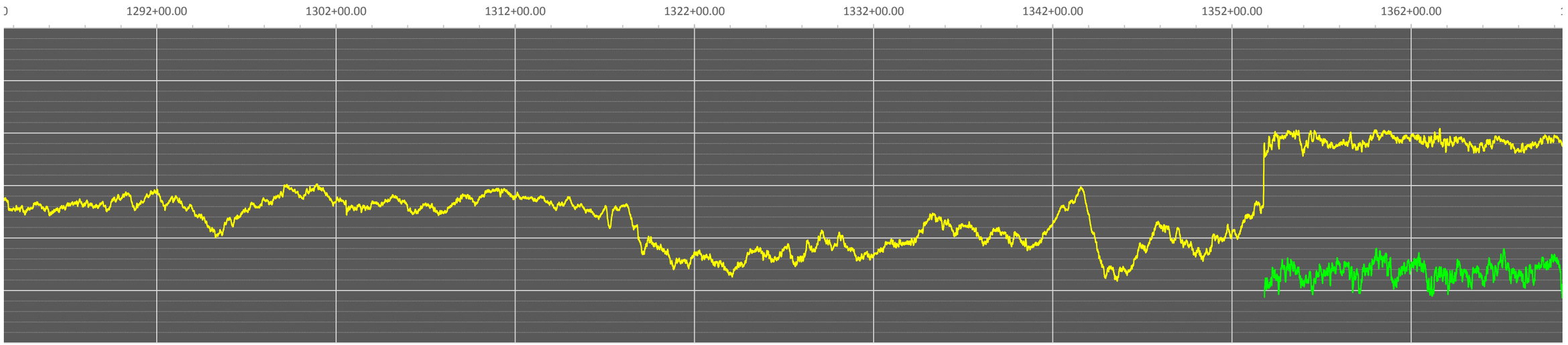
I-95 SB Right Travel Lane

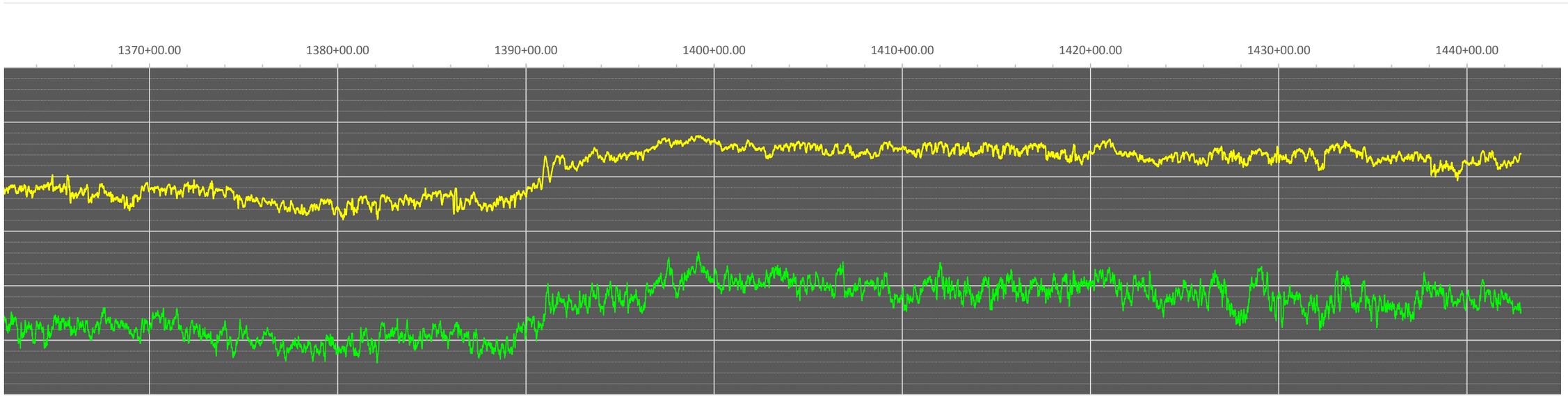



0.00
1200+00.00
1210+00.00
1220+00.00
1230+00.00
1240+00.00
1250+00.00
1260+00.00
1270+00.00


1202+00.00
1212+00.00
1222+00.00
1232+00.00
1242+00.00
1252+00.00
1262+00.00
1272+00.00
1282+00.00


1280+00.00
1290+00.00
1300+00.00
1310+00.00
1320+00.00
1330+00.00
1340+00.00
1350+00.00
1360+00.00


1292+00.00
1302+00.00
1312+00.00
1322+00.00
1332+00.00
1342+00.00
1352+00.00
1362+00.00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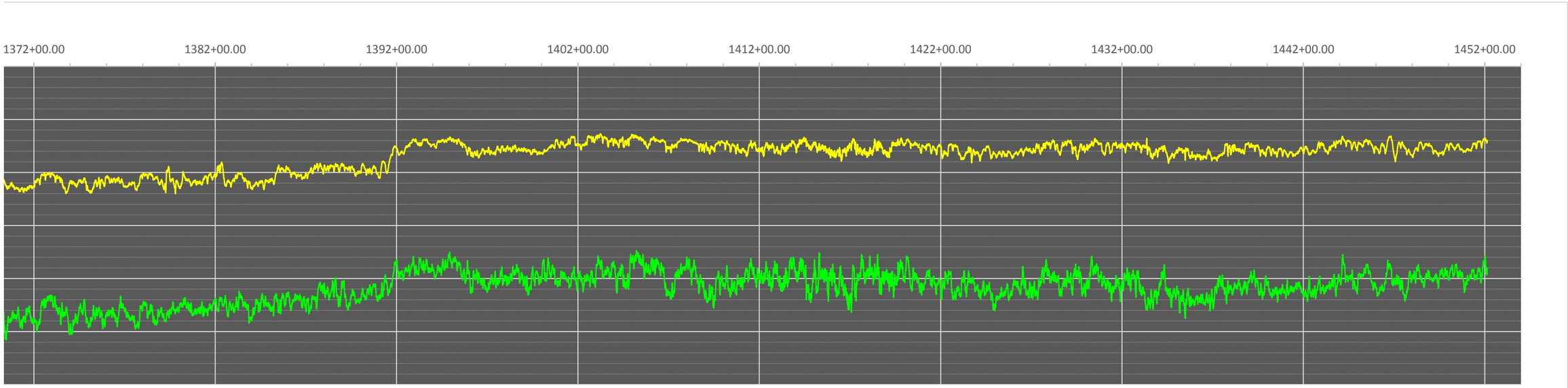
1430+00.00
1440+00.00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1392+00.00
1402+00.00
1412+00.00
1422+00.00
1432+00.00
1442+00.00
1452+00.00

Appendix IV - Kessler DCP Test Results

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-1 NB-OSS **Date:** 1/23/2018 **Personnel:** VGM
Thickness of Stone (in): 0

Test Data	
No. of Blows	Cummulative Penetration (mm)
1	9
1	15
1	22
1	38
1	48
3	77
3	123
3	174
2	204
2	232
2	255
2	276
2	301
2	326
2	350
2	368
2	382
3	404
3	433
3	463
3	495
3	526
3	552
3	580
3	608
3	633
3	658
3	683
3	704
3	726
3	750
3	778
3	805
3	836
3	870
3	893
3	921

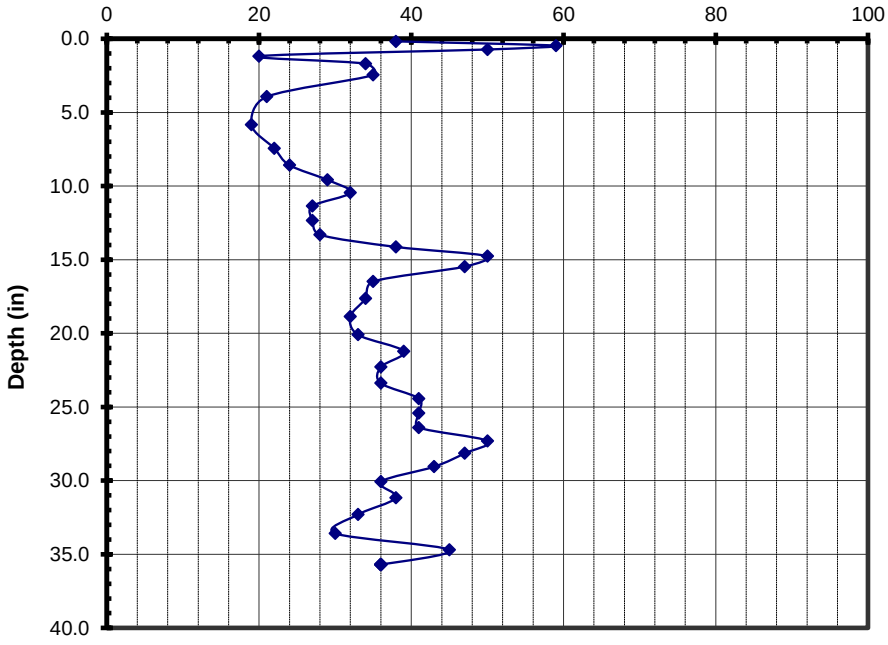
CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	37
Average CBR	n/a	Average CBR	36
Weighted Avera	n/a	Weighted Average	34
Max CBR	n/a	Max CBR	59
Min CBR	n/a	Min CBR	19

Estimated Field CBR Value*



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-2 NB-OSS **Date:** 1/23/2018 **Personnel:** VGM
Thickness of Stone (in): 0

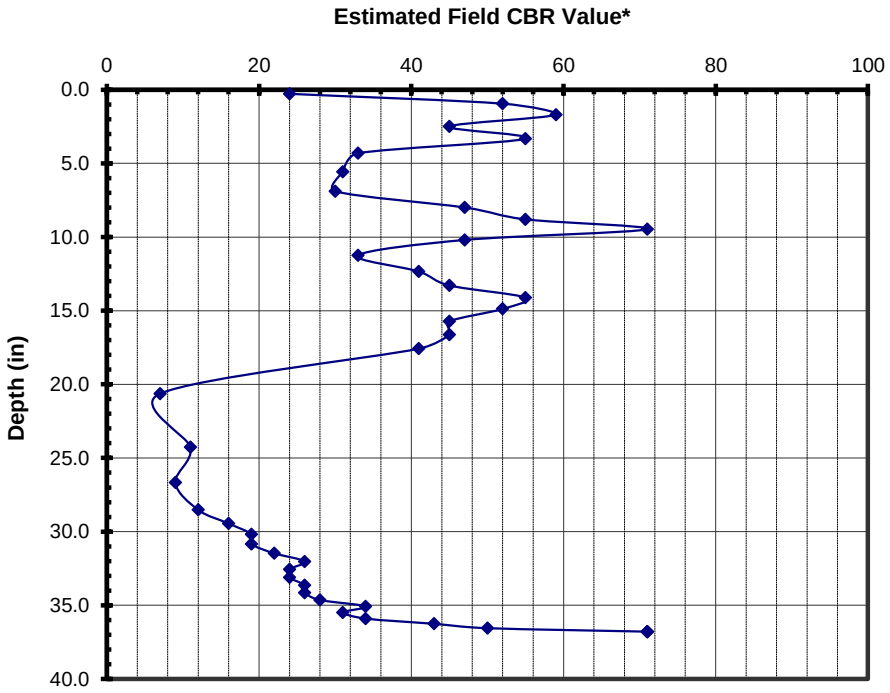
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	14
3	34
3	52
3	75
3	94
3	125
3	158
3	192
3	214
3	233
3	248
3	270
3	301
3	326
3	349
3	368
3	388
3	411
3	434
3	459
3	589
2	644
2	711
1	738
1	758
1	775
1	792
1	807
1	820
1	834
1	848
1	861
1	874
1	886
1	896
1	907
1	917
1	925
1	932
1	937

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	40
Average CBR	n/a	Average CBR	36
Weighted Avera	n/a	Weighted Average	30
Max CBR	n/a	Max CBR	71
Min CBR	n/a	Min CBR	7



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-3 NB-OSS **Date:** 1/23/2018 **Personnel:** VGM
Thickness of Stone (in): 0

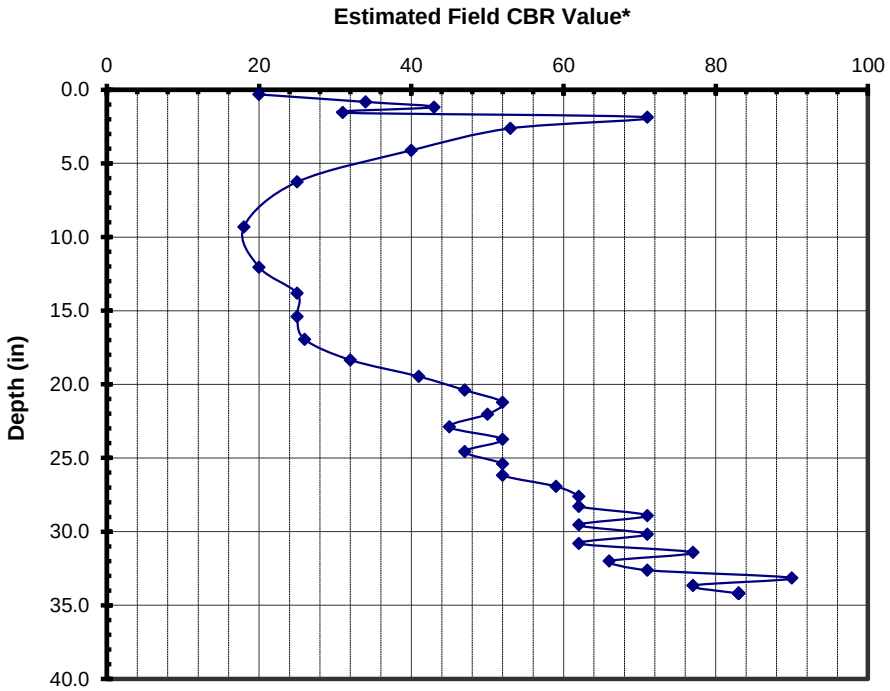
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	16
1	26
1	34
1	45
1	50
5	83
5	126
5	192
5	281
3	331
3	371
3	411
3	450
3	482
3	507
3	529
3	549
3	570
3	593
3	613
3	635
3	655
3	675
3	693
3	710
3	727
3	742
3	759
3	774
3	791
3	805
3	821
3	836
3	848
3	862
3	875

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	36
Average CBR	n/a	Average CBR	50
Weighted Avera	n/a	Weighted Average	42
Max CBR	n/a	Max CBR	90
Min CBR	n/a	Min CBR	18



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-4 NB-OSS **Date:** 2/24/2018 **Personnel:** VGM
Thickness of Stone (in): 0

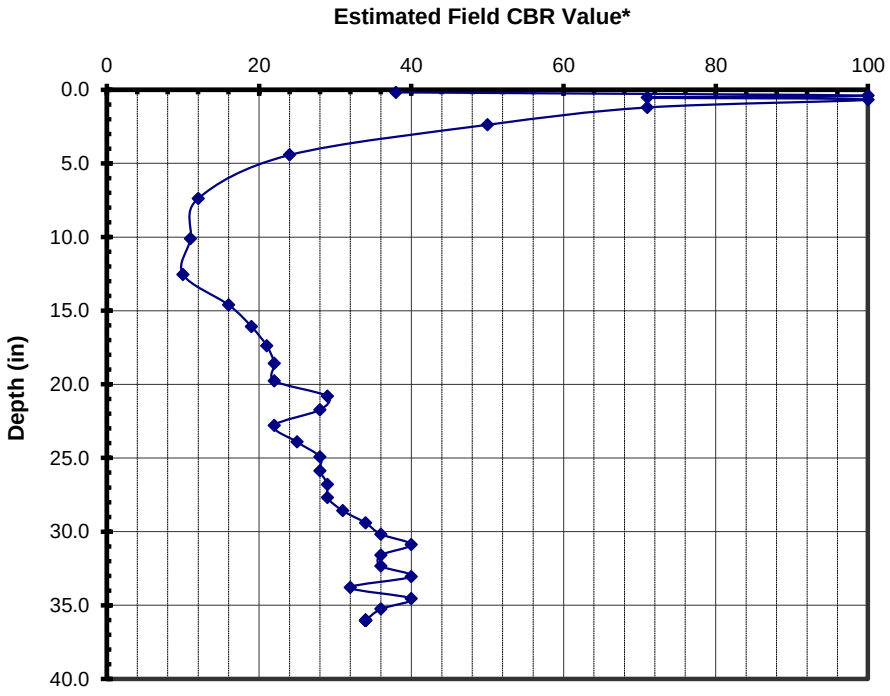
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	9
1	11
1	16
1	18
5	43
5	78
5	147
3	228
2	286
2	351
2	391
2	426
2	457
2	487
2	517
2	540
2	564
2	594
2	621
2	645
2	669
2	692
2	715
2	737
2	757
2	776
2	793
2	812
2	831
2	848
2	869
2	886
2	905
2	925

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	34
Average CBR	n/a	Average CBR	35
Weighted Avera	n/a	Weighted Average	27
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	10



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-5 NB-OSS **Date:** 1/24/2018 **Personnel:** VGM
Thickness of Stone (in): 0

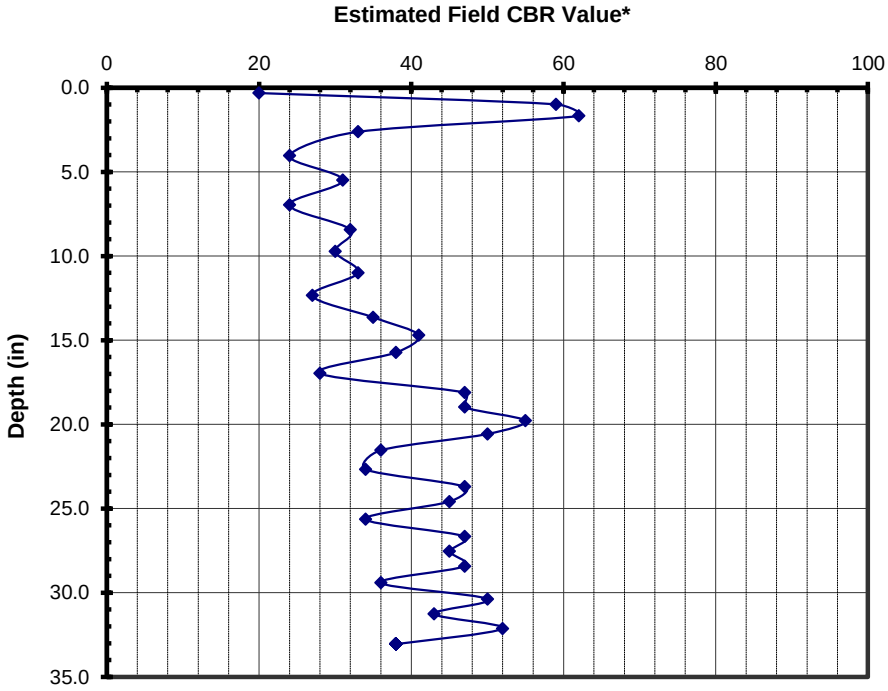
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	16
3	34
3	51
3	82
3	123
3	156
3	198
3	230
3	264
3	295
3	332
3	361
3	386
3	413
3	449
3	471
3	493
3	512
3	533
3	561
3	591
3	613
3	636
3	666
3	688
3	711
3	733
3	761
3	782
3	806
3	826
3	853

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	32
Average CBR	n/a	Average CBR	40
Weighted Avera	n/a	Weighted Average	38
Max CBR	n/a	Max CBR	62
Min CBR	n/a	Min CBR	20



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-6 NB-OSS **Date:** 1/24/2018 **Personnel:** VGM
Thickness of Stone (in): 0

Test Data	
No. of Blows	Cummulative Penetration (mm)
1	8
1	12
1	16
1	19
1	22
5	41
5	58
5	77
5	126
5	219
3	281
3	327
3	363
3	395
3	420
3	446
3	469
3	494
3	512
3	533
3	551
3	570
3	586
3	601
3	618
3	633
5	661
5	687
5	712
5	735
5	755

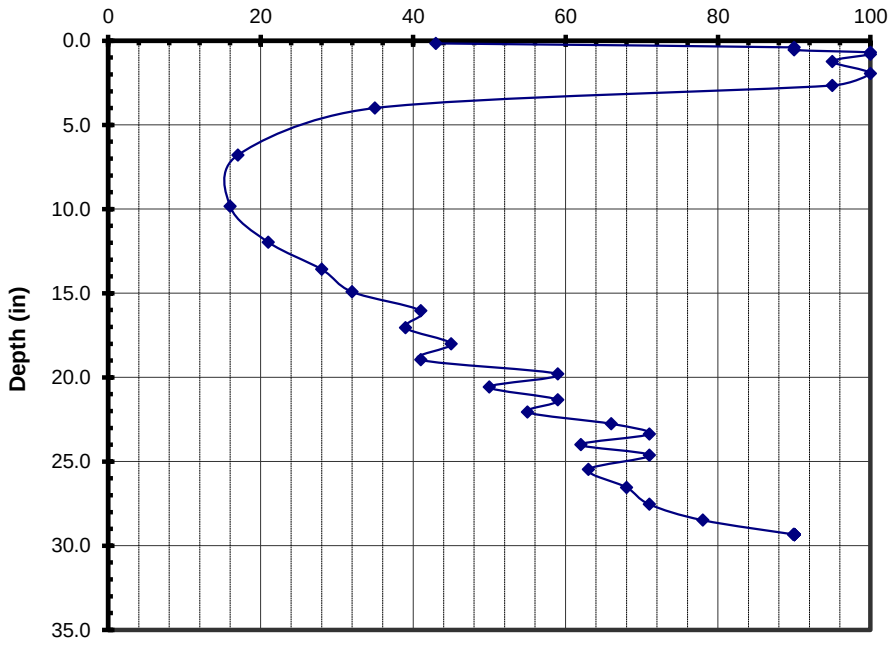
CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	31
Average CBR	n/a	Average CBR	61
Weighted Avera	n/a	Weighted Average	47
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	16

Estimated Field CBR Value*



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-10 NB-OSS **Date:** 1/24/2018 **Personnel:** VGM
Thickness of Stone (in): 0

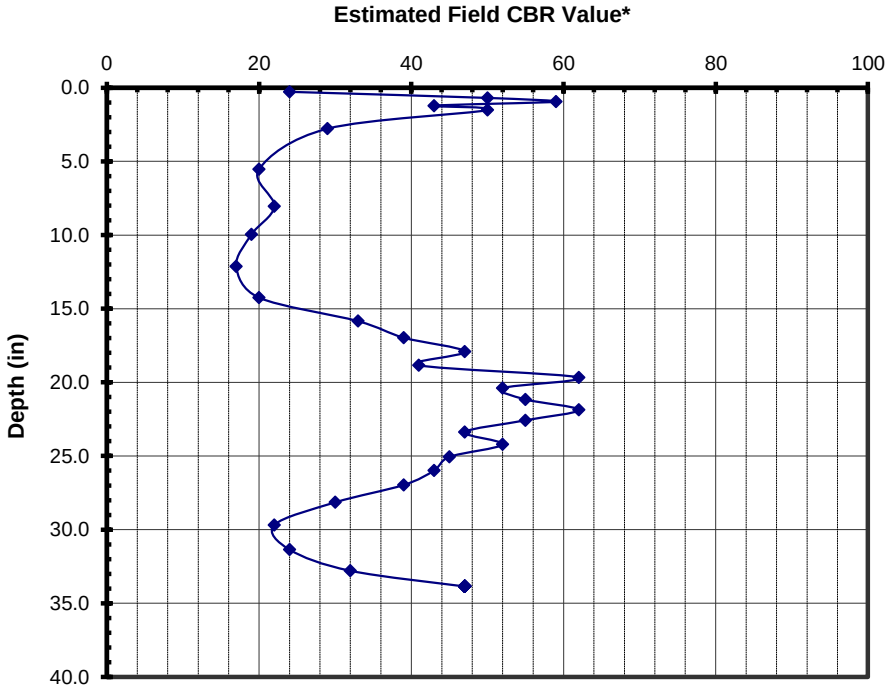
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	14
1	21
1	27
1	35
1	42
5	99
5	182
3	227
3	279
3	337
3	387
3	418
3	444
3	466
3	491
3	508
3	528
3	547
3	564
3	583
3	605
3	625
3	648
3	672
3	698
3	732
3	776
3	817
3	849
3	871

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	30
Average CBR	n/a	Average CBR	39
Weighted Avera	n/a	Weighted Average	33
Max CBR	n/a	Max CBR	62
Min CBR	n/a	Min CBR	17



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-11 NB-OSL **Date:** 1/24/2018 **Personnel:** VGM
Thickness of Stone (in): 0

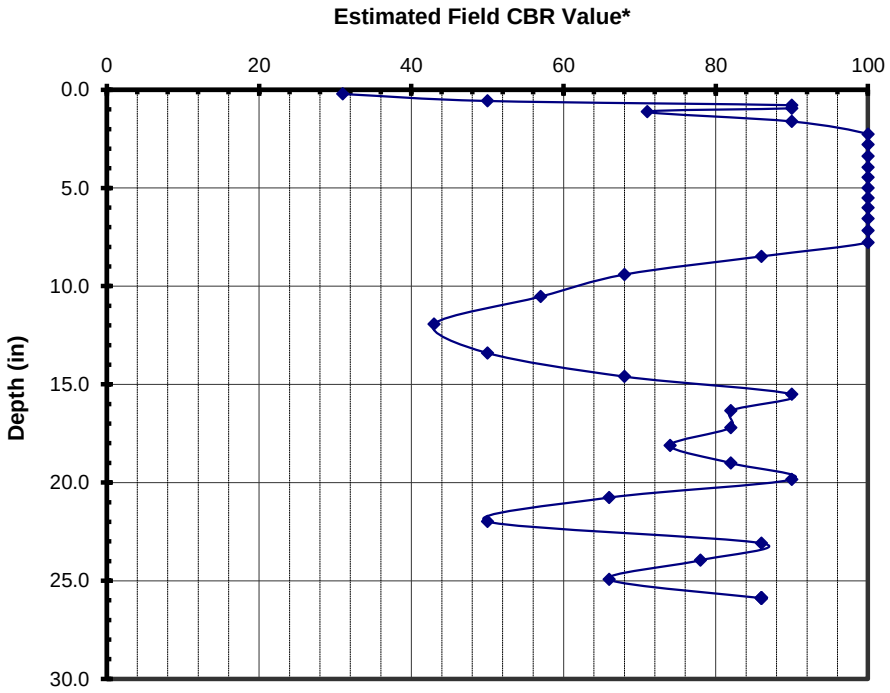
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	11
1	18
1	22
1	26
1	31
5	51
5	64
5	78
5	94
5	107
5	120
5	134
5	146
5	159
5	174
5	190
5	205
5	226
5	252
5	283
5	323
5	358
5	384
5	404
5	426
5	448
5	472
5	494
5	514
5	541
5	576
5	597
5	620
5	647
5	668

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	35
Average CBR	n/a	Average CBR	81
Weighted Avera	n/a	Weighted Average	76
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	31



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-13 SB-OSS **Date:** 1/15/2018 **Personnel:** VGM
Thickness of Stone (in): 0

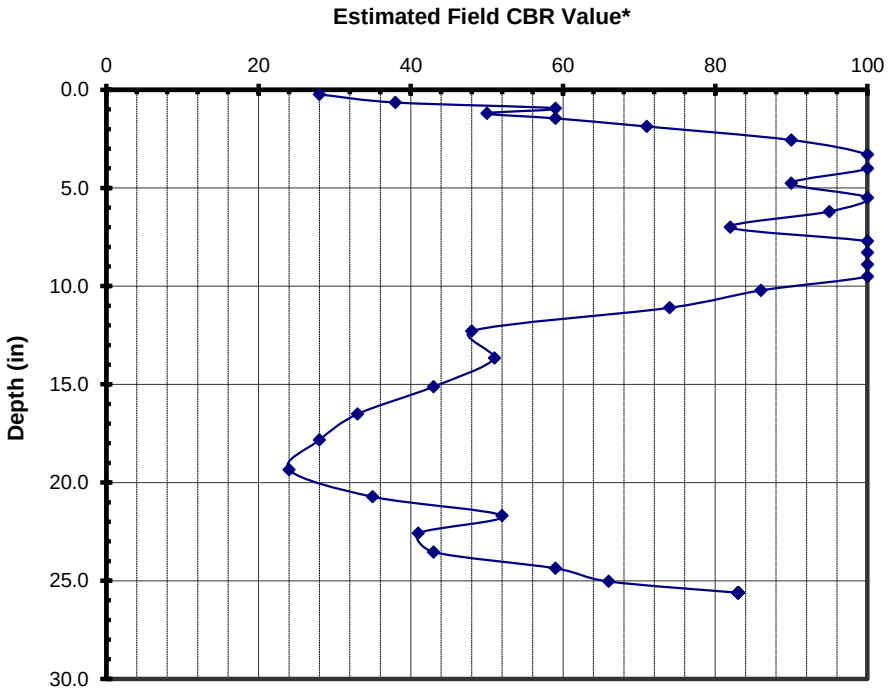
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	12
1	21
1	27
1	34
1	40
3	55
5	75
5	93
5	111
5	131
5	148
5	167
5	189
5	203
5	218
5	234
5	249
5	270
5	294
5	330
5	364
5	404
3	435
3	471
3	512
3	541
3	561
3	586
3	610
3	628
3	644
3	657

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	32
Average CBR	n/a	Average CBR	67
Weighted Avera	n/a	Weighted Average	61
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	24



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-14 SB-OSS **Date:** 1/15/2018 **Personnel:** VGM
Thickness of Stone (in): 0

Test Data	
No. of Blows	Cummulative Penetration (mm)
1	21
1	31
1	44
1	53
1	61
3	85
3	107
3	130
3	149
3	168
3	190
3	211
3	233
3	255
3	288
3	338
2	371
2	402
2	424
2	454
2	489
2	531
2	571

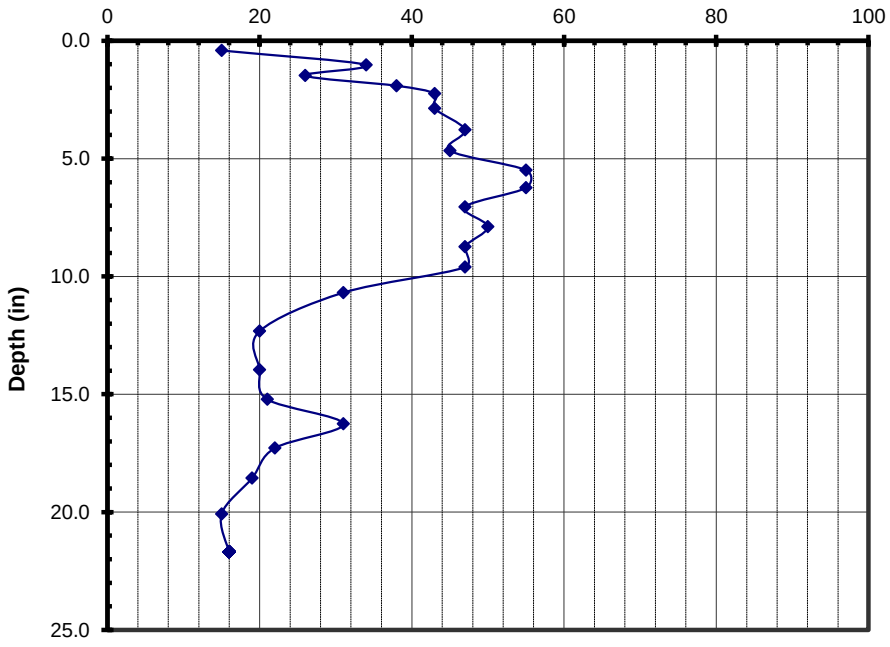
CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	23
Average CBR	n/a	Average CBR	34
Weighted Avera	n/a	Weighted Average	31
Max CBR	n/a	Max CBR	55
Min CBR	n/a	Min CBR	15

Estimated Field CBR Value*



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-15 SB-OSS **Date:** 1/16/2018 **Personnel:** VGM
Thickness of Stone (in): 0

Test Data	
No. of Blows	Cummulative Penetration (mm)
1	21
1	34
1	43
1	51
1	59
3	75
5	97
5	121
5	159
3	186
3	215
3	255
3	294
3	317
3	338
3	354
3	379
3	397
3	415
3	435
3	455
3	475
3	496
3	515
3	535
3	555

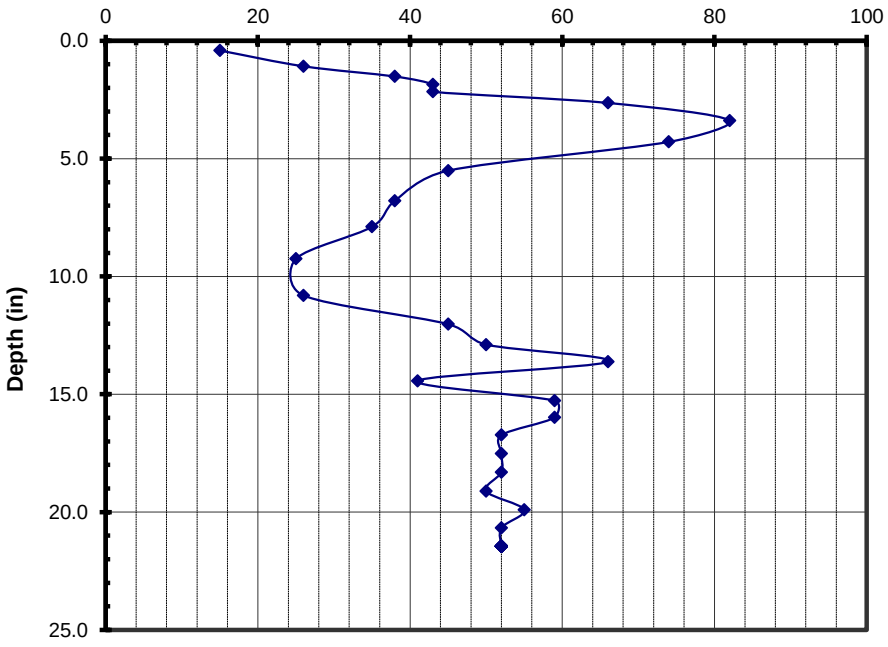
CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	26
Average CBR	n/a	Average CBR	48
Weighted Aver	n/a	Weighted Average	46
Max CBR	n/a	Max CBR	82
Min CBR	n/a	Min CBR	15

Estimated Field CBR Value*



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-26 SB-OSL **Date:** 1/16/2018 **Personnel:** VGM
Thickness of Stone (in): 0

Test Data	
No. of Blows	Cummulative Penetration (mm)
1	20
1	28
1	35
1	48
1	55
3	95
3	160
2	210
2	238
2	259
2	285
2	310
2	338
2	381
2	422
2	459
2	483
2	505
2	527

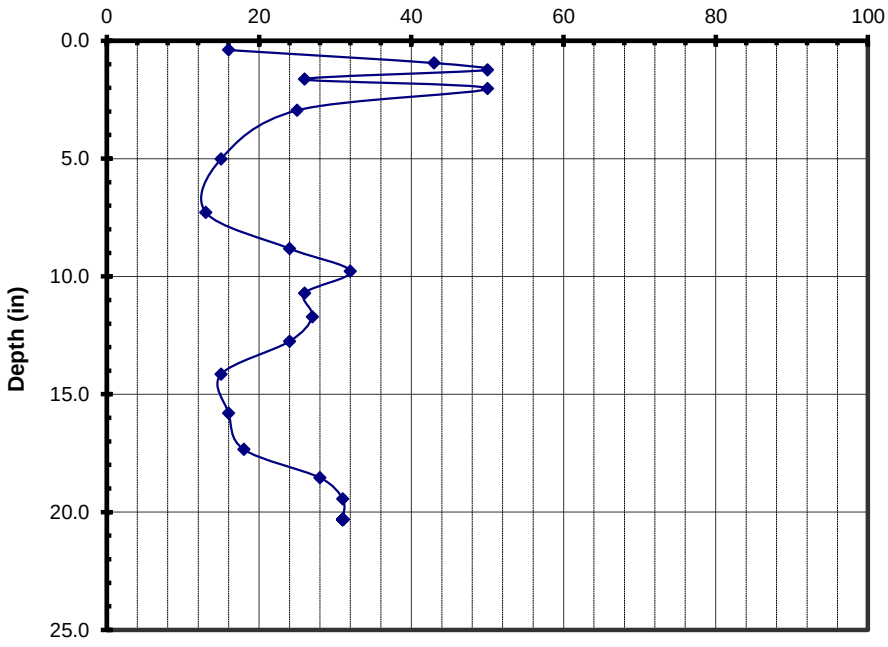
CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	19
Average CBR	n/a	Average CBR	27
Weighted Avera	n/a	Weighted Average	22
Max CBR	n/a	Max CBR	50
Min CBR	n/a	Min CBR	13

Estimated Field CBR Value*



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-16 SB-OSS **Date:** 1/22/2018 **Personnel:** VGM
Thickness of Stone (in): 0

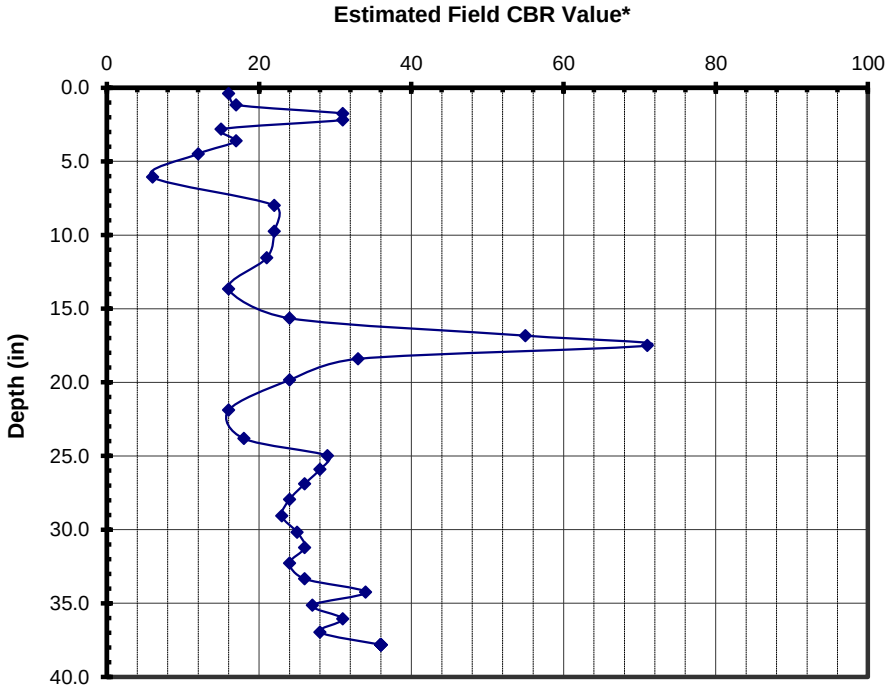
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	20
1	39
1	50
1	61
1	82
1	101
1	127
1	181
3	225
3	270
3	317
3	377
3	418
3	437
3	452
3	483
3	525
3	587
2	623
2	646
2	670
2	696
2	724
2	753
2	780
2	806
2	834
2	860
2	880
2	905
2	927
2	951
2	970

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	33
Average CBR	n/a	Average CBR	26
Weighted Avera	n/a	Weighted Average	23
Max CBR	n/a	Max CBR	71
Min CBR	n/a	Min CBR	6



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-17 SB-OSS **Date:** 1/22/2018 **Personnel:** VGM
Thickness of Stone (in): 0

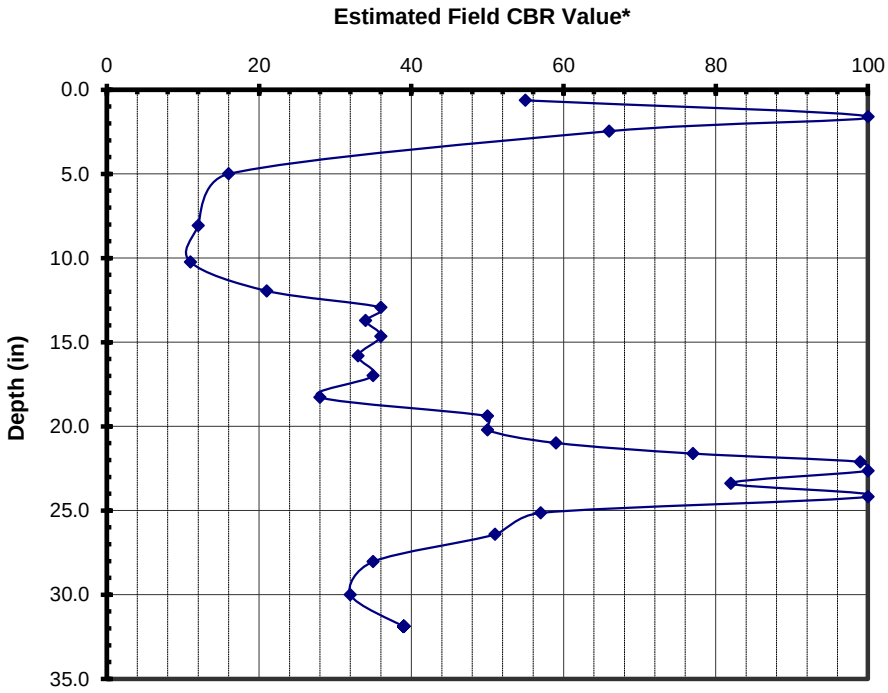
Test Data	
No. of Blows	Cummulative Penetration (mm)
5	32
5	49
5	76
5	178
2	232
2	288
2	319
2	338
2	358
3	386
3	417
3	446
3	482
3	503
3	524
3	542
3	556
3	567
5	583
5	605
5	623
5	654
5	688
5	736
5	788
5	832

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	26
Average CBR	n/a	Average CBR	51
Weighted Avera	n/a	Weighted Average	40
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	11



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-18 SB-OSS **Date:** 1/22/2018 **Personnel:** VGM
Thickness of Stone (in): 0

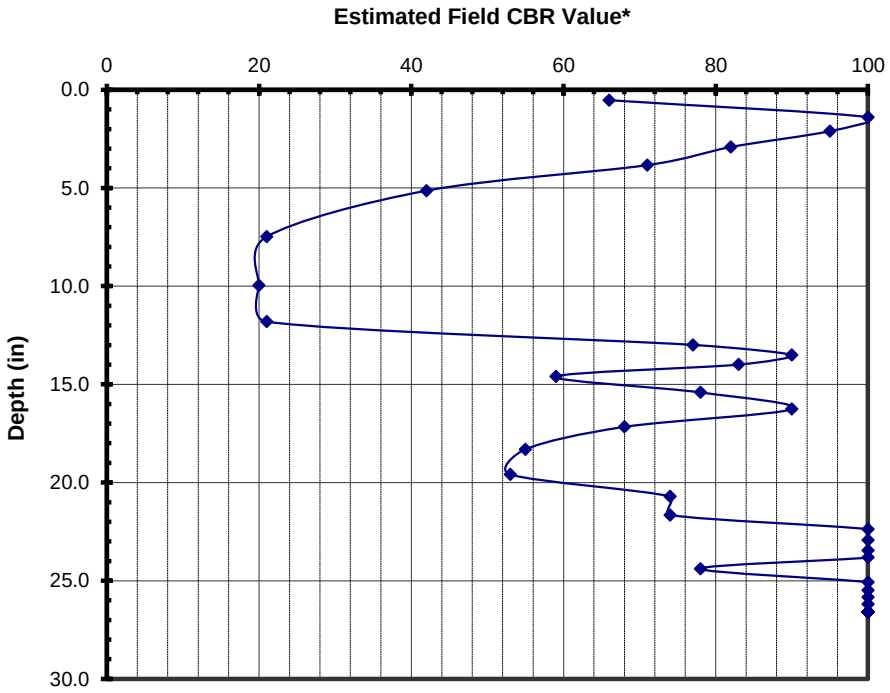
Test Data	
No. of Blows	Cummulative Penetration (mm)
5	27
5	44
5	63
5	85
5	110
5	151
5	229
3	277
3	323
3	337
3	349
3	362
3	380
5	403
5	423
5	449
5	481
5	514
5	538
5	562
5	575
5	590
5	602
5	608
5	631
5	643
5	652
5	661
5	670
5	681

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	30
Average CBR	n/a	Average CBR	77
Weighted Avera	n/a	Weighted Average	62
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	20



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-24 SB-OSL **Date:** 1/22/2018 **Personnel:** VGM
Thickness of Stone (in): 0

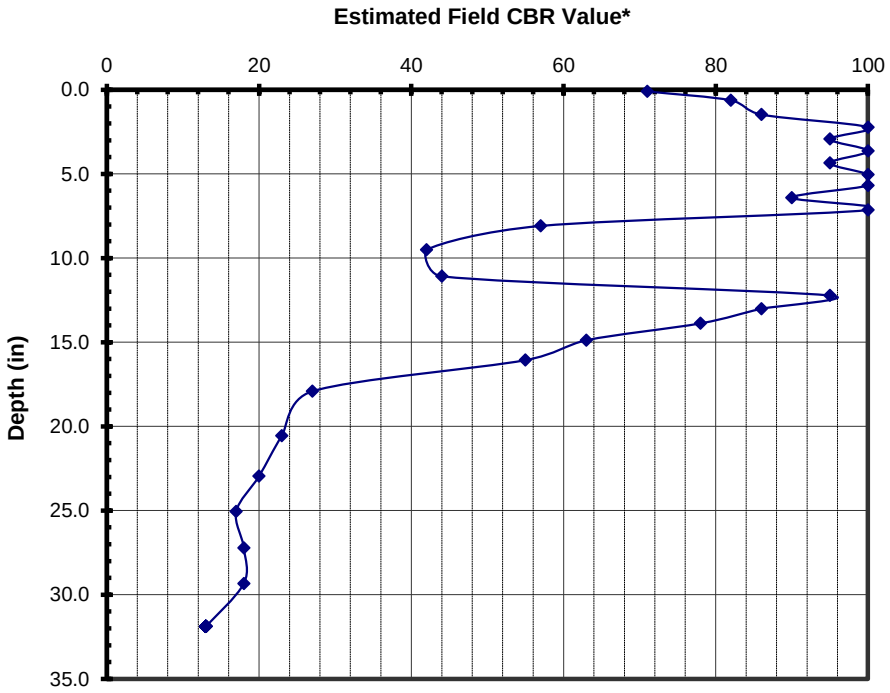
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	5
5	27
5	48
5	65
5	84
5	101
5	120
5	136
5	153
5	173
5	190
5	221
5	262
5	301
5	320
5	341
5	364
5	392
5	424
5	486
5	558
3	608
3	665
3	718
3	772
3	848

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	26
Average CBR	n/a	Average CBR	64
Weighted Avera	n/a	Weighted Average	47
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	13



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-19 SB-OSS **Date:** 1/22/2018 **Personnel:** VGM
Thickness of Stone (in): 0

Test Data	
No. of Blows	Cummulative Penetration (mm)
1	6
1	20
1	27
1	33
1	35
5	62
5	85
5	128
3	161
3	199
3	232
3	273
3	308
3	338
3	369
3	394
3	415
3	427
3	472
3	505
3	526
3	572
3	602
3	626
3	655
3	688
3	718
3	747
3	777
3	802
3	826
3	846
3	870
3	899

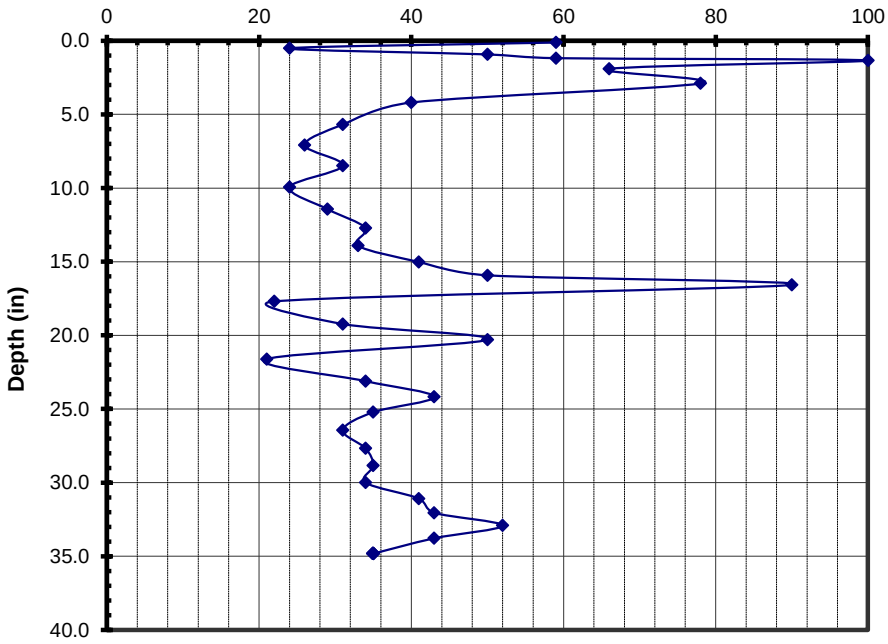
CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	34
Average CBR	n/a	Average CBR	43
Weighted Avera	n/a	Weighted Average	37
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	21

Estimated Field CBR Value*



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-25 SB-OSL **Date:** 1/22/2018 **Personnel:** MSH
Thickness of Stone (in): 0

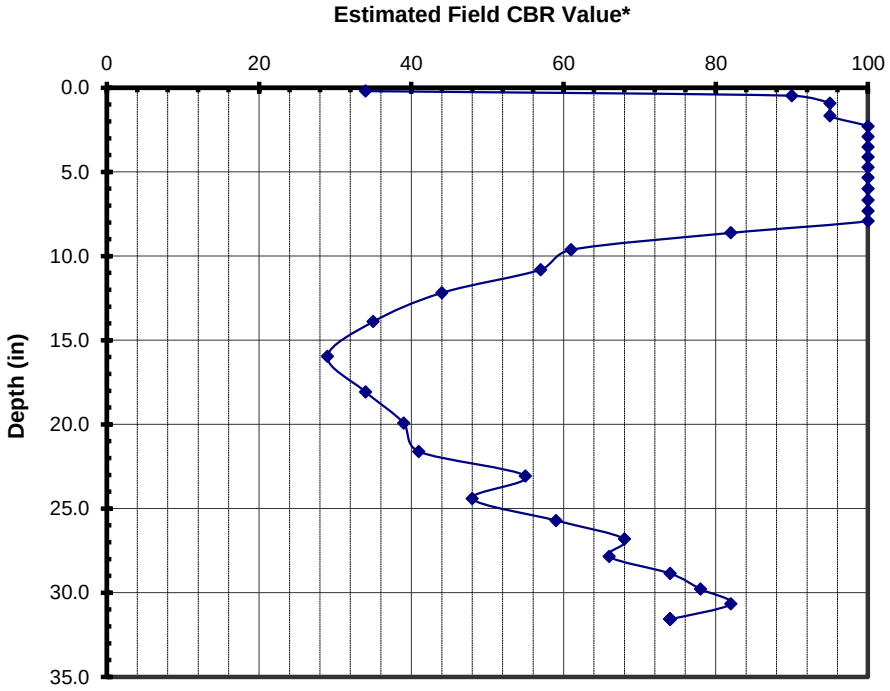
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	10
1	14
5	33
5	52
5	65
5	83
5	96
5	113
5	127
5	144
5	161
5	178
5	194
5	208
5	230
5	259
5	290
5	329
5	377
5	434
5	484
5	528
5	570
5	602
5	638
5	668
5	694
5	721
5	745
5	768
5	790
5	814

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	32
Average CBR	n/a	Average CBR	73
Weighted Avera	n/a	Weighted Average	63
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	29



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-20 SB-OSS **Date:** 1/23/2018 **Personnel:** MSH
Thickness of Stone (in): 0

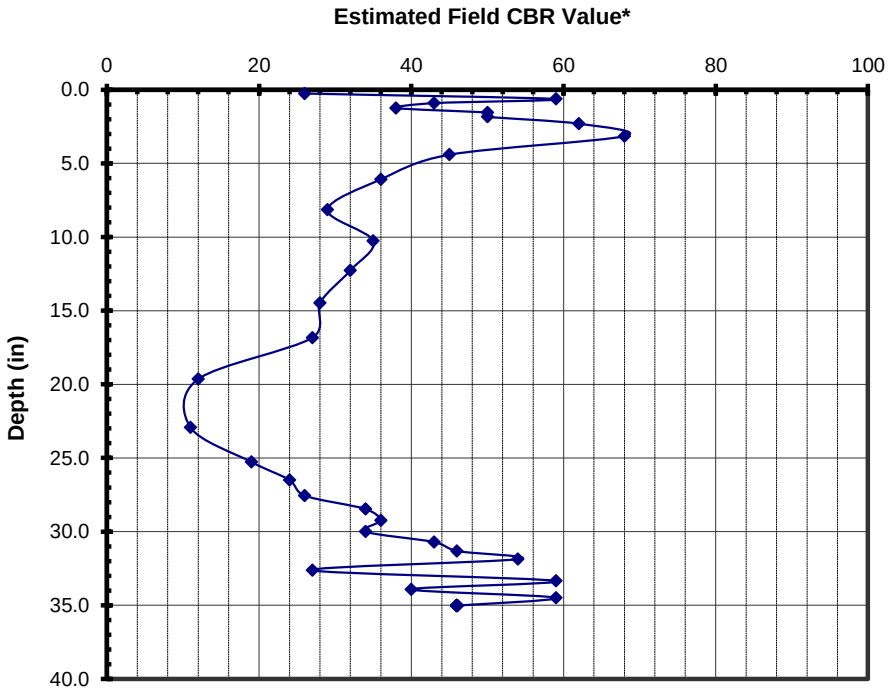
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	13
1	19
1	27
1	36
1	43
1	50
3	67
5	93
5	131
5	178
5	236
5	285
5	338
5	397
5	458
3	540
3	625
2	659
2	687
2	713
2	733
2	752
2	772
2	788
2	803
2	816
2	841
2	853
2	870
2	882
2	897

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	31
Average CBR	n/a	Average CBR	39
Weighted Avera	n/a	Weighted Average	31
Max CBR	n/a	Max CBR	68
Min CBR	n/a	Min CBR	11



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-21 SB-OSS **Date:** 1/23/2018 **Personnel:** MSH
Thickness of Stone (in): 0

Test Data	
No. of Blows	Cummulative Penetration (mm)
1	23
1	31
1	39
1	48
1	56
3	74
3	95
3	116
3	144
3	172
3	201
3	228
3	249
3	272
3	301
3	334
3	380
2	428
2	477
2	516
2	547
2	576
2	603
2	626
2	644
2	659
2	675
2	690
2	705
3	722
3	738
3	760
3	774
3	786
3	806
3	819
3	834
3	852
3	865
3	875
3	887
9	918

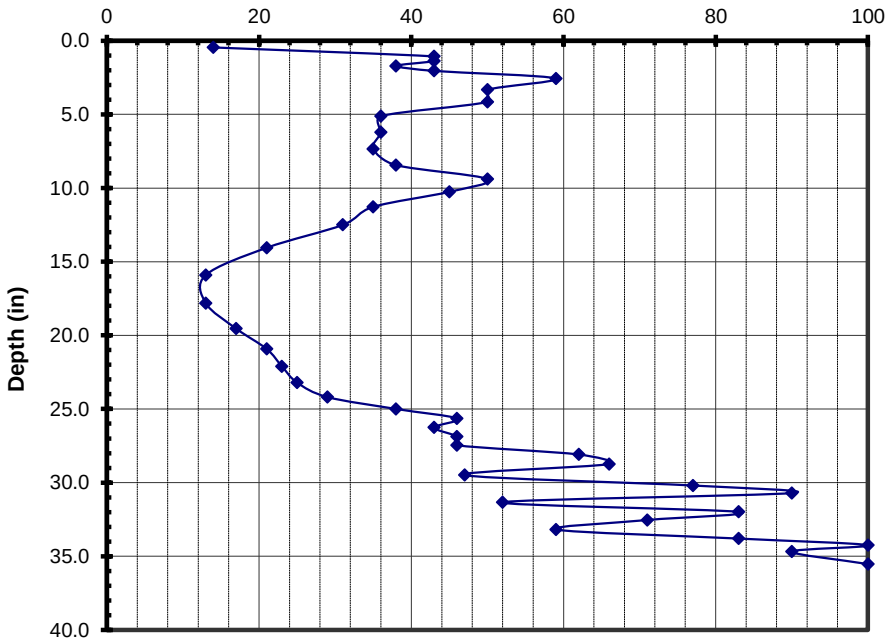
CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

Stone		Soil Subgrade	
# Values	n/a	# Values	42
Average CBR	n/a	Average CBR	48
Weighted Avera	n/a	Weighted Average	41
Max CBR	n/a	Max CBR	100
Min CBR	n/a	Min CBR	13

Estimated Field CBR Value*



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

KESSLER DCP TEST RESULTS

Project Name: NC DOT I-95 Widening
S&ME Project No.: 6235-17-048

Test Location: C-22 SB-OSS **Date:** 1/23/2018 **Personnel:** MSH
Thickness of Stone (in): 0

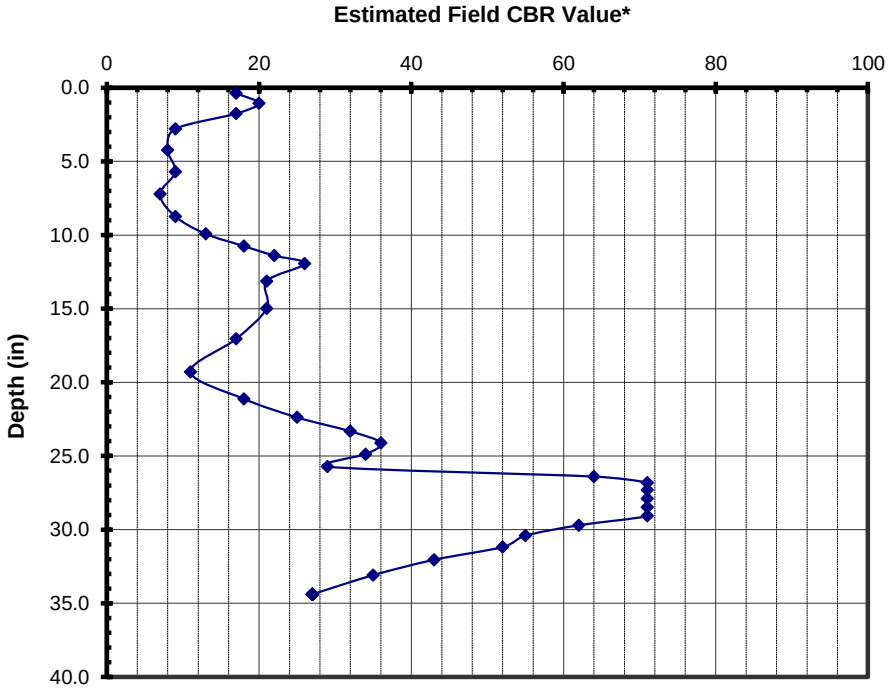
Test Data	
No. of Blows	Cummulative Penetration (mm)
1	19
1	35
1	54
1	88
1	127
1	163
1	204
1	240
1	264
1	282
1	297
1	310
3	357
3	404
3	462
2	518
2	555
2	582
2	603
2	622
2	642
2	665
2	676
2	686
3	701
3	716
3	731
3	746
3	763
3	782
3	802
3	826
3	855
3	892

CBR - DCP Correlation for Soil Subgrade

- (●) North Carolina Department of Transportation (Shin, et al 1989)
- ( ) U.S. Army Corps of Engineers (Webster, et al 1992)
- ( ) Piedmont Residual Soils (Coonse 1999)

Test Summary

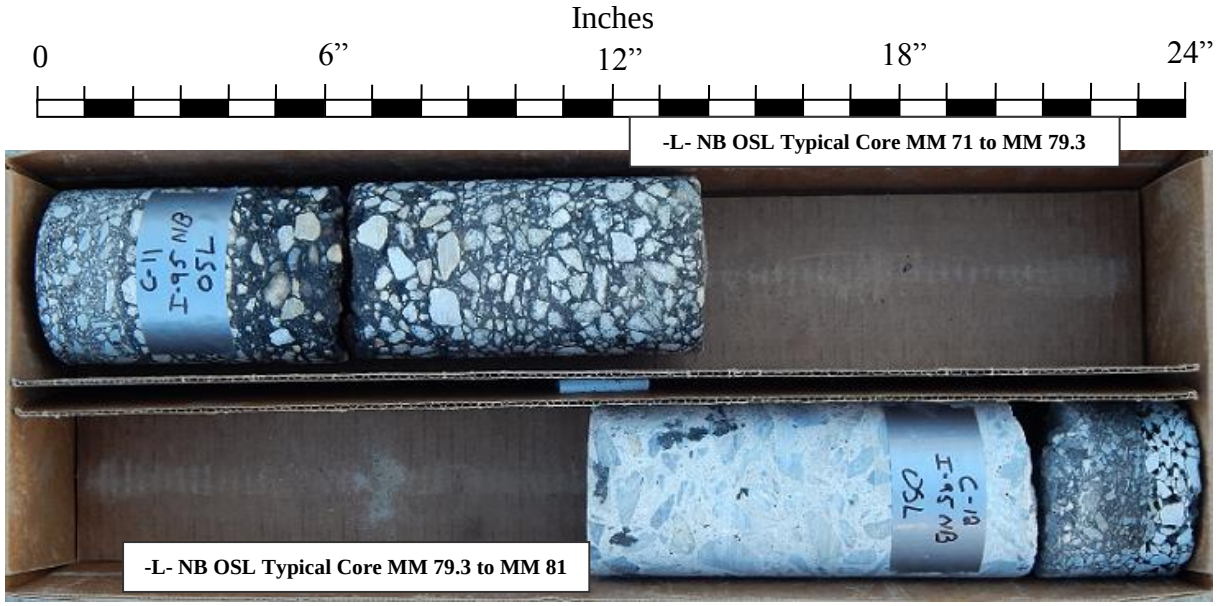
Stone		Soil Subgrade	
# Values	n/a	# Values	34
Average CBR	n/a	Average CBR	33
Weighted Avera	n/a	Weighted Average	26
Max CBR	n/a	Max CBR	71
Min CBR	n/a	Min CBR	7



* Stone Field CBR estimated using published NCDOT relationship.
Subgrade Field CBR estimated using relationship indicated above.

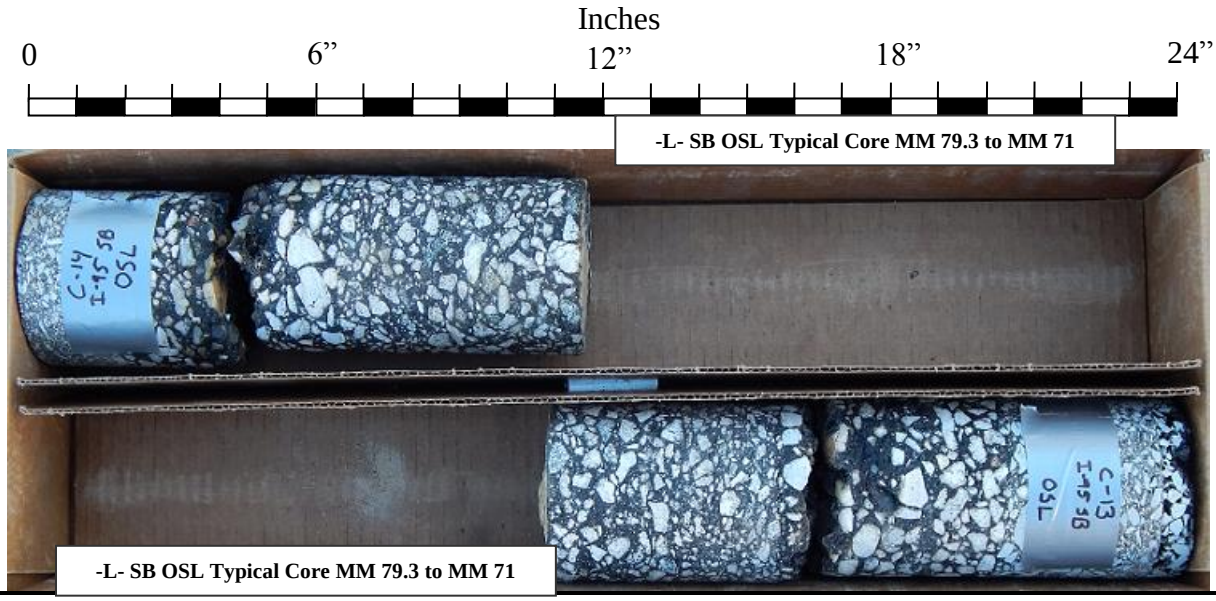
Appendix V – Core Photos

Project No.:	*I.D. No.*: I-5986B	*County*: Johnston & Harnett	*Dates:01/13-01/23/2018*
Site Description: I-95 Widening from MM 71 to MM 81			
Consultant: S&ME, Inc.	*Core Size*: 4 - inch	*Drill Machine:*	
Geologist / Engineer: Vlad Mitchev			



-L- NB OSL Typical Core MM 71 to MM 79.3

-L- NB OSL Typical Core MM 79.3 to MM 81



-L- SB OSL Typical Core MM 79.3 to MM 71

-L- SB OSL Typical Core MM 79.3 to MM 71

Notes:

OSL = Outside Lane
ISL = Inside Lane
RTL = Right Turn Lane
OSS = Outside Shoulder
ACCEL = Acceleration Lane
PS = Paved Shoulder
LTL = Left Turn Lane
ISS = Inside Shoulder
MED = Median

S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

JAMES H. TROGDON, III
SECRETARY

August 18, 2017

MEMORANDUM TO: Christopher A. Peoples, PE
State Materials Engineer

Steve Kendall, PE
Division Project Engineer

FROM: J. L. Pilipchuk, PE, LG
State Geotechnical Engineer

STATE PROJECT: 53077.1.1 (I-5877) – Turnkey, DDC
COUNTY: Harnett
DESCRIPTION: Improve Interchanges at SR 1811 (Bud Hawkins Road) and SR 1002 (Long Branch Road)

SUBJECT: Geotechnical Recommendations for Pavement Design

The Geotechnical Engineering Unit has completed the evaluation of the pavement design investigation for this project and presents the following recommendations.

The proposed work consist of improving the interchanges on I-95 at Bud Hawkins Road and Long Branch Road. Improvements consist of modifying ramps and loops at the interchange as well as improving some Y lines and services roads.

Soil Type: The soils encountered beneath the existing roadway consist of roadway embankment and Coastal Plain soils. The predominant soil types are silty/clayey sand (A-2-4/A-2-6) sandy silt (A-4) and sandy/silty clay (A-6/A-7).

Anticipated borrow will likely consist of residual soils that consist of fine and silty sands (A-3, A-2-4). The design soil type is silty sand (A-2-4).

The length of this project is 2.095 miles.

Mailing Address:
NC DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
1589 MAIL SERVICE CENTER
RALEIGH NC 27699-1589

Telephone: 919-707-6850
Fax: 919-250-4237
Customer Service: 1-877-368-4968

Website: www.ncdot.gov

Location:
CENTURY CENTER COMPLEX
ENTRANCE B-2
1020 BIRCH RIDGE DRIVE
RALEIGH NC

Pavement Design Inputs: The following values are recommended to be used with the Design soil type:

ENVIRONMENTAL INPUTS								
DESIGN SOIL TYPE(S)	PASSING #200 SIEVE (%)	OPTIMUM MOISTURE CONTENT (%)	MAXIMUM DRY DENSITY (pcf)	D_{60}(in)	LL	(PI)	SPECIFIC GRAVITY (G_S)	CBR
Sandy Silt (A-2-4)	22	9.8	121.0	0.0136	20	3	2.69	21.5

*Note: Soil data taken from county soil results.

Areas of Special Geotechnical Interest

1) Highly Plastic Clays:

Line	Station and Offset	PI
L	97+00 SB ACCEL	26
L	89+00 SB OSS	24
L	70+00 NB ISS	25
L	122+00 NB ISS	20
L	122+00 NB OSL	25
L	127+00 NB OS	16

2) Wet to Saturated Soils:

Line	Station and Offset	Depth	Moisture Description	Percent Moisture
L	26+00 SB OSS	2.0’ – 5.6’	Wet	NT
L	26+00 SB ACCEL	0.0’ – 0.6’	Wet	13%
L	26+00 SB OSL	4.5’ – 5.6’	Saturated	24.8
L	26+00 SB ISS	0.0’ – 4.8’	Wet	NT
L	97+00 SB OSS	3.0’ – 5.6’	Wet	19.8%
L	97+00 SB ACCEl	0.0’ – 0.8’	Wet	17.6%

- NT = Not Tested
- ACCEL = Acceleration Lane

3) Existing Pavement

Drainage sand was not recorded on this project, however a distinct layer of sand was encountered on the I-5878 project and appeared to be a drainage layer. The Geotechnical Engineering Unit anticipates that this sand layer will be present on this project as well. If the drainage sand is encountered on this project it should be removed. The new pavement structure should be designed to accommodate the lateral movement of water to prevent the blockage of water underneath the pavement.

DESIGN AND CONSTRUCTION RECOMMENDATIONS

I. Subgrade Stability

A. Aggregate Subgrade

Recommend a quantity of 1,600 cubic yards of shallow undercut to be included in the project contract as a contingency item.

Geotextile for Soil Stabilization

Recommend 4,800 square yards of Geotextile for Soil Stabilization to be included in the project contract as a contingency item.

Class IV Subgrade Stabilization

Recommend 3,200 tons of Class IV Subgrade Stabilization material to be included in the project contract as a contingency item.

II. Miscellaneous

A. Proof Rolling

It is recommended that proof rolling be performed on this project and should conform to Standard Specifications, Article 260.

Note: For additional recommendation and quantities refer to the forthcoming Geotechnical Report-Final Design and Construction Recommendations.

JLP/MAM/JBB

ATTACHMENT 1:	Pavement and Subgrade Inventory	12
ATTACHMENT 2:	Core Evaluation Sheet	2
ATTACHMENT 4:	Dynamic Cone Penetrometer Graphs	9

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
Summary of Quantities

WBS Number: 53077.1.1 County: Harnett Project Engineer:
TIP Number: I-5877 Field Office: Central Project Geologist: J. B. Barfield
Description: Improve Interchanges at SR 1811 (Bud Hawkins Road) and SR 1002 (Long Branch Road)

Pay Item No.	Pay Item/ Quantity Adjustment	Spec Book Section No. or Special Provision (SP) Reference	Report Section	Alignment	Begin Station	End Station	Quantity	Units / %
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	I. A	Contingency	N/A	N/A	4,800	SY
						Total Quantity of Geotextile for Soil Stabilization =	**4,800**	**SY**
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	I. A	Contingency	N/A	N/A	1,600	CY
						Total Quantity of Shallow Undercut =	**1,600**	**CY**
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	I. A	Contingency	N/A	N/A	3,200	TON
						Total Quantity of Class IV Subgrade Stabilization =	**3,200**	**TON**

REFERENCE: I-5877

PROJECT: 53077

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	I-5877	1	12

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

ROADWAY SUBSURFACE INVESTIGATION

COUNTY HARNETT

PROJECT DESCRIPTION I-95 INTERCHANGES AT SR 1811 (BUD HAWKINS ROAD) AND SR 1002 (LONG BRANCH ROAD)

PAVEMENT AND SUBGRADE INVENTORY

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF PREPARING THE SCOPE OF WORK TO BE INCLUDED IN THE REQUEST FOR PROPOSAL. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N.C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

SOIL AND ROCK BOUNDARIES WITHIN A BOREHOLE ARE BASED ON GEOTECHNICAL INTERPRETATION UNLESS ENCOUNTERED IN A SAMPLE. INTERPRETED BOUNDARIES MAY NOT NECESSARILY REFLECT ACTUAL SUBSURFACE CONDITIONS BETWEEN SAMPLED STRATA AND BOREHOLE INFORMATION MAY NOT NECESSARILY REFLECT ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

NOTES:
1. THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N.C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
2. BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

PERSONNEL

S&ME Inc.

INVESTIGATED BY V.G. MITCHEV

DRAWN BY J.R. SWARTLEY

CHECKED BY S.S. LANEY

SUBMITTED BY S.S. LANEY

DATE AUGUST 2017

NORTH CAROLINA PROFESSIONAL SEAL 031484 ENGINEER VLADIMIR G. MITCHEV

DocuSigned by: Vladimir G. Mitchev 8/22/2017
BCFD5CA9586E4B7... SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
I-5877	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE,

VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1			A-3	A-2			A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b			A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6			
SYMBOL														
% PASSING #10	50 MX													
#40	30 MX		50 MX	51 MN										
#200	15 MX	25 MX		10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
MATERIAL PASSING #40 LL PI	— 6 MX			— NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
GROUP INDEX	0			0	0		4 MX		8 MX	12 MX	16 MX	NO MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND					SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS SUBGRADE	EXCELLENT TO GOOD								FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	< 4 4 TO 10 10 TO 30 30 TO 50 > 50	N/A
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	< 2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 > 30	< 0.25 0.25 TO 0.5 0.5 TO 1.0 1 TO 2 2 TO 4 > 4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL — LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL — PLASTIC LIMIT		
OM — OPTIMUM MOISTURE SL — SHRINKAGE LIMIT	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NON PLASTIC	0-5	VERY LOW
SLIGHTLY PLASTIC	6-15	SLIGHT
MODERATELY PLASTIC	16-25	MEDIUM
HIGHLY PLASTIC	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY), MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE.
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LL < 31
MODERATELY COMPRESSIBLE	LL = 31 - 50
HIGHLY COMPRESSIBLE	LL > 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE	10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME	20 - 35%
HIGHLY ORGANIC	> 10%	> 20%	HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW — PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 — DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT, DPT, DMT, VST, PMT — TEST BORING
- AUGER BORING
- CORE BORING
- MW — MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING WITH CORE
- SPT N-VALUE

RECOMMENDATION SYMBOLS

- UNDERCUT
- SHALLOW UNDERCUT
- UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE
- UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK
- UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS

S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] CME-45C
- [x] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [ ] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [ ] CASING [ ] W/ ADVANCER
- [ ] TRICONE _____" STEEL TEETH
- [ ] TRICONE _____" TUNG.-CARB.
- [ ] CORE BIT
- [x] 3.5 INCH AUGER

HAMMER TYPE:
- [ ] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [ ] -N _____

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [ ] _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FOOT
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC.

ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: • see note

ELEVATION: FEET

NOTES:

NBL - NORTHBOUND LANE
SBL - SOUTHBOUND LANE
OSS - OUTSIDE SHOULDER
ISS - INSIDE SHOULDER
OSL - OUTSIDE LANE
ISL - INSIDE LANE

DATE: 8-15-14

PAVEMENT INVESTIGATION DATA SHEET

Project:	53077.1.1	County:	HARNETT	Date:	07/26/2017 - 07/27/2017
TIP:	I-5877	Route:	I-95 INTERCHANGES AT SR 1811 (BUD HAWKINS ROAD) & SR 1002 (LONG BRANCH ROAD)	Notes By:	VGM/JRW

		Width				Thickness						Subgrade						GPS Coordinates	
Position (Sta.,Lane,Shldr.)	Cut/Fill (Est. of Amount)	Lane(s)	Shoulder(s)	Offset Distance (See Notes)	Crown "C" or Super "S"	Gross to Top of Soil	Asphalt	Concrete	ABC	Stabilized Subgrade Soil	Pavement Layering	Description	Sample Number	AASHTO Classification	Soil Moisture	Probe Depth	Asphalt Notes	Northing	Easting
-L- 26+00 SB OSS	FILL 2.0'	-		1.5'	C	11.0"	11.0"	-	-	-	Asphalt	0.0'-2.0' Roadway Embankment, Tan, Orange, Sandy Clay 2.0'-5.6' Coastal Plain, Gray, Sandy Silt	Reference S-6 Reference S-3	A-7-6 A-4	M W	5.6'	No visual distress. Core disintegrated, measured in core hole.	546037.5	2110733.0
-L- 26+00 SB ACCEL	FILL 2.0'	ACCEL 10.1'	2.8'	3.8'	C	10.50"	10.50"	-	-	-	Asphalt	0.0'-0.6' Roadway Embankment, Tan, Silty Sand 0.6'-2.0' Tan, Orange, Sandy Clay 2.0'-4.5' Coastal Plain, Gray Silt 4.5'-5.6' Gray, Sandy Silt	S-7 Reference S-6 Reference S-9 S-8	A-2-4 A-7-6 A-4 A-4	W M M S	5.6'	Low severity transverse cracking, oxidation (loss of aggregate), moderate severity longitudinal joint crack between the accel lane and travel lane.	546037.5	2110732.9
-L- 26+00 SB OSL	FILL 3.5'	12.2'		1.6'	C	13.25"	13.25"	-	-	-	Asphalt	0-0.6' Roadway Embankment, Tan, Silty Sand 0.6'-3.5' Tan, Orange, Sandy Clay 3.5'-5.6' Coastal Plain, Gray Silt	Reference S-7 Reference S-6 S-9	A-2-4 A-7-6 A-4	W M M	5.6'	Low severity longitudinal fatigue cracking in outside wheel path of outside lane. Oxidation (loss of aggregate).	546033.1	2110742.3
-L- 26+00 SB ISS	FILL 3.5'	11.6'	3.8'	1.9'	C	10.75"	10.75"	-	-	-	Asphalt	0.0'-3.5' Roadway Embankment, Tan, Orange, Sandy Clay 3.5'-4.8' Coastal Plain, Gray Silt 4.8'-5.6' Gray, Sandy Silt	Reference S-6 Reference S-9 Reference S-8	A-7-6 A-4 A-4	W W S	5.6'	Low severity longitudinal fatigue cracking in outside wheel path of inside lane.	546023.5	2110763.0
-L- 89+00 SB OSS	FILL 3.3'	12.0'	10.5'	5.8'	C	7.50"	7.50"	-	-	-	Asphalt	0.0'-0.6' Roadway Embankment, Tan, Orange, Silty Sand 0.6'-3.3' Tan, Orange, Silty Clay 3.3'-5.6' Coastal Plain, Gray, Sandy Silt	S-5 S-6 Reference S-3	A-2-4 A-7-6 A-4	W M M	5.6'	Moderate severity transverse cracking in shoulder, 2-3' in length. Low severity longitudinal cracking in midwidth lane.	551742.2	2113406.6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-L- 97+00 SB OSS	FILL 3.0'	-		1.8'	C	10.25"	10.25"	-	-	-	Asphalt	0.0'-3.0' Roadway Embankment, Tan, Orange, Sandy Clay 3.0'-5.6' Coastal Plain, Gray, Sandy Silt	Reference S-2 S-3	A-7-6 A-4	M W	5.6'	Low to moderate severity longitudinal cracking in shoulder (1' in length).	552468.1	2113742.7
-L- 97+00 SB ACCEL	FILL 3.4'	ACCEL 10.8'	2.5'	-4.0'	C	9.75"	9.75"	-	-	-	Asphalt	0.0'-0.8' Roadway Embankment, Tan, Orange, Clayey, Fine Sand 0.8'-3.4' Tan, Orange, Sandy Clay 3.4'-5.6' Coastal Plain, Gray, Sandy Silt	S-1 S-2 Reference S-3	A-2-6 A-7-6 A-4	W M M	5.6'	Severe transverse cracking (4-8' in length). Moderate severity longitudinal fatigue cracking in both wheel paths of accel lane. Oxidation (loss of aggregate). Severe longitudinal joint crack between accel and travel lane.	552463.9	2113751.5
-L- 97+00 SB OSL	FILL 3.4'	12.1'		1.9'	C	14.0"	14.0"	-	-	-	Asphalt	0.0'-1.0' Roadway Embankment, Tan, Orange, Clayey, Fine Sand 1.0'-3.4' Tan, Orange, Sandy Clay 3.4'-5.6' Coastal Plain, Gray, Sandy Silt	S-4 Refefernce S-2 Reference S-3	A-2-6 A-7-6 A-4	M M M	5.6'	No visual distress in travel lanes, newly resurfaced.	552459.0	2113762.1
-L- 97+00 SB ISS	FILL 3.7'	12.0'	3.5'	2.0'	C	9.75"	9.75"	-	-	-	Asphalt	0.0'-3.7' Roadway Embankment, Tan, Orange, Sandy Clay 3.7'-5.6' Coastal Plain, Gray, Sandy Silt	Ferference S-2 Reference S-3	A-7-6 A-4	M M	5.6'	No visual distress.	552447.7	2113786.1

Notes:

OSL = Outside Lane	CTL = Center Turn Lane	OSS = Outside Shoulder	PS = Paved Shoulder	RT = Right	NB = Northbound
ISL = Inside Lane	RTL = Right Turn Lane	ISS = Inside Shoulder	RT LN = Right Lane	LT = Left	SB = Southbound
CL = Center Lane	DECEL = Deceleration Lane	GM = Grass Median	LT LN = Left Lane	(I) = Inside	FW = From White
LTL = Left Turn Lane	ACCEL = Acceleration Lane	OGS = Outside Grass Shoulder	COL = Collector Lane	(O) = Outside	FY = From Yellow

S&ME

S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

PAVEMENT INVESTIGATION DATA SHEET

Project:	53077.1.1	County:	HARNETT	Date:	07/26/2017 - 07/27/2017
TIP:	I-5877	Route:	I-95 INTERCHANGES AT SR 1811 (BUD HAWKINS ROAD) & SR 1002 (LONG BRANCH ROAD)	Notes By:	VGM/JRW

		Width				Thickness						Subgrade							GPS Coordinates	
Position (Sta.,Lane,Shldr.)	Cut/Fill (Est. of Amount)	Lane(s)	Shoulder(s)	Offset Distance (See Notes)	Crown "C" or Super "S"	Gross to Top of Soil	Asphalt	Concrete	ABC	Stabilized Subgrade Soil	Pavement Layering	Description	Sample Number	AASHTO Classification	Soil Moisture	Probe Depth	Asphalt Notes	Northing	Easting
-L- 70+00 NB OSS	FILL 3.5'	12.2'	9.0'	4.9'	C	11.0"	11.0"	-	-	-	Asphalt	0.0'-3.5' Roadway Embankment, Orange Sand 3.5'-5.6' Coastal Plain, Tan, Orange, Sandy Clay	S-3 Reference S-1	A-1-b A-7-6	M M	5.6'	High severity transverse cracking (2-4' in length). Moderate severity longitudinal cracking (3-5" in length).	549995.2	2112656.6
-L- 70+00 NB OSL	FILL 3.4'			2.2'	C	15.0'	15.0"	-	-	-	Asphalt	0.0'-3.4' Roadway Embankment, Orange Sand 0.6'-2.0' Tan, Orange, Sandy Clay	Reference S-3 Reference S-1	A-1-b A-7-6	M M	5.6'	No visual distress in travel lanes, newly resurfaced.	549984.0	2112680.5
-L- 70+00 NB ISS	FILL 3.1'	11.8'	3.7'	2.9'	C	10.25"	10.25"	-	-	-	Asphalt	0.0'-3.1' Roadway Embankment, Tan, Orange, Sandy Clay 3.1'-5.6' Coastal Plain, Tan, Sandy Clay	S-1 -	A-7-6 A-7-6	M M	5.6'	Asphalt core disintegrated, measured core hole.	549976.9	2112695.7
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-L- 122+00 NB OSS	FILL 5.6'	ACCEL 9.8'	2.8'	1.9'	C	13.75"	13.75"	-	-	-	Asphalt	0.0'-5.6' Roadway Embankment, Tan, Orange, Sandy Clay	Reference S-4	A-6	M	5.6'	No visual distress.	554683.0	2114907.5
-L- 122+00 NB ACCEL	FILL 5.6'			5.2'	C	10.0"	10.0"	-	-	-	Asphalt	0.0'-5.6' Roadway Embankment, Tan, Orange, Silty Clay	S-4	A-7-5	M	5.6'	Moderate to severe longitudinal fatigue cracking in inside wheel path. Moderate severity transverse cracking (3-5' in length). Oxidation.	554688.2	2114896.5
-L- 122+00 NB OSL	FILL 5.6'	12.3'		1.6'	C	13.75"	13.75"	-	-	-	Asphalt	0.0'-5.6' Roadway Embankment, Tan, Orange, Sandy Clay	S-5	A-7-6	M	5.6'	No visual distress in travel lanes, newly resurfaced.	554693.3	2114885.6
-L- 122+00 NB ISS	FILL 3.0'	12.1'	4.1'	2.9'	C	10.25"	10.25"	-	-	-	Asphalt	0.0'-3.0' Roadway Embankment, Tan, Orange, Sandy Clay 3.0'-5.6' Coastal Plain, Tan, Silty Clay	Reference S-1 S-2	A-7-6 A-6	M M	5.6'	No visual distress.	554703.4	2114864.0
-L- 127+00 NB OSS	FILL 2.3'	12.3'	10.2'	6.7'	C	7.50"	7.50"	-	-	-	Asphalt	0.0'-2.3' Roadway Embankment, Orange Sand 2.3'-5.6' Coastal Plain, Tan, Sandy Clay	Reference S-3 S-6	A-1-b A-6	M M	5.6'	Moderate severity transverse cracking, sealed but some reopened. Oxidation.	555136.6	2115117.8

Notes:

OSL = Outside Lane
ISL = Inside Lane
CL = Center Lane
LTL = Left Turn Lane

CTL = Center Turn Lane
RTL = Right Turn Lane
DECEL = Deceleration Lane
ACCEL = Acceleration Lane

OSS = Outside Shoulder
ISS = Inside Shoulder
GM = Grass Median
OGS = Outside Grass Shoulder

PS = Paved Shoulder
RT LN = Right Lane
LT LN = Left Lane
COL = Collector Lane

RT = Right
LT = Left
(I) = Inside
(O) = Outside

NB = Northbound
SB = Southbound
FW = From White
FY = From Yellow

S&ME
S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME
TEST LOCATIONS DESCRIPTION	**DATE RUN**	
-L- 26+00 SB OSS	7/26 - 7/27/2017	

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	546037.5	2110733.0

Cumulative Penetration in Centimeters															
2.4															
5.3															
7.9															
9.7															
10.9															
12.6															
15.5															
19.9															
24.5															
27.0															
28.4															
30.0															
31.5															
32.9															
34.7															
36.2															
38.0															
40.2															
42.7															
45.4															
48.0															
50.4															
52.9															
56.1															
59.4															
62.7															
65.6															
68.7															
71.4															
74.5															
77.4															
80.0															
82.0															
83.6															
85.1															
86.7															
88.3															
90.2															
92.1															
93.6															
95.6															
97.2															
99.6															
102.0															
104.7															
107.1															
110.1															
113.9															

Cumulative Penetration in Centimeters															
1.8	87.3														
2.2	90.3														
2.8	92.4														
3.5	94.2														
4.1	95.7														
4.9	97.1														
5.7	98.8														
6.4	101.0														
7.4	103.5														
8.4	106.2														
9.5	109.1														
10.5	112.3														
11.5	115.3														
12.4															
13.6															
14.8															
16.1															
17.2															
18.4															
19.6															
21.5															
23.5															
25.5															
27.4															
29.3															
30.6															
31.9															
33.0															
34.2															
35.7															
37.2															
38.5															
39.9															
41.2															
42.5															
43.8															
45.2															
46.7															
48.2															
49.7															
51.3															
53.0															
54.8															
58.2															
61.7															
65.1															
68.2															
70.7															
73.5															
76.4															
79.2															
81.8															
84.6															

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME
TEST LOCATIONS DESCRIPTION	**DATE RUN**	
-L- 26+00 SB OSL	7/26 - 7/27/2017	

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	546033.1	2110742.3

Cumulative Penetration in Centimeters															
1.3	21.8	77.7													
2.1	22.1	78.8													
2.8	22.5	80.1													
3.4	22.9	81.5													
3.8	23.3	84.4													
4.1	23.8	86.8													
4.5	24.2	89.8													
4.8	24.8	91.8													
5.2	25.4	94.1													
5.6	26.0	96.5													
5.9	26.6	97.8													
6.2	27.3	99.3													
6.6	28.1														
7.0	28.9														
7.3	29.7														
7.6	30.6														
7.9	31.5														
8.2	32.2														
8.5	32.9														
8.8	33.6														
9.2	34.5														
9.6	35.4														
10.0	36.4														
10.3	37.3														
10.7	38.2														
11.0	39.1														
11.3	40.5														
11.7	41.9														
12.0	43.4														
12.4	45.4														
12.8	47.4														
13.2	48.6														
13.6	49.8														
14.1	51.4														
14.6	53.0														
15.0	54.5														
15.4	55.9														
15.8	57.3														
16.2	58.7														
16.5	59.9														
16.9	61.2														
17.3	62.7														
17.7	64.3														
18.1	65.5														
18.5	66.8														
18.8	68.0														
19.3	69.2														
19.6	70.5														
19.9	71.9														
20.2	73.3														
20.6	74.6														
21.0	75.6														
21.4	76.6														

Cumulative Penetration in Centimeters															
2.3	53.0														
4.0	54.2														
5.0	55.5														
5.7	56.4														
6.8	57.3														
7.5	58.2														
8.0	59.0														
8.4	59.7														
9.0	60.5														
9.7	61.2														
10.3	61.8														
11.0	62.5														
11.6	63.2														
12.2	63.9														
12.8	64.6														
13.3	65.3														
13.9	66.1														
14.6	66.9														
15.3	67.8														
15.9	68.7														
16.6	69.6														
17.3	70.6														
18.0	71.5														
18.7	72.5														
19.5	73.8														
20.2	75.1														
21.1	76.5														
22.0	78.5														
23.0	80.5														
24.0	82.4														
25.0	85.4														
26.0	88.4														
27.3	91.3														
28.7	94.4														
30.2	97.5														
33.2	100.0														
36.2	102.2														
39.1	104.0														
40.5	105.4														
41.5	106.9														
42.4	108.4														
42.9	109.6														
43.6	111.3														
44.0	112.3														
44.7	113.9														
45.4	115.5														
46.0	116.7														
46.9	118.0														
47.9	119.5														
48.9	120.9														
49.9	122.3														
50.8															
51.7															

SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade

S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME

TEST LOCATION DESCRIPTION	DATE RUN
-L- 89+00 SB OSS	7/26 - 4/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	551742.2	2113406.6

TEST LOCATION DESCRIPTION	DATE RUN

Cumulative Penetration in Centimeters									
1.9	75.7								
2.9	77.2								
3.9	78.7								
5.0	80.1								
6.3	81.8								
8.5	83.5								
11.5	85.4								
15.5	86.4								
19.3	87.4								
21.6	88.3								
22.8	88.9								
23.9	89.5								
24.9	89.9								
25.7	90.4								
26.7	90.9								
27.9	91.5								
29.2	92.1								
30.8	92.7								
32.5	93.3								
34.2	93.9								
36.8	94.5								
40.1	95.1								
43.3	95.8								
44.8	96.5								
46.0	97.3								
47.1	98.2								
48.2	99.1								
49.3	99.9								
50.7	101.0								
51.9	102.1								
53.0	103.2								
53.9	104.4								
54.6	106.6								
55.2	106.9								
55.9	108.0								
56.5	109.1								
57.0	110.3								
57.5	112.2								
58.0	114.1								
58.9	116.1								
59.8	119.4								
60.8	122.7								
61.6	126.5								
62.4									
63.3									
64.7									
66.1									
67.6									
68.9									
70.1									
71.3									
72.8									
74.3									

Cumulative Penetration in Centimeters									

SG = Subgrade
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CTBC = Cement-Treated Base Course
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CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 97+00 SB OSS	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	552468.1	2113742.7

Cumulative Penetration in Centimeters

4.8							
9.2							
10.6							
11.8							
13.0							
14.5							
16.4							
18.8							
21.9							
25.3							
28.8							
33.6							
39.1							
41.9							
44.4							
47.7							
51.1							
55.6							
60.1							
66.5							
72.5							
83.4							
91.0							
110.4							
121.1							

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 97+00 SB ACCEL	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	552463.9	2113751.5

Cumulative Penetration in Centimeters

1.5	77.7						
2.4	78.5						
3.5	79.4						
5.0	80.4						
7.6	81.3						
10.5	82.3						
12.4	83.3						
14.3	84.4						
16.7	85.5						
18.5	86.6						
20.5	87.7						
22.2	88.7						
24.0	89.8						
26.7	90.9						
28.9	92.0						
30.7	93.0						
32.0	94.1						
32.8	95.2						
33.7	96.4						
34.5	97.6						
35.4	98.8						
36.50	100.1						
37.6	101.4						
38.7	102.7						
39.9	104.0						
41.1	105.0						
42.4	106.1						
43.7							
45.0							
46.3							
48.0							
49.7							
51.0							
52.4							
53.4							
54.5							
55.7							
56.9							
58.1							
59.4							
60.8							
62.2							
63.6							
65.0							
66.4							
67.8							
69.3							
70.8							
72.1							
73.5							
74.6							
75.8							
76.8							

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 97+00 SB OSL	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	552459.0	2113762.1

Cumulative Penetration in Centimeters

1.2	25.3	64.3					
2.0	26.0	64.6					
2.7	26.8	64.9					
3.3	27.6	65.2					
3.9	28.4	65.5					
4.4	29.2	65.8					
4.9	29.9	66.1					
5.3	31.0	66.4					
5.8	32.0	66.7					
6.3	33.0	67.1					
6.8	33.6	67.5					
7.3	34.3	68.0					
7.8	34.9	68.5					
8.2	35.6	69.0					
8.6	36.3	69.5					
9.0	37.0	70.1					
9.4	37.8	71.0					
9.7	38.6	71.9					
10.0	39.4	72.8					
10.4	40.5	73.7					
10.7	41.6	74.6					
11.0	42.7	75.2					
11.4	43.8	75.8					
11.8	44.8	76.4					
12.1	45.8	77.1					
12.4	46.9	77.9					
12.7	48.0	78.5					
13.0	48.9	79.2					
13.4	49.9	79.7					
13.8	50.4	80.2					
14.1	50.9	80.7					
14.4	51.4	81.3					
14.8	51.9	81.8					
15.2	52.5	82.3					
15.5	53.2	82.9					
15.9	53.9	83.5					
16.4	54.6	84.1					
16.8	55.7	84.7					
17.2	56.8	85.3					
17.7	57.8	85.9					
18.2	57.9	86.4					
18.7	58.7	87.2					
19.2	59.4	88.0					
19.7	60.0	88.8					
20.3	60.7	89.6					
20.8	61.2	90.4					
21.3	61.8						
21.8	62.2						
22.3	62.5						
22.9	62.9						
23.4	63.2						
23.9	63.5						
24.6	63.9						

TEST LOCATION DESCRIPTION	DATE RUN
-L- 97+00 SB ISS	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	552447.7	2113786.1

Cumulative Penetration in Centimeters

2.4	71.6						
3.8	72.6						
5.2	73.6						
5.8	74.7						
6.6	75.7						
7.6	76.7						
8.5	77.8						
10.2	78.9						
11.8	79.9						
13.5	80.9						
15.1	81.9						
17.1	82.9						
19.1	83.9						
23.8	85.0						
27.0	86.0						
30.1	87.1						
32.3	87.8						
33.3	88.8						
34.8	89.8						
36.1	90.8						
37.5	91.7						
39.0	92.6						
40.5	93.5						
41.5	94.4						
42.6	95.3						
43.7	96.2						
44.8	97.2						
45.7	98.1						
46.5	99.0						
47.3	99.9						
48.1	100.8						
49.1	101.7						
50.1	102.6						
50.7	103.5						
52.4	104.5						
53.1	105.5						
54.8	106.4						
56.0	107.3						
57.2	108.2						
58.1	109.2						
59.1	110.2						
60.0	111.2						
60.9	112.2						
61.8	113.2						
62.6	114.3						
63.5	115.4						
64.4	116.6						
65.3	118.0						
66.3	119.2						
67.4	120.4						
68.5	121.6						
69.5	123.0						
70.6							

SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade

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Raleigh, North Carolina 27616

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 70+00 NB OSS	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	549995.2	2112656.6

Cumulative Penetration in Centimeters

0.6	39.2										
1.2	42.8										
1.5	46.1										
1.6	48.7										
1.7	51.1										
1.8	53.5										
2.0	55.5										
2.2	57.4										
2.6	59.8										
3.0	61.6										
3.4	63.4										
3.8	65.1										
4.2	66.7										
4.6	68.2										
5.0	69.8										
5.4	71.5										
5.8	73.1										
6.2	74.8										
6.6	76.2										
7.0	77.4										
7.4	78.8										
7.8	80.1										
8.2	81.4										
8.6	82.8										
9.0	84.0										
9.4	85.2										
9.8	86.3										
10.3	87.9										
10.9	89.2										
11.5	90.4										
12.1	91.7										
12.7	93.0										
13.2	94.4										
13.6	95.7										
14.2	97.0										
14.8	98.2										
15.4	99.4										
16.0	100.6										
16.7	101.7										
17.4	103.1										
18.1	104.4										
18.8	105.8										
19.6	107.0										
20.5	108.2										
21.4	109.3										
22.3	110.5										
23.2	111.7										
24.1	112.8										
25.4	113.9										
26.7	115.0										
28.1	116.1										
31.8											
35.5											

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 70+00 NB OSL	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	549984.0	2112680.5

Cumulative Penetration in Centimeters

0.8	11.0	61.0									
1.4	11.2	62.2									
1.7		63.3									
2.1		64.5									
2.6		65.6									
2.9		66.7									
3.2	1.0	67.7									
3.5	1.5	68.8									
3.7	2.1	69.9									
3.9	2.5	71.0									
4.1	2.9	71.9									
4.3	3.2	72.8									
4.5	3.5	73.8									
4.7	3.8	74.8									
5.0	4.2	75.8									
5.2	4.6	76.9									
5.4	5.1	77.7									
5.6	5.6	78.5									
5.8	6.1	79.3									
5.9	6.6	80.3									
6.0	7.2	81.3									
6.20	8.8	82.3									
6.4	10.4	83.2									
6.5	12.0	84.1									
6.7	13.6	85.0									
6.8	15.2	85.9									
6.9	17.7	86.8									
7.0	20.1	87.7									
7.2	22.3										
7.4	24.8										
7.5	28.3										
7.6	30.7										
7.8	32.7										
8.0	34.8										
8.1	36.4										
8.2	38.3										
8.3	39.8										
8.5	40.3										
8.6	42.7										
8.8	44.2										
9.0	45.7										
9.2	46.9										
9.4	48.2										
9.6	49.4										
9.7	50.8										
9.9	51.8										
10.1	53.0										
10.2	54.2										
10.3	55.4										
10.5	56.4										
10.6	57.8										
10.7	58.8										
10.9	59.9										

Augered 13.2 cm

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 70+00 NB ISS	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	549976.9	2112695.7

Cumulative Penetration in Centimeters

1.2	76.1	112.3									
2.0	76.7										
2.8	77.5										
5.0	78.2										
8.0	78.9										
12.2	79.5										
16.7	80.5										
20.2	81.5										
23.5	81.5										
26.4	81.2										
29.2	81.9										
32.2	83.5										
34.8	84.2										
36.7	84.9										
38.5	85.6										
40.7	86.3										
42.2	87.0										
43.9	87.6										
45.3	88.3										
46.7	89.0										
47.9	89.7										
49.3	90.4										
50.4	91.2										
51.4	91.9										
52.7	92.6										
53.7	93.3										
54.7	94.0										
55.6	94.3										
56.5	95.4										
57.4	96.1										
58.3	96.4										
59.3	97.5										
60.1	98.2										
61.0	98.8										
61.8	99.4										
62.7	100.1										
63.6	100.8										
64.5	101.6										
65.2	102.4										
65.9	103.1										
66.6	103.8										
67.5	104.4										
68.4	105.1										
69.4	105.8										
70.0	106.4										
70.6	107.1										
71.2	107.8										
71.9	108.4										
72.6	109.0										
73.2	109.6										
73.9	110.3										
74.6											
75.4											

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 127+00 NB OSS	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	555136.6	2115117.8

Cumulative Penetration in Centimeters

2.4	77.8										
4.7	78.5										
7.6	79.2										
10.4	79.9										
13.1	80.6										
16.3	81.3										
19.3	82.1										
21.1	82.9										
22.8	83.8										
24.5	84.7										
26.4	85.6										
28.0	86.6										
29.6	87.4										
31.2	88.2										
32.4	89.1										
33.6	89.8										
34.7	90.6										
35.8	91.3										
36.9	92.0										
37.9	92.7										
39.4	93.4										
40.9	93.9										
42.4	94.4										
44.0	94.9										
45.6	95.5										
47.2	96.0										
48.6	96.6										
50.0	97.3										
51.3	98.0										
52.6	98.8										
54.0	99.5										
55.4	100.2										
56.7	100.9										
58.0	101.6										
59.4	102.3										
60.5	102.9										
61.6	103.6										
62.8	104.3										
63.9	104.9										
65.0	105.5										
66.0	106.0										
67.1	106.6										
68.1	107.1										
69.1	107.6										
70.1	108.1										
71.0	108.7										
72.0	109.3										
73.0	109.9										
74.0											
75.0											
75.7											
76.4											
77.1											

SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade

S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 122+00 NB OSS	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	554683.0	2114907.5

Cumulative Penetration in Centimeters

1.7	103.1							0.6	79.3						
3.8	104.0							1.7	80.1						
5.7	104.9							3.0	81.0						
8.1	105.8							4.7	81.8						
10.9	106.7							7.0	82.6						
13.6	107.6							9.7	83.4						
15.9	108.6							13.4	84.3						
18.7	109.3							16.0	85.2						
22.0	110.0							18.8	86.0						
25.5	110.6							21.7	86.9						
28.8	111.5							24.4	87.8						
33.2	112.4							27.6	88.6						
37.0	113.4							30.5	89.5						
40.9								33.0	90.4						
44.0								35.2	91.2						
46.4								37.4	92.1						
49.4								39.4	93.0						
52.8								41.4	93.9						
55.4								43.0	94.8						
57.6								44.7	95.7						
60.3								46.5	96.5						
62.0								48.10	97.3						
63.6								49.6	98.1						
65.5								51.1	99.0						
67.0								52.6	99.8						
68.5								54.0	100.6						
69.8								55.5	101.4						
71.1								56.8	102.2						
72.6								58.2	103.0						
73.9								59.5	103.8						
75.2								60.6	104.7						
76.4								61.6	105.6						
77.8								63.0	106.4						
79.2								64.1	107.2						
80.8								65.0	108.1						
82.0								65.9	109.0						
83.2								66.8	109.9						
84.5								67.8	110.8						
85.7								68.6	111.6						
86.9								69.4	112.2						
88.0								70.1	112.8						
89.1								70.8	113.3						
90.2								71.5	114.0						
91.4								72.2	114.7						
92.5								72.8	115.4						
93.6								73.4	116.1						
94.6								74.0	116.8						
95.6								74.8	117.4						
96.6								75.6							
97.5								76.4							
98.5								77.1							
99.5								77.8							
100.5								78.5							

CONE PENETROMETER DATA CODE SHEET

TIP	PROJECT I.D.	ROUTE
I-5877	53077.1.1	I-95
COUNTY	**ENGINEER**	**TECHNICIANS**
HARNETT	VLAD MITCHEV	S&ME

TEST LOCATIONS DESCRIPTION	DATE RUN
-L- 122+00 NB OSL	7/26 - 7/27/2017

DATUM	CUT/ FILL	NORTHING	EASTING
SG	FILL	554693.3	2114885.6

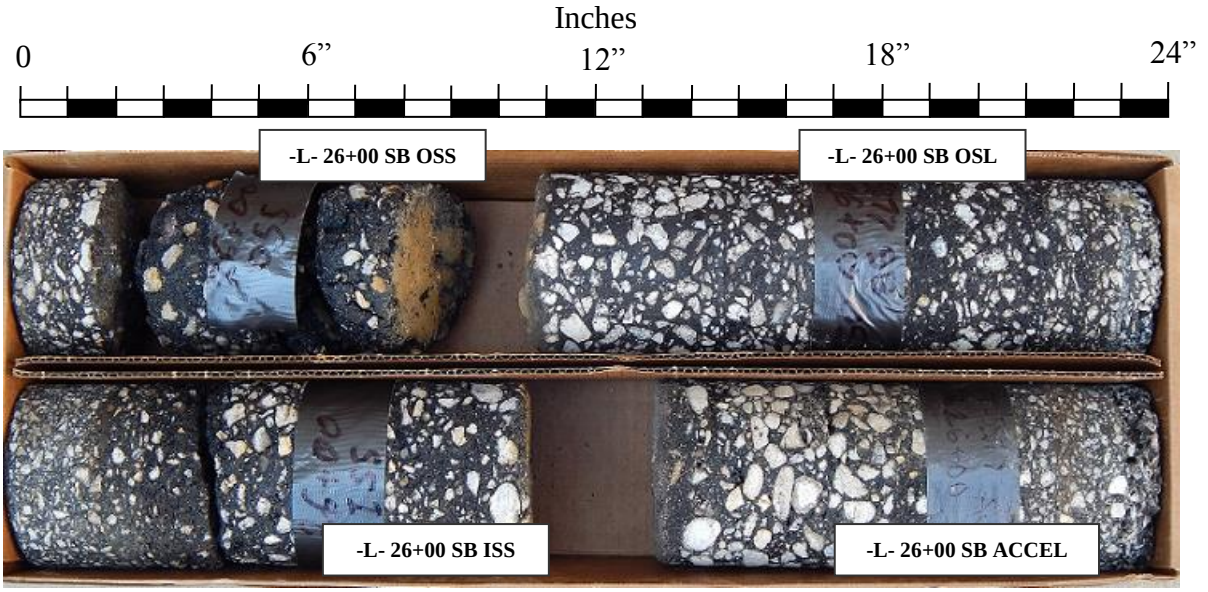
Cumulative Penetration in Centimeters

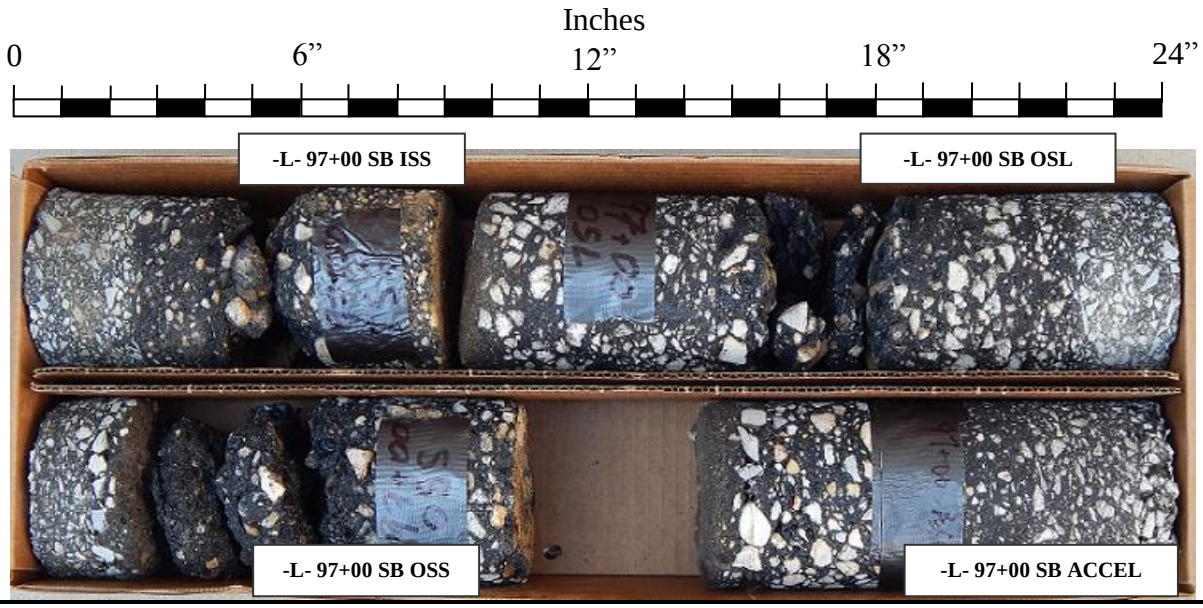
0.5	14.0	58.8						2.7	85.9						
1.3	14.2	59.6						5.5	87.0						
1.8		60.4						8.2	88.1						
2.1	Augered	61.2						11.5	89.2						
2.4	12.5 cm	62.0						14.2	90.4						
2.7		62.9						16.4	91.5						
3.0		63.7						18.3	92.6						
3.3	1.3	64.6						20.0	93.6						
3.7	2.6	65.5						22.0	94.7						
4.1	4.0	66.4						24.0	95.8						
4.3	6.5	67.3						26.8	96.8						
4.5	8.5	68.1						29.5	97.7						
4.8	11.0	69.0						31.8	98.6						
5.1	13.0	69.8						33.7	99.6						
5.4	15.0	70.6						35.3	100.5						
5.6	16.6	71.4						37.2	101.4						
5.8	18.3	72.2						39.2	102.4						
6.1	19.9	73.0						41.4	103.3						
6.3	21.5	73.8						43.6	104.2						
6.6	23.1	74.5						45.7	105.1						
6.8	24.7	75.3						47.7	106.1						
7.1	26.1	76.1						49.5	107.1						
7.3	27.6	76.8						51.5	108.0						
7.5	28.9	77.6						53.1	108.7						
7.8	30.2	78.4						54.6	109.5						
8.0	31.4	79.1						56.0	110.2						
8.2	32.6	79.7						57.4	111.0						
8.4	33.9	80.3						58.8	111.9						
8.6	35.2	81.0						60.2	112.8						
8.9	36.4	81.8						61.6							
9.2	37.6	82.7						63.1							
9.5	38.6	83.5						64.3							
9.7	39.6	84.2						65.5							
10.0	39.9	84.9						66.7							
10.2	40.2	85.7						67.7							
10.4	41.6	86.5						68.7							
10.6	43.0	87.3						69.8							
10.8	44.0	88.2						70.7							
11.0	45.0							71.6							
11.3	46.1							72.6							
11.5	47.1							73.5							
11.7	48.1							74.4							
11.9	49.2							75.2							
12.0	50.2							76.1							
12.1	51.2							77.0							
12.3	52.2							77.9							
12.5	53.0							78.9							
12.8	53.7							79.9							
13.1	54.5							81.0							
13.4	55.4							82.3							
13.6	56.3							83.6							
13.8	57.2							83.9							
13.9	58.0							84.9							

SG = Subgrade
SS = Stabilized Soil
CTBC = Cement-Treated Base Course
ABC = Aggregate Base Course
ESG = Estimated Subgrade

S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

Project No.: 53077.1.1	*I.D. No.*: I-5877	*County*: Harnett	*Dates:07/27-07/27/17*
Site Description: I-95 Interchanges at SR 1811 (Bud Hawkins Road) and SR 1002 (Long Branch Road)			
Consultant: S&ME, Inc.	*Core Size*: 4 - inch	*Drill Machine:* CME-55	
Geologist / Engineer: Vlad Mitchev, PE/ Joe Williamson, PE			





Notes:

OSL = Outside Lane
ISL = Inside Lane
RTL = Right Turn Lane
OSS = Outside Shoulder
ACCEL = Acceleration Lane
PS = Paved Shoulder
LTL = Left Turn Lane
ISS = Inside Shoulder
MED = Median

S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

Project No.: 53077.1.1	*I.D. No.*: I-5877	*County*: Harnett	*Dates:07/27-07/27/17*
Site Description: I-95 Interchanges at SR 1811 (Bud Hawkins Road) and SR 1002 (Long Branch Road)			
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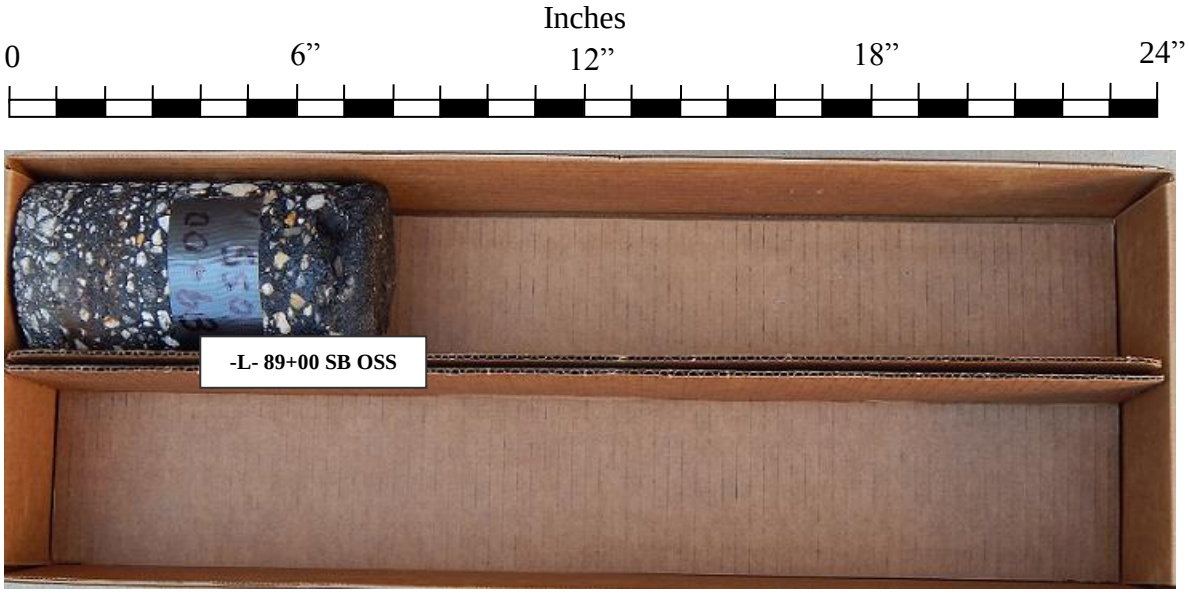

Notes:

OSL = Outside Lane	ACC = Acceleration Lane	MED = Median
ISL = Inside Lane	PS = Paved Shoulder	
RTL = Right Turn Lane	LTL = Left Turn Lane	
OSS = Outside Shoulder	ISS = Inside Shoulder	

S&ME, Inc.
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Project No.: 53077.1.1	*I.D. No.*: I-5877	*County*: Harnett	*Dates:07/27-07/27/17*
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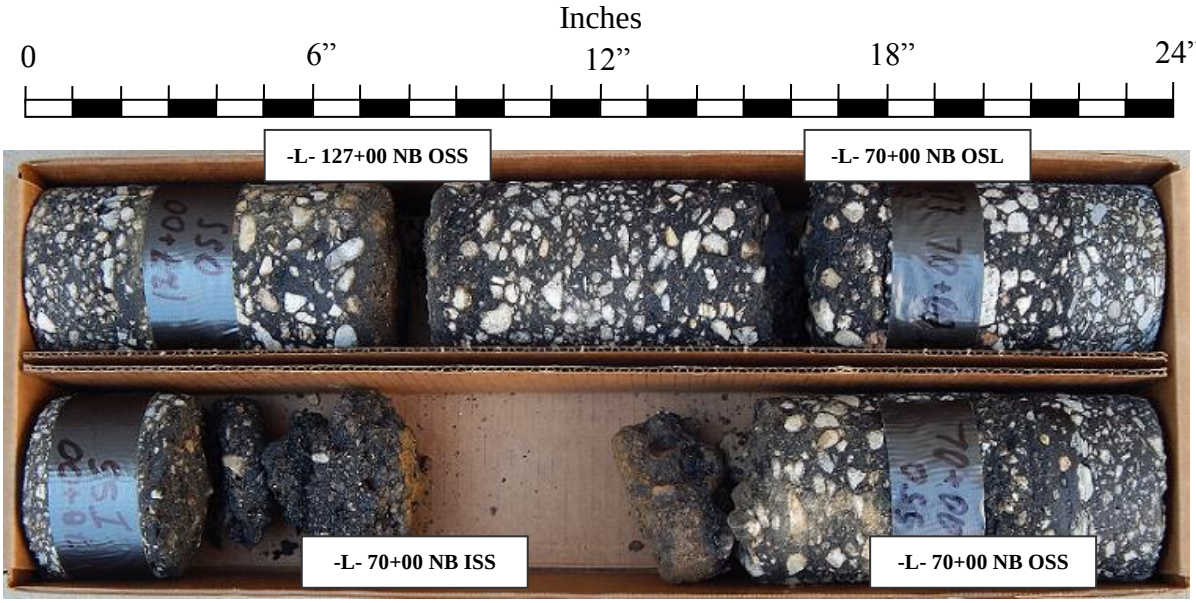

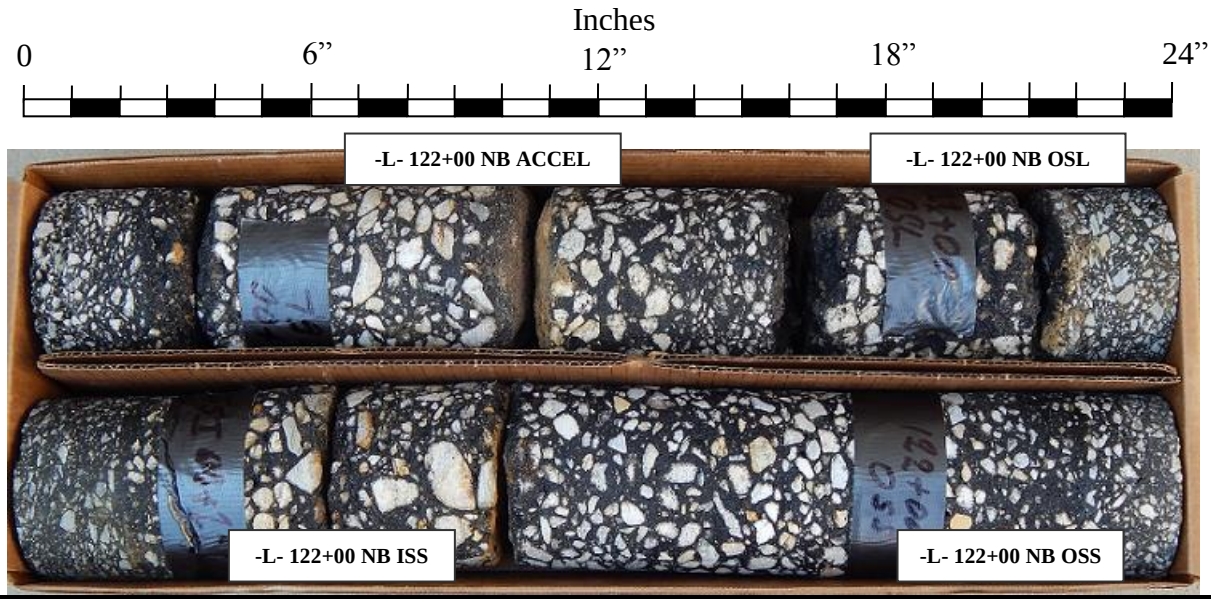

Notes:

OSL = Outside Lane	ACCEL = Acceleration Lane	MED = Median
ISL = Inside Lane	PS = Paved Shoulder	
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S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

PAVEMENT CORES FOR
53077.1.1, I-5877, Harnett County

LINE	STATION	LAYER THICKNESS (in)	LAYERS	REMARKS
-L-	26+00 SB OSS	2.00	S	1 lift, superpave mix,
	11" Asphalt		I/B	The remaining 2 pieces are highly stripped, bleeding present, subround to sub angular quartz aggregate, poor grain to grain contact.
-L-	26+00 SB ACCEL	0.75	OGFC	1 lift, open graded friction course (OGFC), low severity stripping
	10.5" Asphalt	2.00	S	1-2 lifts, super pave mix
		2.00	S	1 lift, older mix design, subround to subangular quartz aggregate, poor grain to grain contact
		4.50	B	1 lift, low severity stripping
		1.25		1 lift, large quartz aggregate in sand asphalt matrix
-L-	26+00 SB OSL	0.50	OGFC	1 lift, low severity stripping
	13.25" Asphalt	2.00	S	1 lift, superpave mix, low severity stripping
		4.25	I	2 lifts, older mix design, low severity stripping, poor grain to grain contact
		6.25	B	1 lift, minor bleeding present
-L-	26+00 SB ISS	2.00	S	1 lift, Superpave mix
	10.75" Asphalt	2.00	S	1 lift, older mix design, moderate severity stripping, delaminated from lower lift
		6.75	B	2 lifts, low to moderate severity stripping, lifts delaminated, subround to subangular quartz aggregate, poor grain to grain contact of large aggregate.
-L-	89+00 SB OSS	1.00	S	1 lift, superpave mix
	7.5" Asphalt	1.50	S	1 lift, older mix design, round to subround quartz aggregate, poor grain to grain contact,
		4.50	B	1 lift, low severity stripping in bottom 3.5", bleeding present, round to subround quartz aggregate, poor grain to grain contact
		0.75	SD	1 lift, sand asphalt (SD), 0.75" bottom-up crack
-L-	97+00 SB OSS	1.75	S	1 lift, superpave mix
	10.25" Asphalt	-	-	older design mix, lifts are highly stripped (pieces)
		4.00	B	1 lift, moderate severity stripping, subround to subangular quartz aggregate, poor grain to grain contact
-L-	97+00 SB ACCEL	1.00	OGFC	1 lift, low severity stripping
	9.75" Asphalt	4.00	S	3 lifts, lift three has subrounded quartz aggregate, sparse aggregate in sandy matrix.
		4.00	B	1 lift, low severity stripping, bleeding present, round to subround quartz aggregate
		0.75	SD	1 lift, low severity oxidation
-L-	97+00 SB OSL	2.00	S	1 lift, superpave mix
	14" Asphalt	1.00	S	1 lift, older mix design
		2.25	I	1 lift, low severity stripping, bleeding present
		-	-	1 lift, high severity stripping (rubble) with bleeding present
		1.75	S	1 lift
		3.00	I	1 lift, bleeding present
-L-	97+00 SB ISS	2.25	S	1 lift, Superpave
	9.75" ASphalt	1.50	S	1 lift, older mix design, moderate severity stripping
		-	-	1 lift, high severity stripping (rubble), round to subround quartz aggregate
		3.00	B	1 lift, moderate severity stripping, round to subround quartz aggregate

* -L- stationing was used for all coring locations

PAVEMENT CORES FOR

53077.1.1, I-5877, Harnett County

LINE	STATION	LAYER THICKNESS (in)	LAYERS	REMARKS
-L-	70+00 NB OSS	1.75	S	1 lift, superpave mix
		2.00	S	1 lift, older mix design, subround to subangular quartz aggregate, poor grain to grain contact, low sev. stripping
	11" Asphalt	4.00	B	1 lift, low severity stripping, quartz aggregate
		2.00	-	1 lift, large quartz aggregate in sand asphalt matrix, moderately stripped, asphalt missing
-L-	70+00 NB OSL	2.00	S	1 lift, Superpave mix
		1.50	S	1 lift, older mix design, low severity stripping
	15" Asphalt	6.50	I	2 lifts, moderate to high severity stripping with a portion of these lifts missing, quartz aggregate
		4.50	B	1 lift, low severity stripping in bottom 2"
-L-	70+00 NB ISS	2.50	S	1 lift, superpave mix
	10.25" Asphalt	-	-	remaining portion of this core is highly stripped into 3 large pieces, bleeding present
-L-	122+00 NB OSS	1.75	S	2 lifts, superpave mix
	13.75" Asphalt	2.25	I	1 lift, older mix design, round to subround quartz aggregate, poor grain to grain contact, bleeding at upper contact
		9.75	B	2 lifts, moderate severity stripping in bottom 3" of top lift
-L-	122+00 NB ACCEL	0.75	OGFC	1 lift
		2.00	S	1 lift, superpave mix
	10" Asphalt	1.00	S	1 lift, low to moderate stripping, delaminated from lower lift
		6.00	B	2 lifts, high severity stripping in top 0.5" with asphalt missing, subground to round quartz aggregate
		0.50	SD	1 lift, sand asphalt
-L-	122+00 NB OSL	2.25	S	1 lift, superpave mix
		-	-	surface lift has been stripped away
	13.75 Asphalt	4.00	I	1 lift, older mix design, moderate severity stripping, subround to subangular quartz aggregate, bottom of lift has been stripped
		2.00	I	1 lift
		3.00	B	1 lift, poor grain to grain contact
-L-	122+00 NB ISS	2.50	S	lifts indistinquishible, superpave mix design
	10.25" Asphalt	1.50	S	1 lift, older mix design, mechanical break in center of lift, moderate severity stripping, subround to subangular quartz aggregate, poor grain to grain contact
		2.50	I	1 lift, moderate severity stripping, subround to subangular quartz aggregate, delaminated from lower lift
		3.75	B	1 lift, sparse large aggregate, low severity stripping, large quartz aggregates are subround to subangular, majority of aggregate in lift are less than 10mm.
-L-	127+00 NB OSS	1.50	S	1 lift, superpave mix
	7" Asphalt	5.50	B	1 lift, low severity stripping, subround to subangular quartz aggregate

* -L- stationing was used for all coring locations

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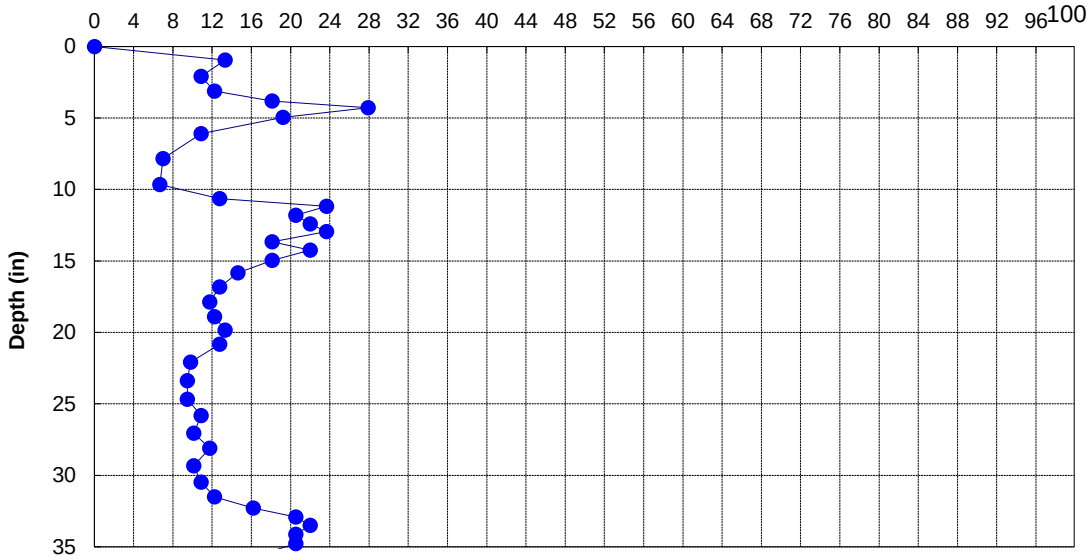
GEOLOGIST	JBB
GEOTECHS	S&ME

FILE	I-5877_CONEPEN.xls

-L- 26+00 SB OSS
RAW
FILL
Datum = SG
07/26/17
1

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

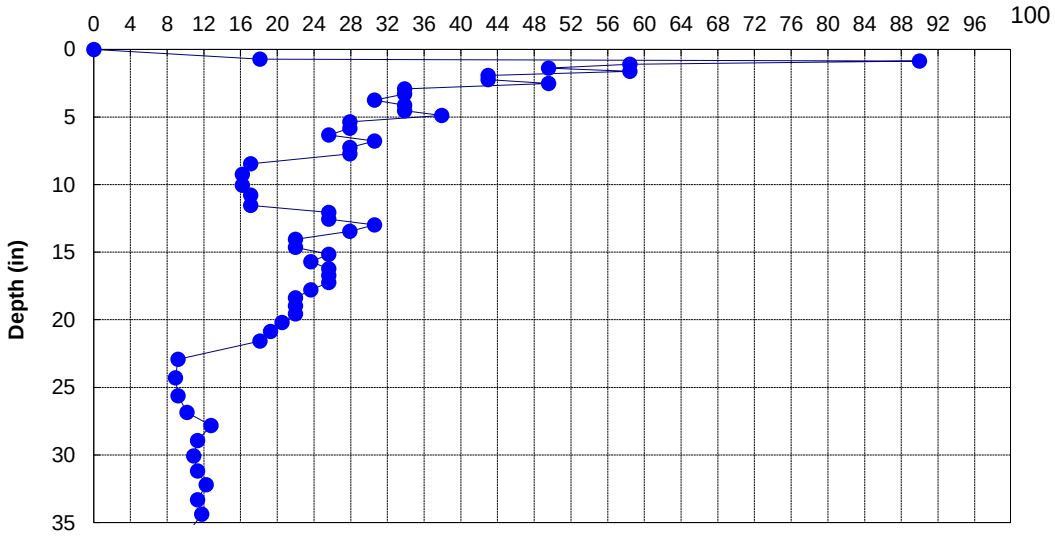
Interval 0.0 to 44.8	
# of Values	48
Avg CBR	15.1
Wghtd Avg.	13.5
Max CBR	27.9
Min CBR	6.7



-L- 26+00 SB ACCEL
RAW
FILL
Datum = SG
07/26/17
2

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 45.4	
# of Values	66
Avg CBR	24.1
Wghtd Avg.	18.7
Max CBR	90.0
Min CBR	8.9



CONE PENETROMETER RESULTS
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GEOTECHS	S&ME

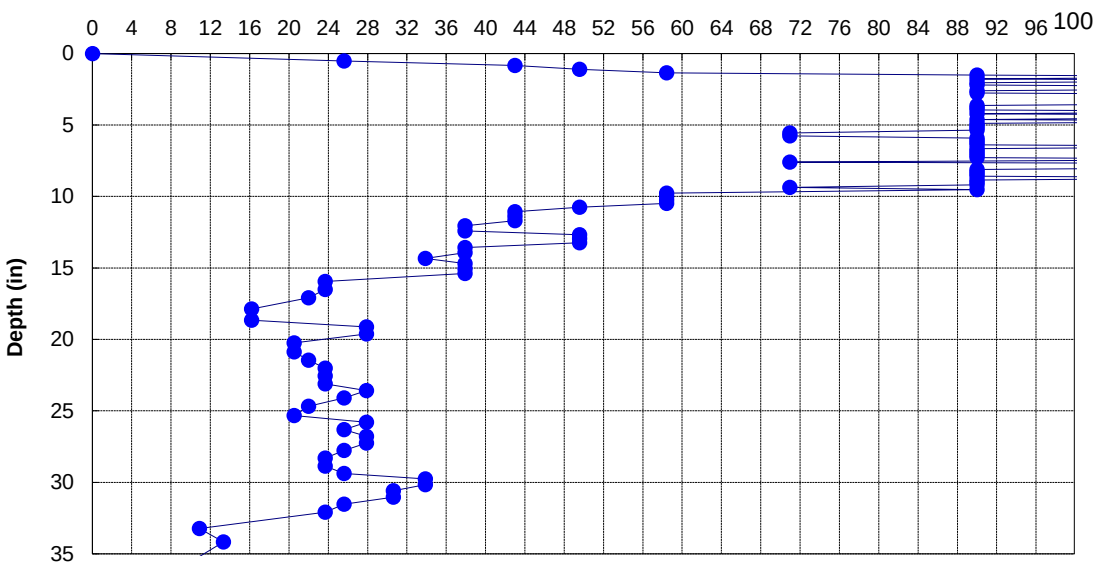
FILE	I-5877_CONEPEN.xls

-L- 26+00 SB OSL — RAW — FILL — 07/26/17 — 3

Datum = SG

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 39.1	
# of Values	118
Avg CBR	63.9
Wghtd Avg.	40.7
Max CBR	100+
Min CBR	10.5

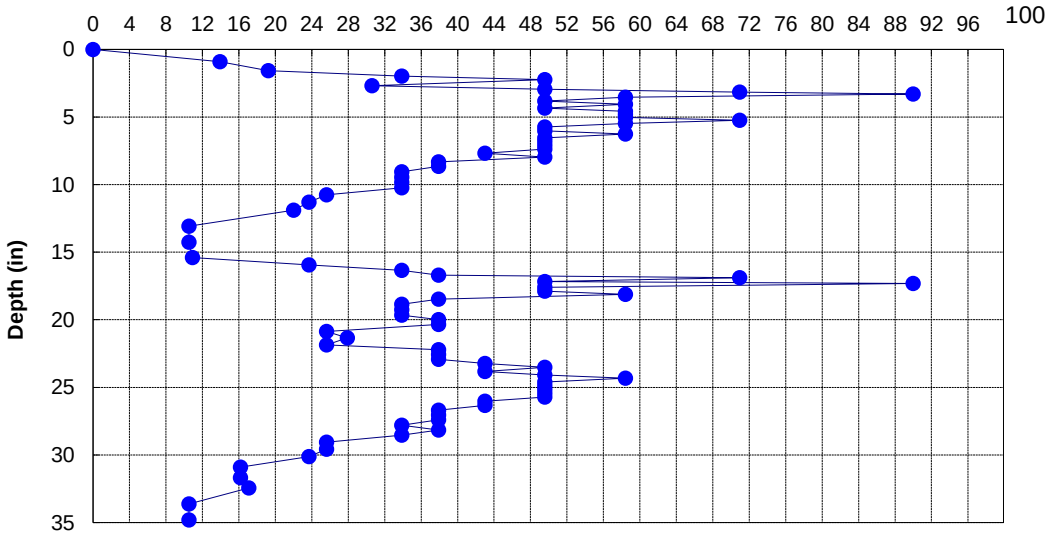


-L- 26+00 SB ISS — RAW — FILL — 07/26/17 — 4

Datum = SG

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 48.1	
# of Values	104
Avg CBR	37.0
Wghtd Avg.	28.5
Max CBR	90.0
Min CBR	10.1



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GEOLOGIST	JBB
GEOTECHS	S&ME

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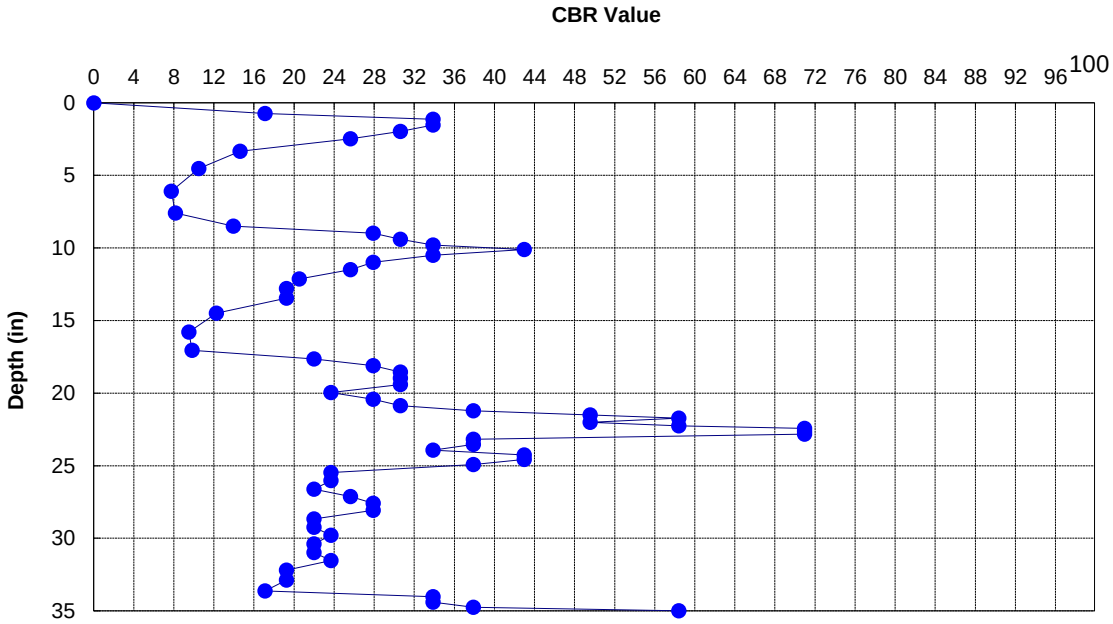
-L- 89+00 SB OSS RAW 5

FILL

Datum = SG 07/26/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 49.8	
# of Values	96
Avg CBR	34.6
Wghtd Avg.	25.3
Max CBR	100+
Min CBR	7.7



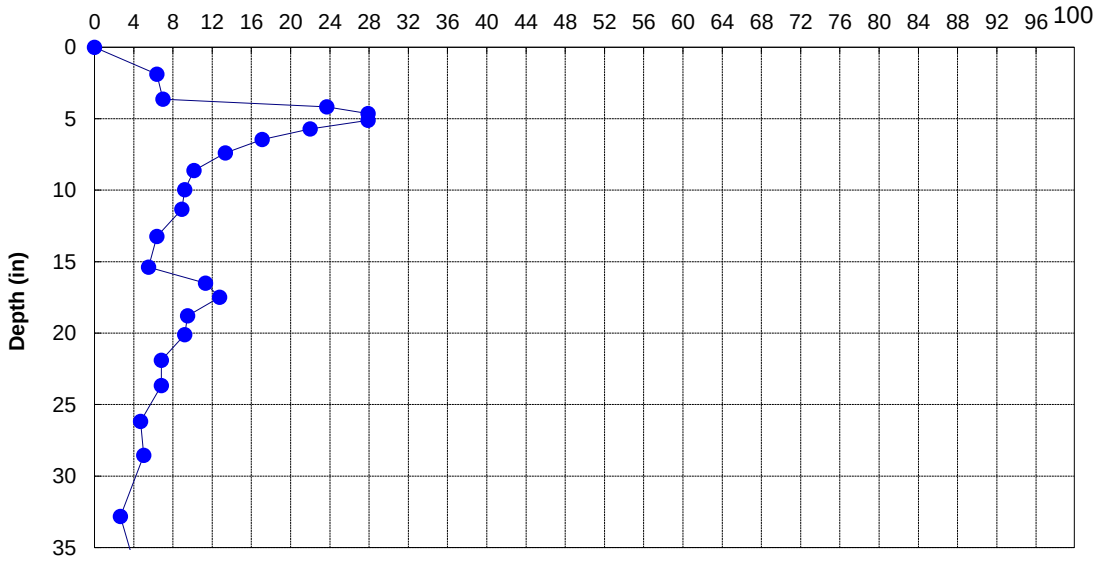
-L- 97+00 SB OSS RAW 6

FILL

Datum = SG 07/26/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 47.7	
# of Values	25
Avg CBR	10.5
Wghtd Avg.	6.3
Max CBR	27.9
Min CBR	1.4



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GEOTECHS	S&ME

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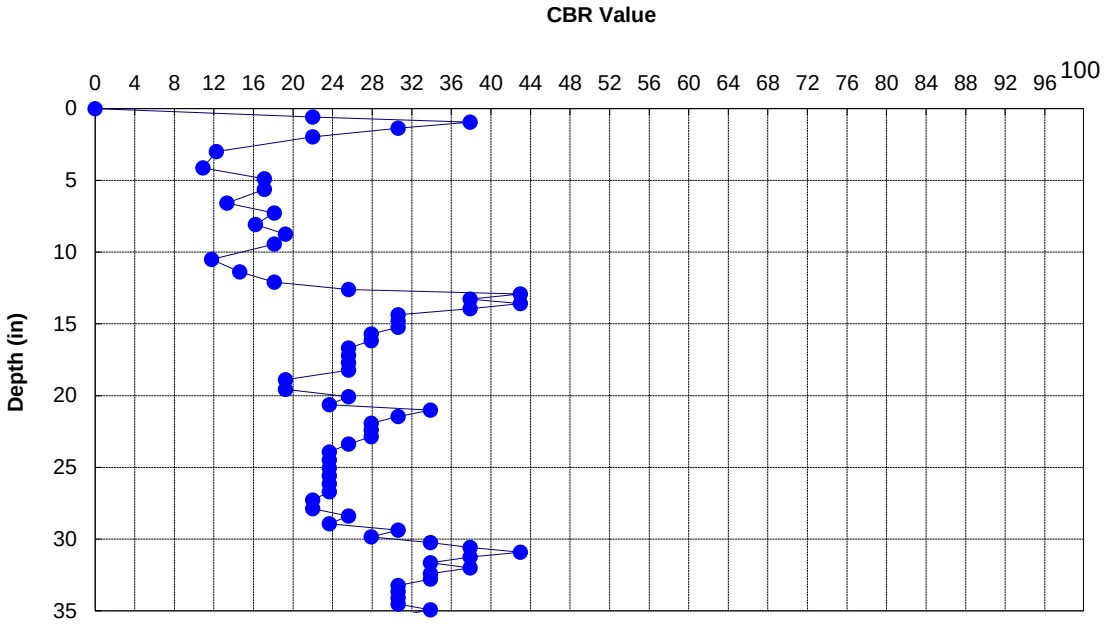
-L- 97+00 SB ACCEL RAW 7
FILL
Datum = SG 07/27/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

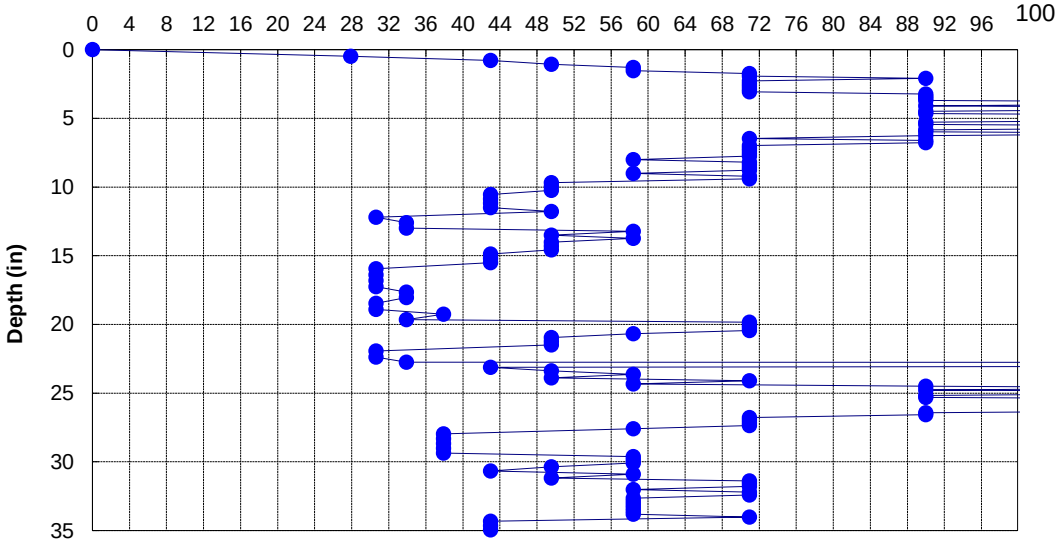
Interval 0.0 to 41.8	
# of Values	80
Avg CBR	27.2
Wghtd Avg.	25.1
Max CBR	43.0
Min CBR	10.9



-L- 97+00 SB OSL RAW 8
FILL
Datum = SG 07/26/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 35.6	
# of Values	152
Avg CBR	71.0
Wghtd Avg.	59.0
Max CBR	100+
Min CBR	27.9



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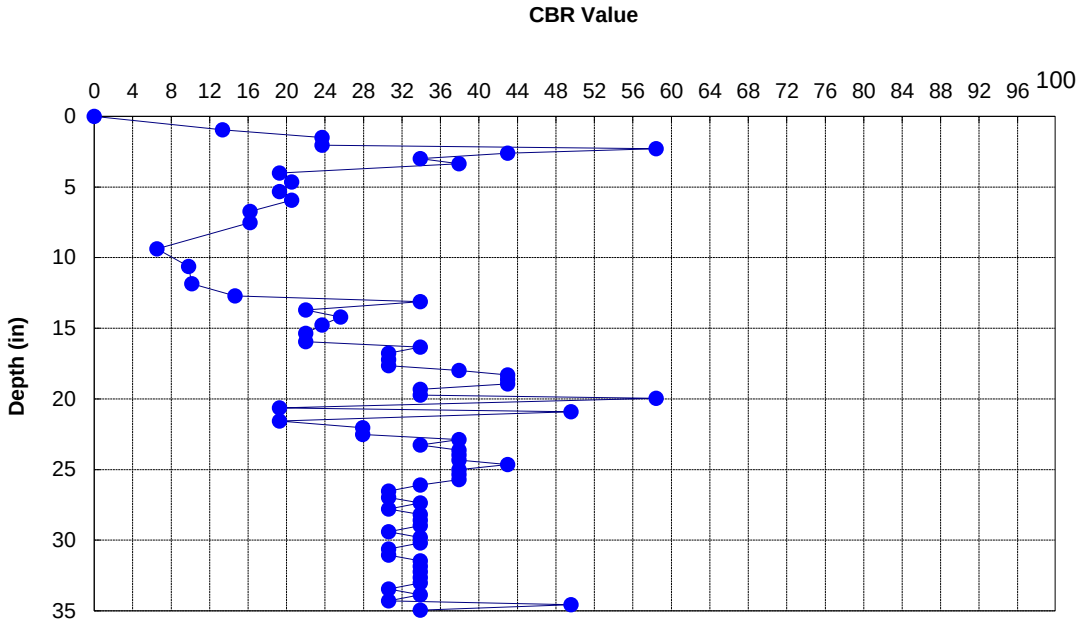
-L- 97+00 SB ISL RAW 9

FILL

Datum = SG 07/26/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 48.4	
# of Values	105
Avg CBR	32.1
Wghtd Avg.	28.6
Max CBR	58.4
Min CBR	6.5



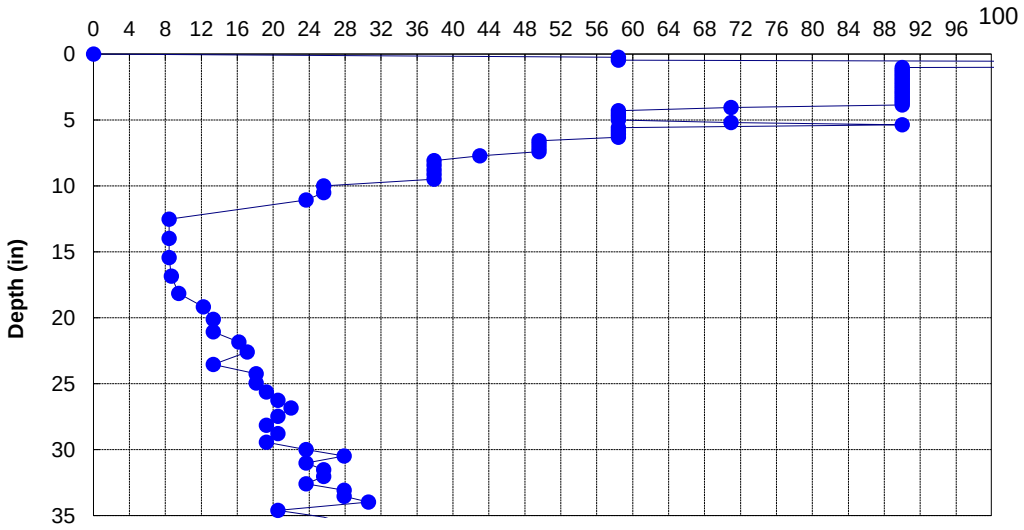
-L- 70+00 NB OSS RAW 10

FILL

Datum = SG 07/26/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 45.7	
# of Values	104
Avg CBR	56.8
Wghtd Avg.	30.1
Max CBR	100+
Min CBR	8.4



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GEOTECHS	S&ME

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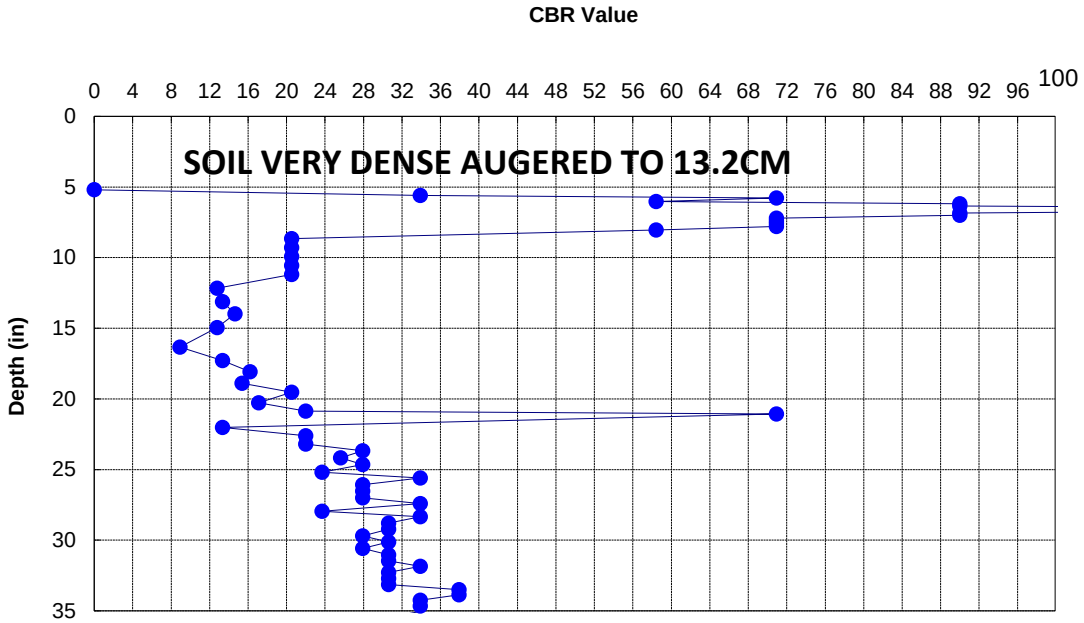
-L- 70+00 NB OSL — RAW — FILL — 07/26/17 — 11

Datum = SG

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 39.7	
# of Values	75
Avg CBR	39.3
Wghtd Avg.	28.7
Max CBR	100+
Min CBR	8.9

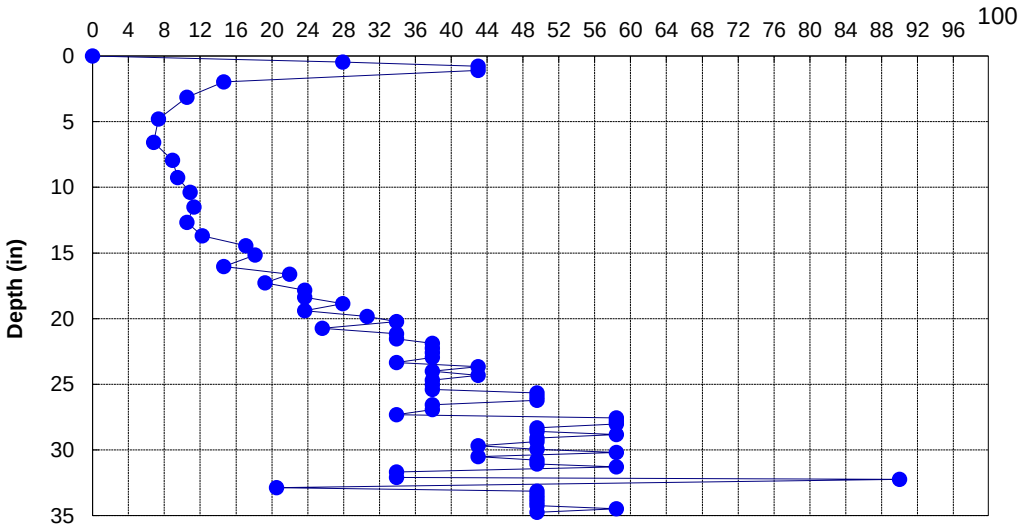


-L- 70+00 NB ISS — RAW — FILL — 07/26/17 — 12

Datum = SG

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 43.4	
# of Values	102
Avg CBR	42.1
Wghtd Avg.	31.2
Max CBR	100+
Min CBR	6.8



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GEOTECHS	S&ME

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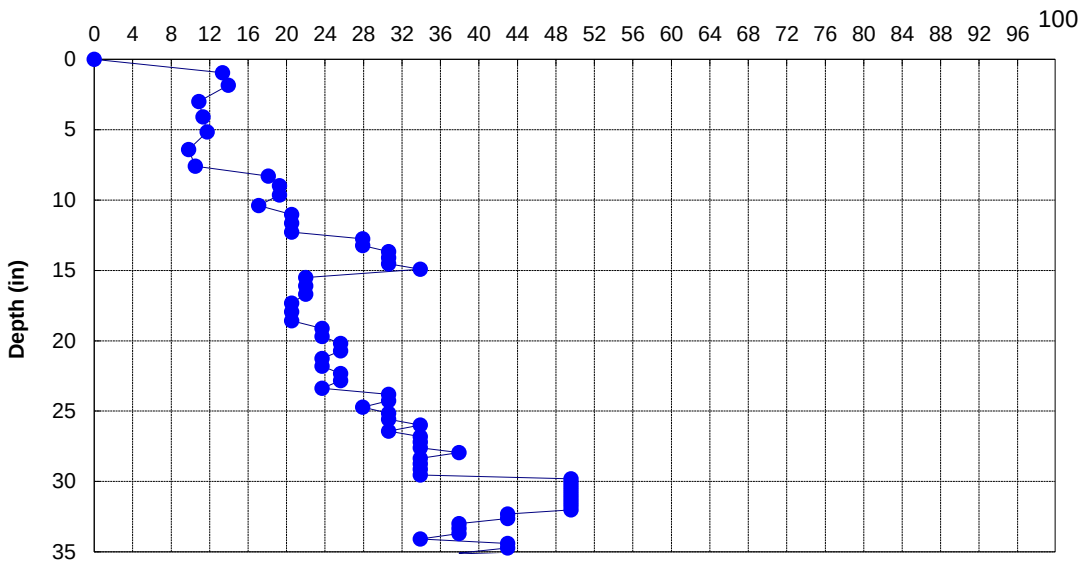
-L- 127+00 NB OSS — RAW — 13

FILL

Datum = SG — 07/27/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 43.3	
# of Values	101
Avg CBR	38.7
Wghtd Avg.	31.0
Max CBR	70.9
Min CBR	9.8



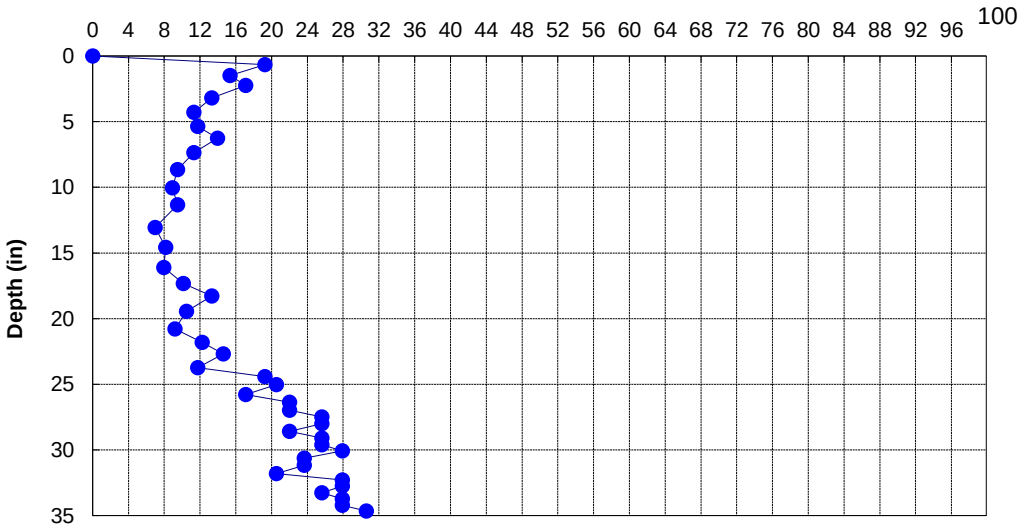
-L- 122+00 NB OSS — RAW — 14

FILL

Datum = SG — 07/26/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 44.6	
# of Values	66
Avg CBR	24.7
Wghtd Avg.	19.0
Max CBR	58.4
Min CBR	7.0



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GEOTECHS	S&ME

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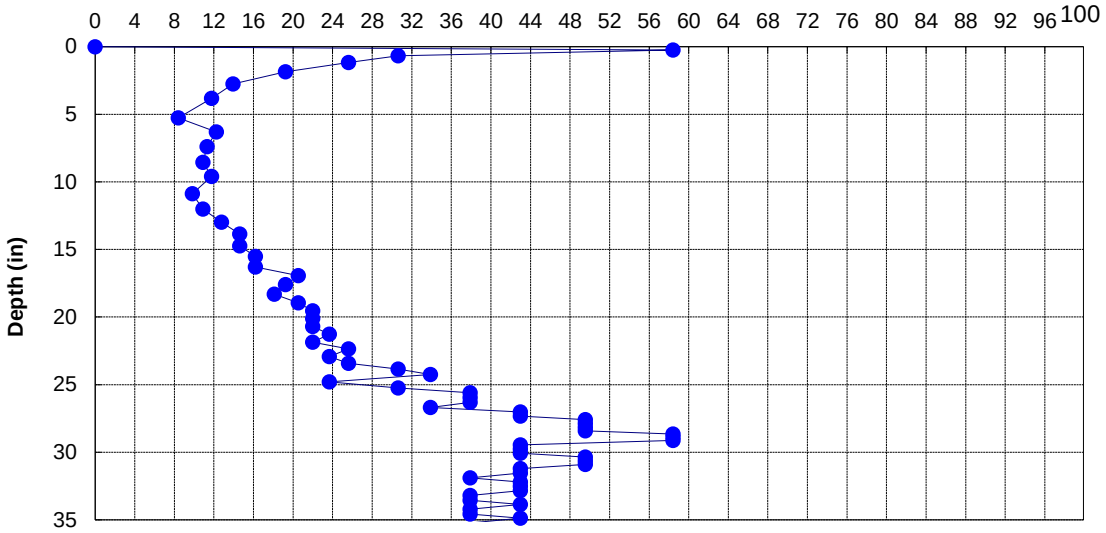
-L- 122+00 NB ACCEL — RAW — 15
FILL
Datum = SG — 07/27/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

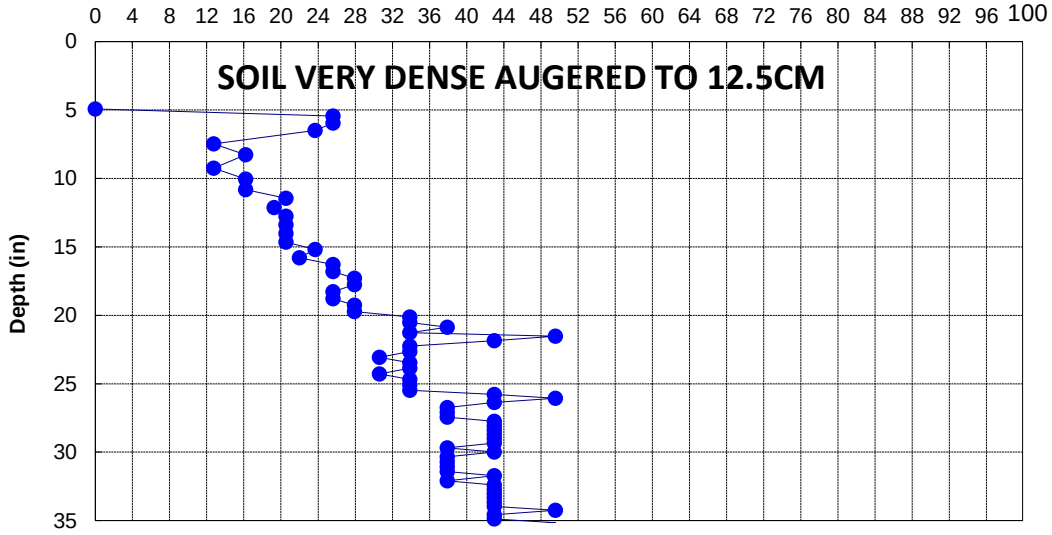
Interval 0.0 to 46.2	
# of Values	101
Avg CBR	36.2
Wghtd Avg.	29.2
Max CBR	70.9
Min CBR	8.4



-L- 122+00 NB OSL — RAW — 16
FILL
Datum = SG — 07/27/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 39.6	
# of Values	84
Avg CBR	35.9
Wghtd Avg.	32.2
Max CBR	58.4
Min CBR	12.8



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-L- 122+00 NB ISS RAW 17

FILL

Datum = SG 07/27/17

Interval 0.0 to 0.0	
# of Values	0
Avg CBR	#DIV/0!
Wghtd Avg.	#DIV/0!
Max CBR	0.0
Min CBR	0.0

Interval 0.0 to 44.4	
# of Values	82
Avg CBR	28.7
Wghtd Avg.	24.1
Max CBR	58.4
Min CBR	9.5