March 7, 2019 Geotechnical Report – Design and Construction Recommendations (REVISED)

A Design Build Project

I-95 widening from south of SR 1811 (Bud Hawkins Road - Exit 70) to north of SR 1002 (Long Branch Road – Exit 71)

Harnett County

March 7, 2019

March 7, 2019

MEMORANDUM TO:	John L. Pilipchuk, L.G., P.E. State Geotechnical Engineer
STATE PROJECT:	I-5877
F.A. NUMBER:	N/A
COUNTY:	Cumberland and Harnett Counties
DESCRIPTION:	I-95 from SR 1811 (Bud Hawkins Road) (Exit 70) to SR 1002 (Long Branch Road) (Exit 81) - Widen to eight lanes. -L- Station 790+00 to 946+00
SUBJECT:	Geotechnical Report – Design and Construction Recommendations (REVISED)

S&ME Inc. has completed a subsurface investigation for this project and submits the following recommendations. **Please note that this report supersedes the previously submitted report dated October 31, 2018 based on design revisions received January 16, 2019**.

I. Slope and Embankment Stability

A. Slope Design

Recommend that all slopes be constructed at a ratio of 3:1 (H:V) or flatter.

B. Undercut

A quantity of 1000 cubic yards of Undercut Excavation for embankment stability should be included in the project contract as a contingency item to be used at the discretion of the Engineer.

C. Geotextile for Soil Stabilization

A quantity of 1000 square yards of Geotextile for Soil Stabilization should be included in the project contract as a contingency item to be used at the discretion of the Engineer.

II. Subgrade Stability

A. Undercut for Subgrade Stability

The following areas contain highly plastic clays with plasticity indices (PI) greater than 20 and should be undercut. These areas are shown by a double hatch symbol on the cross sections. The depth of undercut should be to 3 feet below subgrade or to suitable soils, whichever is less. The estimated total volume of soils to be undercut is 29,650 cubic yards. Quantities of these materials may be obtained from the cross sections. Recommend that these undercut soils be wasted.

Line	Stations	Location
-Y12-	24+25 to 28+75	LT and RT
-Y12RPB-	13+50 to 19+75	LT and RT
-Y23-	10+00 to 15+85	LT and RT
-Y13RPC-	14+75 to 17+95	LT and RT
-Y13RPD-	13+15 to 14+50	LT and RT
-Y13RPD-	15+15 to 18+75	LT and RT
-SR7-	14+70 to 49+02.62	LT and RT
-SR8-	10+25 to 24+25	LT
-SR9-	10+75 to 13+25	LT and RT
-SR9-	14+75 to 16+25	LT and RT
-SR9-	22+25 to 29+25	LT and RT
-SR9-	32+25 to 34+75	LT and RT
-SR9-	34+75 to 45+16	LT and RT
-SR9-	48+17 to 63+68	LT and RT
-SR9-	66+68 to 72+18	LT and RT
-DR5-	29+25 to 33+75	LT and RT

An additional quantity of 2,900 cubic yards of undercut is recommended for inclusion in the contract as a contingency item, to be used in areas for undercut at the discretion of the Engineer.

B. Aggregate Subgrade
These conditions were encountered at the following locations:

Line	Stations	Location
-L-	790+00 to 946+00	LT and RT
-Y24-	10+00 to 13+25	LT and RT
-Y24-	13+75 to 21+25	LT and RT
-Y24-	27+25 to 39+75	LT and RT
-Y24-	40+25 to 47+25	LT and RT

A quantity of 53,550 cubic yards of Shallow Undercut is recommended for inclusion in the contract to be used for the above locations. We recommend that an additional 5,500 cubic yards of shallow undercut be included as a contingency item.

C. Geotextile for Soil Stabilization
A quantity of 233,950 square yards of Geotextile for Soil Stabilization should be included for the project to be used in the undercut areas discussed in Section II A and II B. An additional quantity of 23,000 square yards of geotextile for soil stabilization should be included in the project contract as a contingency.

Geotextile for soil stabilization should be included in the project quantities at the following locations.

Line	Stations	Location
-L-	790+00 to 946+00	LT and RT
-Y12-	24+25 to 28+75	LT and RT
-Y12RPB-	13+50 to 19+75	LT and RT
-Y23-	10+00 to 15+85	LT and RT
-Y24-	10+00 to 13+25	LT and RT
-Y24-	13+75 to 21+25	LT and RT
-Y24-	27+25 to 39+75	LT and RT
-Y24-	40+25 to 47+25	LT and RT
-Y13RPC-	14+75 to 17+95	LT and RT
-Y13RPD-	13+15 to 14+50	LT and RT
-Y13RPD-	15+15 to 18+75	LT and RT
-SR7-	14+70 to 49+02.62	LT and RT
-SR8-	10+25 to 24+25	LT and RT
-SR9-	10+75 to 16+25	LT and RT
-SR9-	22+25 to 29+25	LT and RT
-SR9-	32+25 to 34+75	LT and RT
-SR9-	34+75 to 45+16	LT and RT
-SR9-	48+17 to 63+68	LT and RT
-SR9-	66+68 to 72+18	LT and RT
-DR5-	29+25 to 33+75	LT and RT

D. Subsurface Drainage – Subsurface Drain

Groundwater was encountered within 6 feet of proposed grade in several places along the project as noted below. A quantity of 64,050 linear feet of 6" Perforated Subdrain Pipe for subsurface drain (Roadway Standard Drawing No. 815.02) should be included for the project. An additional quantity of 6,500 linear feet of 6" Perforated Subdrain Pipe for subsurface drain should be included in the contract as a contingency item to be used at the discretion of the Engineer.

Recommend that subsurface drains be installed near these stations.

Line	Stations	Location
-L-	790+00 to 887+00	LT and RT
-L-	903+00 to 946+00	LT and RT
-Y12RPB-	10+00 to 16+50	LT and RT
-Y13RPB-	10+00 to 17+50	LT and RT
-Y13RPC-	10+00 to 16+50	LT and RT
-Y24-	10+00 to 49+50	LT and RT

III. Borrow Specifications

A. Borrow Criteria

Common borrow for embankment construction to subgrade shall meet Coastal Plain criteria outlined in the Standard Specifications, Article 1018-2(B).

B. Select Granular Material

Select Granular Material for embankment construction on geotextile for soil stabilization and/or backfill shall meet the criteria outlined in Standard Specifications, Article 1016-3 Class II or III. A quantity of 29,650 cubic yards of Select Granular Material should be included for the undercut areas listed in Section IIA. An additional quantity of 3,400 cubic yards of Select Granular Material is recommended for inclusion in the contract as a contingency item, to be used at the discretion of the Engineer.

C. Class IV Subgrade Stabilization

A quantity of 115,050 tons Class IV Subgrade Stabilization is recommended for inclusion in the contract to be used for the areas discussed in Section II B. We recommend that an additional 11,500 tons of Class IV Subgrade Stabilization be included as a contingency item.

D. Shrinkage Factor

A shrinkage factor of 25% is recommended in the calculation of all earthwork quantities.

IV. Miscellaneous

A. Reduction of Unclassified Excavation – Clearing and Grubbing

A loss of 16,400 cubic yards is estimated on the project due to clearing and grubbing.

B. Reduction of Unclassified Excavation –Unsuitable Waste

The following areas of excavation contain plastic clays with plasticity indices (PI) greater than 20 and should be considered unsuitable unclassified excavation and wasted.

Line	Stations	Location
-L-	818+75 to 835+25	LT and RT
-L-	836+25 to 851+75	LT and RT
-L-	854+75 to 856+25	LT and RT
-L-	863+25 to 869+75	LT and RT
-L-	872+25 to 877+25	LT and RT
-L-	879+75 to 881+75	LT and RT
-L-	905+25 to 917+25	LT and RT
-L-	920+25 to 935+75	LT and RT
-L-	938+75 to 944+25	LT and RT
-Y12RPB-	13+50 to 19+75	LT and RT
-Y13RPD-	13+15 to 19+25	LT and RT
-Y24-	10+00 to 21+25	LT and RT
-Y24-	27+25 to 39+75	LT and RT
-Y24-	40+25 to 47+25	LT and RT
-SR7-	14+70 to 29+90	LT and RT
-SR7-	30+90 to 49+02.62	LT and RT

-SR8-	22+75 to 23+25	LT
-SR9-	21+75 to 28+75	LT
-SR9-	32+25 to 34+75	LT

These soils are shown by the single hatch pattern (/////) on cross-sections and should be wasted. Calculated quantity of highly plastic unsuitable unclassified excavation to be wasted is 62,000 cubic yards.

C. Reduction of Unclassified Excavation –Acceptable but not to be used in the top 3 feet of embankment or backfill

The following areas of excavation contains plastic clays with plasticity indices (PI) greater than 15 and less than 20 and unclassified excavation that is marginally acceptable but not in the top three feet of embankment or backfill.

Line	Stations	Location
-SR8-	10+25 to 11+75	LT and RT
-SR9-	10+75 to 13+25	LT and RT
-DR5-	27+75 to 34+75	LT and RT

These soils are shown by the asterisk hatch pattern (***) on cross-sections and are marginal and should not be used in the top three feet of embankment or backfill. Calculated quantity of moderately plastic unclassified excavation is 1,900 cubic yards.

D. Water Wells
Four monitoring wells were found within the proposed right of way limits on the project at the following location:

Line	Station	Location
-Y13RPD-	18+50	CL
- Y13RPD -	18+55	38 LT
- Y13RPD -	18+85	27 LT
- Y13RPD -	19+60	30 LT

This well should be sealed in accordance with the North Carolina Department of Transportation Standard Specification, Section 205, “Sealing Abandoned Wells”.

Prepared by,

DocuSigned by:
Stacie Mitchell
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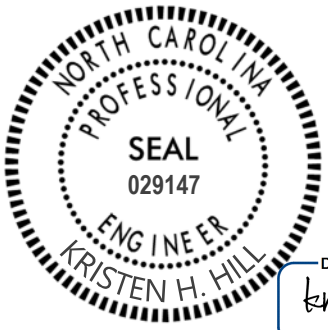
Stacie E. Mitchell, PE
Project Engineer

Prepared by,



DocuSigned by:
kristen Hill
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Kristen H. Hill, PE
Senior Engineer

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
Summary of Quantities

WBS Number: N/A
TIP Number: I-5986B (I-5877)
Description: I-95 Widening from SR 1811 to I-40

County: Cumberland/Harnett
Field Office: Charlotte

Project Engineer: Stewart Laney
Project Geologist: N/A

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 / %
0015000000-N	Sealing Abandoned Wells	205 - Sealing Abandoned Wells	IV. D	-Y13RPD-	18+50.00	19+60.00	4	EA
						Total Quantity of Sealing Abandoned Wells =	**4**	**EA**
0036000000-E	Undercut Excavation	225 - Roadway Excavation	I. B	Contingency	N/A	N/A	1,000	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-Y12-	24+25.00	28+75.00	1,000	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-Y12RPB-	13+50.00	19+75.00	1,700	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-Y23-	10+00.00	15+85.00	1,400	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-Y13RPC-	14+75.00	17+95.00	400	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-Y13RPD-	13+15.00	14+50.00	500	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-Y13RPD-	15+15.00	18+75.00	1,600	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR7-	14+70.00	49+02.62	8,200	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR8-	10+25.00	24+25.00	3,200	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR9-	10+75.00	13+25.00	600	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR9-	14+75.00	16+25.00	100	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR9-	22+25.00	29+25.00	1,800	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR9-	32+25.00	34+75.00	700	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR9-	34+75.00	45+16.00	2,800	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR9-	48+17.00	63+68.00	3,300	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-SR9-	66+68.00	72+18.00	1,500	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	-DR5-	29+25.00	33+75.00	850	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. A	Contingency	N/A	N/A	2,900	CY
						Total Quantity of Undercut Excavation =	**33,550**	**CY**
0195000000-E	Select Granular Material	265 - Select Granular Material	III. B	Varies	N/A	N/A	29,650	CY
0195000000-E	Select Granular Material	265 - Select Granular Material	III. B	Contingency	N/A	N/A	3,400	CY
						Total Quantity of Select Granular Material =	**33,050**	**CY**
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	I. C	Contingency	N/A	N/A	1,000	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-L-	790+00.00	946+00.00	179,800	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y12-	24+25.00	28+75.00	1,400	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y12RPB-	13+50.00	19+75.00	2,000	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y23-	10+00.00	15+85.00	1,700	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y13RPC-	14+75.00	17+95.00	800	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y13RPD-	13+15.00	14+50.00	500	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y13RPD-	15+15.00	18+75.00	2,300	SY

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
Summary of Quantities

WBS Number: N/A
TIP Number: I-5986B (I-5877)
Description: I-95 Widening from SR 1811 to I-40

County: Cumberland/Harnett
Field Office: Charlotte

Project Engineer: Stewart Laney
Project Geologist: N/A

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	II. C	-SR7-	14+70.00	49+02.62	18,200	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR8-	10+25.00	24+25.00	3,700	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR9-	10+75.00	13+25.00	700	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR9-	14+75.00	16+25.00	400	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR9-	22+25.00	29+25.00	2,100	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR9-	32+25.00	34+75.00	700	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR9-	34+75.00	45+16.00	3,100	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR9-	48+17.00	63+68.00	4,300	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-SR9-	66+68.00	72+18.00	1,600	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y24-	10+00.00	13+25.00	950	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y24-	13+75.00	21+25.00	2,600	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y24-	27+25.00	39+75.00	3,850	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-Y24-	40+25.00	47+25.00	2,100	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	-DR5-	29+25.00	33+75.00	1,150	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. C	Contingency	N/A	N/A	23,000	SY
						Total Quantity of Geotextile for Soil Stabilization =	**257,950**	**SY**
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	-L-	790+00.00	946+00.00	51,100	CY
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	-Y24-	10+00.00	13+25.00	200	CY
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	-Y24-	13+75.00	21+25.00	550	CY
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	-Y24-	27+25.00	39+75.00	1,200	CY
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	-Y24-	40+25.00	47+25.00	500	CY
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. B	Contingency	N/A	N/A	5,500	CY
						Total Quantity of Shallow Undercut =	**59,050**	**CY**
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. C	-L-	790+00.00	946+00.00	109,300	TON
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. C	Contingency	N/A	N/A	11,500	TON
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. C	-Y24-	10+00.00	13+25.00	550	TON
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. C	-Y24-	13+75.00	21+25.00	1,550	TON
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. C	-Y24-	27+25.00	39+75.00	2,350	TON
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	III. C	-Y24-	40+25.00	47+25.00	1,300	TON
						Total Quantity of Class IV Subgrade Stabilization =	**126,550**	**TON**
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. D	Contingency	N/A	N/A	6,500	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. D	-L-	790+00.00	887+00.00	38,800	LF

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Project Engineer: Stewart Laney
Project Geologist: N/A

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2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. D	-L-	903+00.00	946+00.00	17,200	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. D	-Y12RPB-	10+00.00	16+50.00	1,300	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. D	-Y13RPB-	10+00.00	17+50.00	1,500	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. D	-Y13RPC-	10+00.00	16+50.00	1,300	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. D	-Y24-	10+00.00	49+50.00	3,950	LF
						Total Quantity of 6" Perforated Subdrain Pipe =	**70,550**	**LF**
N/A	Unclassified Excavation - Acceptable, but not to be used in top 3 ft of embankment or backfill	225 - Roadway Excavation	IV. C	-SR8-	10+25.00	11+75.00	300	CY
N/A	Unclassified Excavation - Acceptable, but not to be used in top 3 ft of embankment or backfill	225 - Roadway Excavation	IV. C	-SR9-	10+75.00	12+25.00	400	CY
N/A	Unclassified Excavation - Acceptable, but not to be used in top 3 ft of embankment or backfill	225 - Roadway Excavation	IV. C	-DR5-	27+75.00	34+75.00	1,200	CY
						Total Quantity of Unclassified Excavation - Acceptable, but not to be used in top 3 ft of embankment or backfill =	**1,900**	**CY**

These Items Only Impact Earthwork Totals								
N/A	Loss Due to Clearing & Grubbing	200 - Clearing and Grubbing	IV. A	N/A	N/A	N/A	16,400	CY
N/A	Shrinkage Factor	235 - Embankments	III. D	N/A	N/A	N/A	25	%
N/A	Unclassified Excavation - Unsuitable Waste	225 - Roadway Excavation	IV. B	N/A	N/A	N/A	62,000	CY