Soil Survey Report

3/6/2014

2/8/2013

06/13/11

12/16/10

08/12/10

12/22/09

Scott Lewis

Alex Taloma

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PPMS: 18964

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1.0 Project Description

The purpose of this project is to replace bridge over Norfolk Southern Railroad. Existing minor road system consists of two 11.0 ft lanes flanked by turning lanes in both travel directions. The proposed typical section consists of full-depth pavement construction at Route 460 Business, Route 636, and Route 641. The project is located in Nottoway County.

2.0 Subsurface Investigation

On September, 2008, the Richmond District Materials Section performed a soil survey utilizing CME 45B drill rig to obtain 6 soil borings that penetrated to approximately 5.0 feet in depth. The borings were advanced thru strata using solid stem augers. Soil samples for field moisture content, CBR, and classification tests were obtained from auger cuttings. Exploration indicated the following strata:

Stratum 1
Crushed Stone and Topsoil- 1.0-1.5 ft crushed stone mixed topsoil stratum

Stratum 2
Reddish Brown Sandy Elastic SILT or Elastic SILT with Sand- 1.0-3.5 ft stratum was in a high moisture condition.

Stratum 3
Brown clayey SAND- 1.0-2.5 ft stratum was in a high moisture condition.

Groundwater and bedrock were not encountered. Additionally, ditches appeared dry and free from excessive yielding material.

Subsequent to our original investigation, on February 10, 2014 a supplemental investigation using a hand auger and soil probe rod was performed in the vicinity of the proposed RTE 636 alignment to verify the presence of potentially unsuitable soils.

2.1 Field Logs and Laboratory Testing

The table below displays condensed field and lab data.

Table 1. Route 460 Soil Data

Station	Offset (feet)	Depths (feet)	USCS	LL (%)	PI (%)	Soaked CBR (%)	Maximum Density (lbs./cu.ft.)	Optimum Water Content (%)	Field Mois-ture (%)
123+00	RT 37.0	1.5-4.0	MH	68.7	32.0	3.3	94.8	25.1	29.0
120+50	LT 12.0	1.5	MH*						30.8
115+50	LT 12.0	2.5-5.0	SC	27.6	12.8	24.3	122.0	10.9	15.6
107+00	RT 10.0	1.5	SC*						14.5
104+50	CL	1.5	MH*						34.1
102+30	LT 12.0	3.0-5.0	MH	54.4	13.3	1.2	100.6	20.8	26.9

*-Denotes visual classification

3.0 Geotechnical Recommendations

Recommendations presented in this report are based on field conditions presented in Section 2.0. Seasonal weather and/or storm events may govern field conditions to differ from Section 2.0. Ultimately, field conditions should be evaluated by field/project engineer during construction. Additionally, borings presented in Section 2.0 may not capture entire strata that may be encountered.

3.1 Ground Improvement

Station 108+50 – 109+50 (RTE 460 Bus.) <Proposed Widening>

Station 300+12 – 315+00 (RTE 636)*

The sections referenced above exhibited high moisture, high moisture sensitivity, and low CBR conditions. Recommend the following alternatives to address unsuitable soils:

I. Unsuitable material located < 3 ft below proposed top of pavement subgrade

1) Undercut 2.0 ft within subgrade prism horizontal limits.
2) Place subgrade stabilization fabric within undercut prism.
3) Backfill with 2.0 ft of #3 Stone.
4) Cap #3 Stone with subgrade stabilization fabric.

II. Unsuitable material located ≥ 3 ft below proposed top of pavement subgrade and / or outside of pavement subgrade prism horizontal limits

1) Place subgrade stabilization fabric over unsuitable area in accordance with manufacturer and VDOT specifications. Extend fabric beyond the unsuitable area a minimum distance equal to the required overlap.
2) Place minimum 2.0 ft of #3 Stone.
3) Cap #3 Stone with subgrade stabilization fabric.

* - **Do not perform ground improvement in areas where the proposed road overlaps existing road prism, apply recommendation presented in Section 3.3 Demolition ~~and Manipulation~~**

3.2 Working Platform

Station 109+50 – 122+00 (RTE 460 Bus.) <Proposed Widening/Mainline>

The section~~s~~ referenced above exhibited high moisture, high moisture sensitivity, and low CBR conditions. The following ~~R~~recommendations ~~the following~~ apply to the existing ground surface area directly beneath the subgrade prism horizontal limits located at a depth < 5 feet below the proposed top

of pavement subgrade (based on the Soils and Aggregate Materials Certification Study Guide, clearing and grubbing of topsoil and vegetation is not required for fills ≥ 5 feet):~~:~~

1) Clear and grub 1.0 - 1.5 ft within subgrade prism horizontal limits.
2) Place subgrade stabilization fabric within clear and grub prism.
3) Backfill with a minimum of 1.0 ft of #3 Stone.
4) Cap #3 Stone with subgrade stabilization fabric.

3.3 Demolition~~ and Manipulation~~

Station 400+12 – 403+50 (RTE 641)

The pavement thickness consisted of 2.0 inches of asphalt pavement. Recommend the following:

1) Demolish the existing pavement in such a manner that results in a nominal particle size of 2.0 in
~~2) Manipulate the demolished pavement and the existing roadbed beneath at a depth of 8.0 in~~

~~* - Manipulation in inclusive to the following that apply including preparing the roadbed, scarifying, pulverizing, drying material, mixing, compacting, finishing, protecting, curing, and maintaining the completed course **<Transport itemized as demolition and manipulation>**~~
~~**** - Additional intermittent areas noted in Section 3.1~~

RTE 636
The beginning approximately 400 feet of existing RTE 636, as measured from the intersection with RTE 460 Business, was reportedly surface treated approximately 20 years ago. The surface treatment was measured at spot locations to range from approximately ¾ inch to 4 inches thick. The remaining portion of the existing RTE 636 alignment consists of an unpaved dirt road.

3.4 Fills

Minimum CBR requirement for borrow material should be noted in the General Notes of the plan set as CBR 10.

3.5 Cuts

Project does not exhibit excessive cut sections.

3.6 Transitions

Cut to fill transition within this project do not exhibit a potential for water intrusion, therefore no CD recommendations.

3.7 Slopes

Excessive slopes with respect to height are proposed MSE wall structure, stability analysis will be provided by MSE wall designer.

3.8 Underdrains

Station 109+00 and 112+50 (RTE 460 Bus.) <Right Side>

Recommend modified UD-4 to drain stone layers resultant of the ground improvement prism. A detail of the modified UD-4 in located in the attachment section.

3.9 Existing Ditches

Station 109+50 – 122+00 (RTE 460 Bus.) <Proposed Widening/Mainline>

Apply recommendations in **Section 3.2** to ditches within proposed earthwork limits.

460 Bus. Turning/Acceleration Lane <Ditches>

Station 158+50 – 176+00 (RTE 460)

The sections referenced above exhibited high moisture, high moisture sensitivity, and low N-values. Recommend the following:

1) Undercut 1.5 ft deep by 3.0 ft wide on center of ditch line
2) Place subgrade stabilization fabric within undercut prism
3) Backfill with CBR 10 material

3.10 SWM Basin

Material within basin limits classified as ML or MH, recommend construct basin without cutoff trench.

4.0 Pavement Recommendation

The pavement was designed using 1993 AASHTO pavement design software called Darwin Pavement Design System. Traffic data for analysis was provided by Traffic Division. Traffic counts were projected to be 4,890 ADT, 170 ADT, and 80 ADT in 2007 with 10% trucks on Route 460, 641, and 636, respectively. Roadbed resilient modulus calculated from a CBR value of 5.4, correlating with a weighted average of site CBR's with respect to exploration depth.

Table 2. Design CBR Methodology

Sample Depth	Boring Depth	Ratio	CBR	Weighted	
4	5	0.8	3.3	2.64	
2.5	5	0.5	24.3	12.15	
3.5	5	0.7	1.2	0.84	
15.5	16	0.96875	3.2	3.1	
15.6	16	0.975	2.7	2.6325	
		3.94375		21.3625	5.416799

Four pavement cores were taken on November, 2008 to evaluate existing asphalt pavement thickness and condition. The pavement thickness was measured to be an average of approximately 8.3 inches. The pavement cores appeared to be in fair condition. Pavement cores along Route 641 and Route 636 were measured to be 2.0 inches and 1.0 inches, respectively. The pavement along Route 641 was in fair condition. The pavement along Route 636 was poor condition with isolated pothole distress.

Additionally, six cores were taken on October, 2010 to evaluate existing asphalt pavement thickness and condition. The pavement thickness was measured to be an average of approximately 7.8 inches. The pavement cores appeared to be in good condition. The subbase was measured to be an average of approximately 15 inches.

The pavement core field sheets are available in the **Attachments Section.**

4.1 Pavement Design

Station 113+00 – 132+00 (RTE 460 Bus.)

Station 152+00 – 155+50 (RTE 460 Bus.)

Thickness	**Pavement Structure**	**Application Rate**
1.5”	**SM-9.5D**	**165 lbs/yd^2**
2.0”	**IM-19.0A**	**220 lbs/yd^2**
4.0”	**BM-25.0A**	**440 lbs/yd^2**
10.0”	**Aggregate 21-B**	

Additionally, pavement design shall extend shall extend thru the **8.0 ft shoulder** limits flanking **RTE 460 Bus**.

Station 301+06.95 – 315+00 (RTE 636)

Thickness	**Pavement Structure**	**Application Rate**
NA	**Prime and Double Seal**	**(IIM-LD-158.11)**
12.0”	**Aggregate 21-B**	

Station 400+12 – 404+50 (RTE 641)

Thickness	**Pavement Structure**	**Application Rate**
1.5”	**SM-9.5D**	**165 lbs/yd^2**
2.0”	**IM-19.0A**	**220 lbs/yd^2**
4.0”	**BM-25.0A**	**440 lbs/yd^2**
10.0”	**Aggregate 21-B**	

Alternative design:

Thickness	*Pavement Structure*	*Application Rate*
1.25”	*SM-9.5D*	*138 lbs/yd^2*
2.5”	*BM-25.0A*	*275 lbs/yd^2*
10.0”	*Aggregate 21-B*	

4.2 Minimum Overlay Design

Station 107+50 – 113+00 (RTE 460 Bus.)

Station 132+00 – 136+00 (RTE 460 Bus.)

Station 136+00 – 137+00 (RTE 460 Bus.)

Recommend mill 0.5" as needed to achieve proposed grade and place the following minimum layers*:

Thickness	Pavement Structure	Application Rate
1.5"	**SM-9.5D**	**165 lbs/yd^2**
2.0"	**IM-19.0A**	**220 lbs/yd^2**

* - **Additionally, BM-25.0A may be utilized in buildup sections greater than 3.5 inches as long as the finishing surface is SM-9.5D.**

4.3 WP-2 (RTE 460 Bus. and BYPASS)

Turning Lane Widening**

Thickness	Pavement Structure	Application Rate
1.5"	**SM-9.5D**	**165 lbs/yd^2**
2.0"	**IM-19.0A**	**330 lbs/yd^2**
4.0"	**BM-25.0A**	**440 lbs/yd^2**
12.0"	**Aggregate 21-B**	

<RTE 460 Bus. Adjacent to Turn Lane Widening>

Recommend mill 3.5" and place the following minimum layers:

Thickness	Pavement Structure	Application Rate
1.5"	**SM-9.5D**	**165 lbs/yd^2**
2.0"	**IM-19.0A**	**220 lbs/yd^2**

<RTE 460 BYPASS Adjacent to Turn Lane Widneing>

<RTE 460 BUS STA 152+00 – 155+50>

Recommend mill 1.5" and place the following minimum layers:

Thickness	Pavement Structure	Application Rate
1.5"	**SM-9.5D**	**165 lbs/yd^2**

**** - Recommend minimum 1.0 ft sawcut from edge of existing pavement.**

4.4 Temporary Pavement Design (RTE 460 Bus.)

The temporary pavement design was based on a design life of 2.0 years.

Thickness	Pavement Structure	Application Rate
3.0”	**IM-19.0A**	**330 lbs/yd^2**
12.0”	**Aggregate 21-B**	

4.5 Temporary Entrance

Construct the fill utilizing the following options:

1) Utilize minimum CBR 10 to construct the proposed fill. At the end of contract business day, place 1.0 ft depth of aggregate material (#25/26 stone) to maintain traffic. Inflate quantity to account for maintaining grade as needed.
2) Utilize coarse aggregate (#10 screening) to construct the proposed fill. Inflate quantity to account for maintaining grade as needed.

4.6 Pavement Demolition

Station 403+50 – 404+50 (RTE 641)

Recommend demolition of pavement at an estimated depth of 2.0 in.

Attachments