

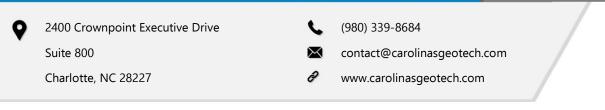


Structure Foundation Recommendations

Prepared for: TGS Engineers, Inc. 201 W. Marion Street, Suite 200 Shelby, North Carolina 28150

January 26, 2023





January 26, 2023

Mr. Jimmy L. Terry, P.E. TGS Engineers, Inc. 201 W. Marion Street, Suite 200 Shelby, North Carolina 28150

WBS ELEMENT:	BP6.R006
T.I.P. NO.:	SF-250245
I.D. NO.:	SF-250245
COUNTY:	Cumberland
DESCRIPTION:	Bridge No. 245 on SR 1414 (Raeford Road) over Branson Creek
SUBJECT:	Structure Foundation Recommendations

Dear Mr. Terry,

Carolinas Geotechnical Group, PLLC (CG2) has completed the Structure Foundation Recommendations for Structure No. 250245 on SR 1414 (Raeford Road) over Branson Creek in Cumberland County, North Carolina. Foundation Recommendations Notes on Plans and Comments, provided NCDOT Structure Inventory Report, and supporting calculations are presented below and attached.

CULVERT -L- 15+21.00

FOUNDATION RECOMMENDATION NOTES ON PLANS:

- 1. EXCAVATE 12 INCHES BELOW THE BOTTOM OF THE CULVERT AND REPLACE WITH FOUNDATION CONDITIONING MATERIAL IN ACCORDANCE WITH ARTICLE 414 OF THE STANDARD SPECIFICATIONS. FOUNDATION CONDITIONING MATERIAL SHOULD CONSIST OF SELECT MATERIAL CLASS V OR VI FOR RCBC.
- 2. IF REQUIRED, UNDERCUT LOOSE SOILS THAT MAY BE ENCOUNTERED BENEATH THE BOTTOM OF THE FOUNDATION CONDITIONING MATERIAL. BACKFILL UNDERCUT AREAS WITH FOUNDATION CONDITIONING MATERIAL.

FOUNDATION RECOMMENDATION COMMENTS:

- 1. The invert elevation at the centerline of the reinforced concrete box culvert is 114.9 feet.
- 2. We anticipate groundwater to impact construction.
- 3. We recommend a quantity of 130 tons of foundation conditioning material (Class V or VI).
- 4. We do not anticipate settlement to be a concern. No camber is necessary.
- 5. Place Select Material Class V or VI when backfilling in water.



Structure Foundation Recommendations

Bridge No. 245 on SR 1414 (Raeford Road) over Branson Creek

Cumberland County, North Carolina

CLOSING

Please do not hesitate to contact us if you have any questions regarding this report or if you need additional services.

Sincerely, Carolinas Geotechnical Group, PLLC

— DocuSigned by:

D. Matthew Brewer

D. Matthew Brewer, P.E. Senior Project Engineer





ATTACHMENTS:

Structure Subsurface Investigation Report (Prepared by CG2) Culvert Survey & Hydraulic Design Report Supporting Calculations

ATTACHMENTS



CULVERT -L- 15+21.00 - STRUCTURE SUBSURFACE INVESTIGATION REPORT (PREPARED BY CG2)



CONTENTS SHEET NO.

2

-3

4 5

R006 BP6. REFERENCE

50245 N **PROJECT:**

DESCRIPTION TITLE SHEET LEGEND (SOIL & ROCK) SITE PLAN BORE LOGS SITE PHOTOS

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION **DIVISION OF HIGHWAYS** GEOTECHNICAL ENGINEERING UNIT

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY CUMBERLAND

PROJECT DESCRIPTION STRUCTURE NO. 250245 OVER BRANSON CREEK ON SR 1414 (RAEFORD ROAD)

STATE N.C.

STATE PROJECT REFERENCE NO. **BP6.R006**

NO.

TOTAL SHEETS

5

1

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOLI TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N.C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT 1991 707-680. THE SUBSIFICACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

CENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU UNI-FLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DECREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOL MOISTURE CONDITIONS MAY YARY 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 NOR CLIMATION FOR THAT. 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 WARANT OR GUARANTE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION WADE, NOR THE INTERPRETATIONS MADE, OR OPNION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCONTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO PERFORM INDEPENDENT SUBSURFACE INVESTIGATIONS AND MAKE INTERPRETATIONS AS NECESSARY TO CONFIRM CONDITIONS ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTIONS FOR METHE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

- NOTES: I, THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR CUARANTEED 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 REDUCETED 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
CG2	EXPLORATION

S.N. PATTERSON, P.G.
INVESTIGATED BY <u>CG2, PLLC</u>
DRAWN BY <u>S. N. PATTERSON, P.G.</u>
CHECKED BY <u>M. BREWER</u> , P.E.
SUBMITTED BYCG2, PLLC
DATE
Prepared in the Office of: CAROLINAS GEOTECHNICAL GROUP 2400 CROWNPOINT EXECUTIVE DRIVE SUITE 800 CHARLOTTE, NC 28227 (980) 339-8684
Docusigned by: D. Matthuw Bruwer 01/26/2023
<u>386129C0A4C1462</u> SIGNATURE DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS GEOTECHNICAL ENGINEERING UNIT SUBSURFACE INVESTIGATION

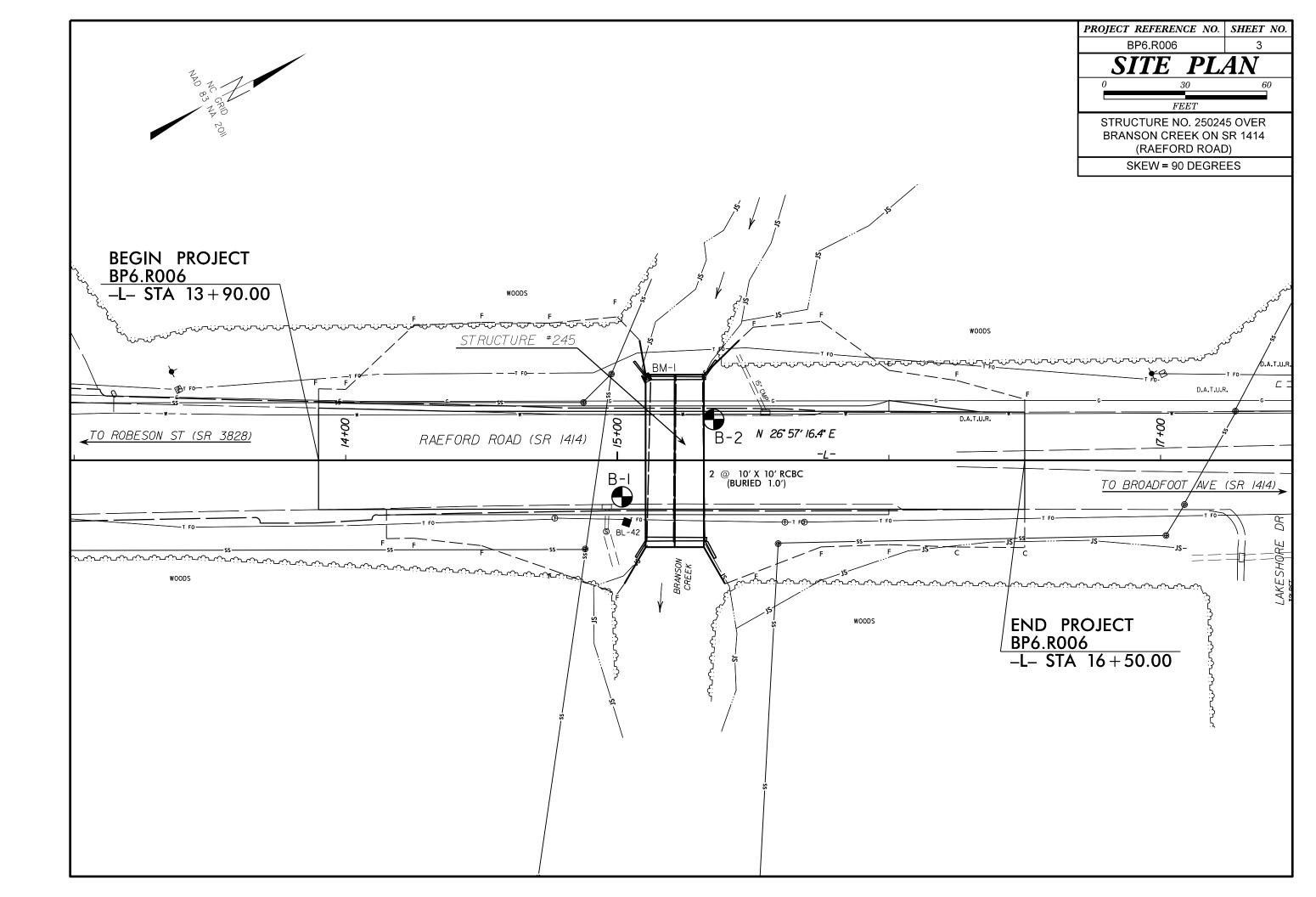
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

			SOIL C	DESCRI	PTION	i						GF	RADATION						ROCK	DESCRI	PTION						
BE PENETH ACCORDIN IS BA CONSISTEN	RATED WITH NG TO THE ASED ON TH NCY,COLOR,	UNCONSOLIDA A CONTINUOU STANDARD PEN E AASHTO SYS TEXTURE, MOIS	IS FLIGHT PON NETRATION TE STEM. BASIC (STURE, AASHTO	WER AUGER ST (AASHI DESCRIPTI D CLASSIF	R AND YI TO T 206 IONS GENE ICATION, (IELD LESS 5. ASTM D15 ERALLY INC AND OTHER	THAN 100 860. SOIL CLUDE THE PERTINEN	BLOWS PE CLASSIFIC FOLLOWIN FACTOR	R FOOT CATION NG:	WELL GRADED - INDICAT UNIFORMLY GRADED - IN GAP-GRADED - INDICATE	DICATE	S THAT SOIL	PARTICLES ARE AL	L APPROXIMA ZES OF TWO	TELY THE SAME SIZE.	ROCK LINE IN SPT REFUSAL BLOWS IN NO REPRESENTED	NDICATE IS PEI N-COAS BY A	ES THE LEVE INETRATION E STAL PLAIN ZONE OF WE	AIN MATERIAL TH EL AT WHICH NON BY A SPLIT SPOC MATERIAL, THE EATHERED ROCK.	HAT WOULD N-COASTAL I ON SAMPLER E TRANSITI	YIELD SPT REFUSAL IF TEST PLAIN MATERIAL WOULD YIELD R EQUAL TO OR LESS THAN 0. ON BETWEEN SOIL AND ROCK						
AS V	S MINERALOC "ERY STIFF.GI	GICAL COMPOSI RAY, SILTY CLAY, M	TION, ANGULAR NOIST WITH INT	TITY, STRU ERBEDDED	JCTURE, P	LASTICITY, ND LAYERS,/	ETC. FOR	EXAMPLE,					SOIL GRAINS IS D	SIGNATED B	Y THE TERMS:	WEATHERED	ALS AR	E TYPICALLY	Y DIVIDED AS FO		ERIAL THAT WOULD YIELD SP						
	S	DIL LEGE	ND AND	AASHT	O CLA	<u>ASSIFIC</u>	ATION			ANGULAR, SUBAN			ICAL COMPOS			ROCK (WR)			100 BLOWS PE								
GENERAL CLASS.		Granular Mater ≤ 35% Passing ■			-CLAY MATE 5% PASSING		ORG	anic materi	ALS	MINERAL NAM			Z, FELDSPAR, MICA, T		ETC.	CRYSTALLINE					IGNEOUS AND METAMORPHIC RO SAL IF TESTED. ROCK TYPE IN						
GROUP		A-3	A-2	_	A-5 A-6	6 A-7	A-1, A-2	A-4, A-5		ARE USED IN	DESCP		N THEY ARE CONSID	ERED OF SIG	GNIFICANCE.	ROCK (CR)		<u> 20.20</u>	GNEISS, GABBE	RO, SCHIST, I	ETC. METAMORPHIC AND NON-COAST4						
	A-1-a A-1-b	A-2-4 A-	2-5 A-2-6 A-2-	-7		A-7-5 A-7-6	A-3	A-6, A-7		SI 101		COMP	RESSIBILITY	LL < 31		NON-CRYSTALI ROCK (NCR)	_INE		SEDIMENTARY	ROCK THAT	WOULD YEILD SPT REFUSAL						
00				*						MODEI	RATELY	COMPRESSIBLE PRESSIBLE	LE	LL = 31 - LL > 50	50	COASTAL PLA SEDIMENTARY			COASTAL PLA	IN SEDIMEN	TS CEMENTED INTO ROCK, BUT E INCLUDES LIMESTONE, SANDS						
% PASSING #10 5	ØMX						GRANULAR	SILT- CLAY	миск,				GE OF MATER			(CP)			SHELL BEDS, E	ETC.							
*40 3i *200 15	Ø MX 50 MX 5 MX 25 MX	51 MN 10 MX 35 MX 35	MX 35 MX 35 /	MX 36 MN :	36 MN 36 '	MN 36 MN	SOILS	SOILS	PEAT	ORGANIC MATERIAL		GRANULAR SOILS	SILT - CLAY SOILS	OTHEF	MATERIAL	FRESH					NU SHOW SLIGHT STAINING. ROCK						
MATERIAL PASSING #40 LL PI	6 MX	- 40 MX 41	MN 40 MX 41 M MX 11 MN 11 M	MN 40 MX -	41 MN 40 M	MX 41 MN	SOILS LITTLE MODER	e or	HIGHLY	TRACE OF ORGANIC MA LITTLE ORGANIC MATT MODERATELY ORGANIC HIGHLY ORGANIC	ATTER TER	2 - 3% 3 - 5% 5 - 10% > 10%	3 - 5% 5 - 12% 12 - 20% > 20%	TRACE LITTLE SOME HIGHLY	1 - 10% 10 - 20% 20 - 35% 35% AND ABOVE		HAMME ROCK (CRYST	R IF CRYSTAL GENERALLY FI	ELLINE. RESH, JOINTS STA ROKEN SPECIMEN F	AINED, SOME	JOINTS MAY SHOW THIN CLAY C BRIGHTLY, ROCK RINGS UNDER H						
	Ø TONE FRAGS. GRAVEL, AND		4 MX	SILT		CLAYEY	AMOUNT ORGAI MATT	is of Nic	ORGANIC SOILS			ER LEVEL IN	UND WATER		DRILLING	SLIGHT (SLI.)	ROCK (1 INCH.	GENERALLY FI . OPEN JOINT	RESH, JOINTS STA IS MAY CONTAIN C	CLAY. IN GRA	ISCOLORATION EXTENDS INTO RO ANITOID ROCKS SOME OCCASIONA LINE ROCKS RING UNDER HAMMEF						
MATERIALS GEN. RATING AS SUBGRADE	Sand	SAND GRAV	el and sand	SOIL	air to poo	SOILS	Fair to Poor	POOR	UNSUITABLE	▼	PERC		VEL AFTER <u>24</u> GATURATED ZONE,OF		RING STRATA	MODERATE (MOD.)	GRANIT	TOID ROCKS,M	MOST FELDSPARS #	ARE DULL A	NATION AND WEATHERING EFFECT ND DISCOLORED, SOME SHOW CLA SIGNIFICANT LOSS OF STRENGTH						
	F	PI OF A-7-5 SUBC					LL - 30			0 00-							Y ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS,										
			ISISTENC		E OF STA		RANGE	E OF UNC		<u> </u>			NEOUS SYMBO			SEVERE (MOD. SEV.)	AND CA	AN BE EXCAV	ATED WITH A GEO	DLOGIST'S PI	IZATION. ROCK SHOWS SEVERE L ICK. ROCK GIVES "CLUNK" SOUND						
GENERAL		COMPACT CONSIS	LOOSE		ATION RES (N-VALUE < 4 4 TO 10	-	COMPR	ESSIVE S (TONS/FT	TRENGTH	L ROADWAY EMBI L WITH SOIL DE SOIL SYMBOL			25 DIP & DIP DIR → OF ROCK STRU OF TOMT TEST BOR UST BOT DET DAT		SLOPE INDICATOR	SEVERE (SEV.)	ALL RO	OCK EXCEPT	GTH TO STRONG S	RED OR STAI SOIL. IN GRA	NED. ROCK FABRIC CLEAR AND E NITOID ROCKS ALL FELDSPARS (ROCK USUALLY REMAIN.						
GRANULA MATERIAL		MEDIUM	DENSE		10 TO 30 30 TO 5	80		N/A			ILL (AF) OTHER (T		Ā	CONE PENETROMETER				YIELD SPT N VALU								
(NON-COH		DEN VERY VERY SO	DENSE SOF T		> 50 > 50 < 2 2 TO 4			< 0.25 0.25 TO 0	1.5			لم	- CORE BORING	•	TEST SOUNDING ROD	VERY SEVERE (V SEV.)	BUT MI REMAIN	NING. SAPROL	CTIVELY REDUCED ITE IS AN EXAMPL	I TO SOIL SI LE OF ROCK	NED. ROCK FABRIC ELEMENTS AF TATUS, WITH ONLY FRAGMENTS O WEATHERED TO A DEGREE THAT <u>F TESTED, WOULD YIELD SPT N</u>						
SILT-CLA MATERIAL (COHESIV	ΑY L	MEDIUM STI VERY HA	STIFF FF STIFF		4 TO 8 8 TO 15 15 TO 30 > 30	3 5		0.5 TO 1 1 TO 2 2 TO 4 > 4	.0	INFERRED ROC) MONITORING WI PIEZOMETER INSTALLATION		TEST BORING WITH CORE SPT N-VALUE	COMPLETE	COMPLETE ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE O SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRIN ALSO AN EXAMPLE.										
			EXTURE	OR GR		IZE		/ 4			F	RECOMMEN	DATION SYMB	OLS						k hardn							
U.S. STD. SIE	VE SIZE		4 10	40	60	200	270					ICLASSIFIED E			SIFIED EXCAVATION -	VERY HARD			CHED BY KNIFE OR WS OF THE GEOLC		K. BREAKING OF HAND SPECIMEN <.						
OPENING (MM BOULDER		BLE G	4.76 2.00 RAVEL	0.42 COARSI SAND	E	FINE	0.053	ILT	CLAY			ISUITABLE WAS ICLASSIFIED E ICEPTABLE DEI		الد علي ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL		HARD	TO DET	TACH HAND S	SPECIMEN.		TH DIFFICULTY. HARD HAMMER B						
(BLDR.) GRAIN MM	305	75	(GR.) 2.0	(CSE. SE	IND SAND (SL.) (CL.)		(F SD.) (SL.)) (F SD.) (SL.)			(F SD.) (SL.)			AR - AUGER REFUSAL		MED	REVIATIONS MEDIUM		VANE SHEAR TEST	MODERATELY HARD	EXCAVA		RD BLOW OF A GEO		OR GROOVES TO 0.25 INCHES DI ICK. HAND SPECIMENS CAN BE D
SIZE IN.	12 S	3 OIL MOIS	TURE -			TION OF TERMS				BT - BORING TERMINATED CL CLAY CPT - CONE PENETRATION		MOD	- MICACEOUS MODERATELY NON PLASTIC	γ-ı	- WEATHERED UNIT WEIGHT DRY UNIT WEIGHT	MEDIUM HARD	CAN BE	E EXCAVATED) IN SMALL CHIPS		BY FIRM PRESSURE OF KNIFE O 1 INCH MAXIMUM SIZE BY HARD						
	MOISTURE S ERBERG LIM		FIELD MO DESCRI	IPTION		DE FOR FI				CSE COARSE DMT - DILATOMETER TES DPT - DYNAMIC PENETRA	т	ORG PMT -	NON PLASTIC γ_{d} - DRY UNIT WEIGHT ORGANIC - PRESSUREMETER TEST <u>SAMPLE ABBREVIATIONS</u> SAPROLITIC S - BULK			SOFT	FROM CHIPS TO SE		GOUGED READILY	SIZE BY MC	OR PICK. CAN BE EXCAVATED IN DDERATE BLOWS OF A PICK POIN						
		LIMIT .	- SATURA (SAT.)			JALLY LIQU OM BELOW				e - VOID RATIO F - FINE FOSS FOSSILIFEROUS		SL 9 SL1	SAND, SANDY SILT, SILTY SLIGHTLY	ST - RS -		VERY SOFT		RE IN THICKN			D READILY WITH POINT OF PICK. GER PRESSURE. CAN BE SCRATCH						
RANGE <			- WET -	(W)		4ISOLID; RE FAIN OPTIM				FRAC FRACTURED, FRAC FRAGS FRAGMENTS	TURES	w - M	TRICONE REFUSAL DISTURE CONTENT		RECOMPACTED TRIAXIAL · CALIFORNIA BEARING	F	RAC	TURE SP	ACING		BEDDING						
		MOISTURE	- MOIST	- (M)	SOL	.ID; AT OR	NEAR OPT	TIMUM MO	ISTURE	HI HIGHLY EQU DRILL UNITS:		V - VE ENT USED ANCING TOOLS:	ON SUBJECT			TERM VERY WIDE WIDE MODERATEI		3	SPACING E THAN 10 FEET 3 TO 10 FEET 1 TO 3 FEET		TERM VERY THICKLY BEDDED THICKLY BEDDED 1 THINLY BEDDED 0.						
SL _	SHRINK4	AGE LIMIT .	- DRY -	(D)		DUIRES ADD TAIN OPTIM			1	CME-45C		CLAY BITS 6. CONTINUOU	S FLIGHT AUGER	X AUT		CLOSE VERY CLOS		0.	0.16 TO 1 FOOT 5 THAN 0.16 FEET	т	VERY THINLY BEDDED 0.0 THICKLY LAMINATED 0.00 THINLY LAMINATED <						
			PLf	ASTICI	ΤY							8"HOLLOW AU		□-в _	— -+												
SLIG	PLASTIC		PLASTI	0-5 6-15	<u>)EX (PI)</u>			Y STRENG VERY LOW SLIGHT		VANE SHEAR TEST					DLS:	FOR SEDIMEN		OCKS, INDUR	RUBBING V	WITH FINGER	F MATERIAL BY CEMENTING.HE R FREES NUMEROUS GRAINS; MMER DISINTEGRATES SAMPLE.						
	ERATELY PL			16-25 26 OR MOR	_			MEDIUM HIGH		PORTABLE HOIST			STEEL TEETH		IT HOLE DIGGER	MODER	ATELY	INDURATED			NRATED FROM SAMPLE WITH ST N HIT WITH HAMMER.						
			(COLOR						X MOBILE B-29			' TUNGCARB.		INDING ROD	INDURA	TED				LT TO SEPARATE WITH STEEL						
		NCLUDE COLO CH AS LIGHT,										CORE BIT			IE SHEAR TEST	EXTRE	MELY I	NDURATED			S REQUIRED TO BREAK SAMPLE OSS GRAINS.						

PROJECT REFERENCE NO.

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ED. AN INFERRED	TERMS AND DEFINITIONS
) SPT REFUSAL.	ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.
1 FOOT PER 60 IS OFTEN	ADUIFER - 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
T N VALUES >	ANGLEALEDUS - APPLIED TO ALL HOURS ON SUBSTANCES COMPUSED OF CLAY MINERALS, OF 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
OCK THAT NCLUDES GRANITE,	HITCH IT IS BECOUNTERED, BUT WHICH THAT IS UNDER SUFFICIENT FRESSURE TO RISE HOUVE 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.
AL PLAIN IF TESTED. C.	$\underline{\text{COLLUVIUM}}$ - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.
MAY NOT YIELD STONE, CEMENTED	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.
RINGS UNDER	DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.
COATINGS IF OPEN.	<u>DIP</u> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.
HAMMER BLOWS IF	DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.
DCK UP TO AL FELDSPAR	FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.
R BLOWS.	FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.
IS. IN AY. ROCK HAS	<u>FLOAT</u> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIG _I NAL POSITION AND DISLODGED FROM PARENT MATERIAL.
H AS COMPARED	FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.
FELDSPARS DULL LOSS OF STRENGTH	FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.
WHEN STRUCK.	JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.
EVIDENT BUT ARE KAOLINIZED	LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.
HNE KHULINIZED	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.
RE DISCERNIBLE DF STRONG ROCK	PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE
T ONLY MINOR VALUES < 100 BPF	OF AN INTERVENING IMPERVIOUS STRATUM.
IN SMALL AND	RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.
S. SAPROLITE IS	ROCK QUALITY DESIGNATION (ROD) - 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.
NS REQUIRES	SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.
BLOWS REQUIRED	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.
DEEP CAN BE DETACHED	$\underline{\text{SLICKENSIDE}}$ - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.
OR PICK POINT. BLOWS OF THE	STANDARD PENETRATION TEST (PENETRATION RESISTANCE)(SPI) - 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 00 FOOT PER 60 BLOWS.
N FRAGMENTS NT. SMALL, THIN	STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.
. PIECES 1 INCH HED READILY BY	STRATA ROCK QUALITY DESIGNATION (SROD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OK OREATER 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: BM-I: N-473220.6678, E-2025690.2000
THICKNESS 4 FEET	
1.5 - 4 FEET	ELEVATION: 127.23 FEET
.16 - 1.5 FEET 03 - 0.16 FEET	NOTES:
08 - 0.03 FEET < 0.008 FEET	F.I.A.D. = FILLED IMMEDIATELY AFTER DRILLING
NUNDO FEEI	ROADWAY DESIGN AND SURVEY INFORMATION DATED 10/12/2022
EAT, PRESSURE, ETC.	PROVIDED BY TGS ENGINEERS.
TEEL PROBE;	
PROBE:	
E;	



GEOTECHNICAL BORING REPORT BORE LOG

10.00] [
	BP6.R		<u> </u>			IP 25024			Y CUMBER		<u>,</u>		GEOLOGIST S. N. Patterson			BP6.F		<u> </u>			P 250245		COUNT	
			Stru	cture N				eek on SR	1414 (Raefo		,			GROUND WTR (ft)				Struc	cture N			ranson Cre	ek on SR	_
	NG NO.					STATION			OFFSET					0 HR. 10.0		RING NO.					TATION 1			0
	AR ELE						PTH 35.0		NORTHING				EASTING 2,025,725	24 HR. FIAD	-	LAR ELI						TH 35.0 ft		N
				E CG2			86% 04/08/20							ERTYPE Automatic	-				E CG2			6% 04/08/202		.
DRIL	LER M	. Brewe					TE 12/01/2		COMP. DA			<u> </u>		Ά	DRI	LER M	I. Brewe					E 12/01/2		C
ELEV (ft)	ELEV	DEPTH (ft)		W CO				PER FOOT		SAMP.			SOIL AND ROCK DES	CRIPTION	ELEV (ft)		DEPTH (ft)	·	W CO				PER FOO	
(11)	(ft)	(11)	0.5ft	0.5ft	0.5ft	0	25	50	75 100	NO.	Имо) G	ELEV. (ft)	DEPTH (ft		(ft)		0.5ft	0.5ft	0.5ft	0	25	50	75
130		ŀ											_		130		+							
	-					<u> </u>							127.9 GROUND SURF			-	İ					· · · · ·	· · · · ·	·⊤
125	126.8 -	L	2	3	3		· · · · · ·				м		ROADWAY EMBAN Asphalt (0.5 f	t)	125	126.6 -	÷	3	2	1		· · · · ·	- · · ·	:
125	124.8_	- 3.1	1	wон	1						м		Very Soft to Mediur Brown-Tan-Orange, Silty, I	Fine to Coarse	125	124.7 -	- 3.5	1	1	1	\downarrow_2°			
	121.9	6.0			_		· · · · · ·						Sandy CLAY (A	A-6)		122.2	6.0	WOH	-	-			· · ·	:
120	-		IMOH	WOH	2	•2 · ·					м			8.0	120						•2			•
	119.4	8.5	WOH	wон	1	- 							UNDIVIDED COASTA Very Loose, Orange-Brow					WOH	1	2	4 3 • • •			•
	-	F							.		Sat.		Coarse SAND (A			-	Ŧ							
115	114.4	13.5										0000	Very Loose, Brown-Blue-Gr Coarse SAND (/	ay, Silty Fine to	115	114.7-	- 13.5		woн		ļ			
	-	t t	WOH	1	1	• 2	· · · · · ·				W	0000		A-3)		-	ŧ	INOH	WOH		•1			:
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105	-	-												<u> </u>	105	- 104.7 -	- 23.5							•
	104.4	<u>- 23.5</u>	8	12	16	$\left \begin{array}{c} \cdot \cdot \cdot \end{array} \right $					м		Very Stiff, Green-Blue-Gra Coarse Sandy CLAY (A-6	y, Silty, Fine to		- 104.7-	<u>- 23.5</u>	6	6	8				
	-	F							· · · · · ·				subangular to subrounded	l gravel, mica,		-	ŧ							:
100	99.4 -	28.5					· · · · ·						and wood fragm (CAPE FEAR FORM	ents IATION)	100	- 99.7 -	- 28.5				· · · ·			
	-	-	7	11	17		. 628		· · · · · ·		м					-	‡	11	23	33	· · · ·		9 56	:
	-	Ł														-	t							
95	94.4 -	33.5	10	17	19	$\left \right $	· · · · ·						93.9 92.9 Hard, Blue-Dark Grav, Fi	34.0	95	94.7 -	- 33.5	12	19	22			· · · ·	+
			10	17	19	+	•36				M		92.9 Hard, Blue-Dark Gray, Fi Sandy, Silty CLAY]		-					• 41		
	-	F											- (CAPE FEAR FORM	IÁTIÓN)		-	Ŧ							
	-	F											 Boring Terminated at Elev Coastal Plain Sandy, Silt 				ŧ							
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SHEET 4

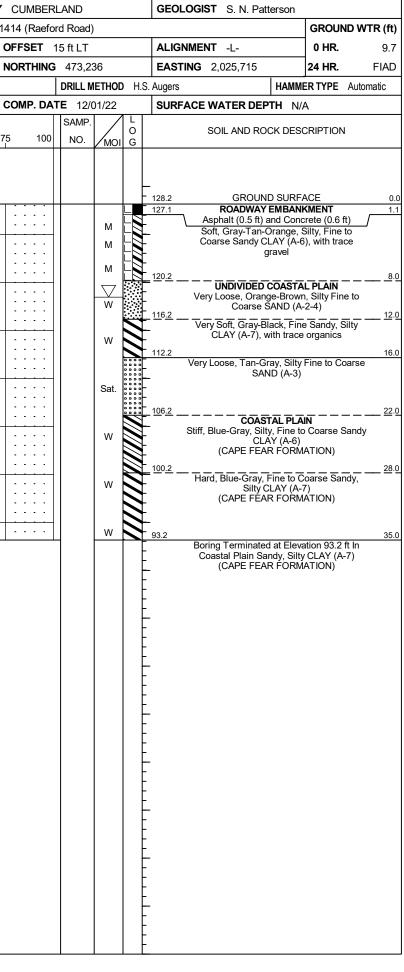




PHOTO #1: END BENT 1 OF EXISTING STRUCTURE NO. 250245 LOOKING NORTHEAST (UPSTATION)



PHOTO #2: END BENT 2 OF EXISTING STRUCTURE NO. 250242 LOOKING SOUTHWEST (DOWNSTATION)



CULVERT SURVEY & HYDRAULIC DESIGN REPORT



DocuSign Envelope ID:	DC3094EF-DD3C-40C	1-BDB0-152D52A5D30E

CULVERT SURVEY & HYDRAULIC DESIGN REPORT N. C. DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS HYDRAULICS UNIT RALEIGH, N. C.

State Proj. Reference NoS	F–250245 WBS P	roject No. <u>BP6.R006</u>	Proj. Station <u>-L- 15+21</u>
County CUMBERLAND SR1414	Culvert On	BRANSON CREEK US 401 BUS	Struc. Inv. No. 250245 SR 1404
On Highway (RAEFORD R	D.) Between	(ROBESON ST.) and	(MORGANTON RD.)
Recommended Structure	2 @ 10' X 10' RC	BC; BURIED 1.0' WITH SIL	LS AND 6" TOP EDGE BEVEL
			POINT Skew 90°
Recommended Location is (Up, At) Down) Stree	ım from Existing Cross	ing
Latitude	5022	Longitude	-78.91406
Statewide Tier 🗌	Regional Tier	X Sub-Region	al Tier 🛛
Bench Mark is	BM-1: -L- STA. 15	+10.81 30.33′ LT, PK_NAIL	IN HEADWALL
Northing 473220.67	Easting 202569	20.20 Elev. 127	.23 ft. Datum: NAVD 88
Temporary Crossing	NONE (OFFSITE DI	etour)	



Designed by: BEN HENEGAR, PE RUSTY LASSITER; CALVIN HAMBLET, EI Assisted by:





Craig J. Lee

8/16/2022 | 12:18 PM EDT

Date

6

Stream Classification (Such as Trout, High Qualit Data on Existing Structure 2 @ 10'x7' RCBC Debris Potential: Low Moderate ... X... High Data on Structures Up and Down Stream <u>U/S STRUCTURE:</u> 0.3 MI. U/S ON MCBAIN DR., NO N HT CR TO BED = 10.0'; O.A.L. = 60.0' D/S STRUCTURE: 0.1 MI. D/S ON WINTERLOCHEN RD. HT CR TO BED=14.0', O.A.L.=66.5' Gage Station No. N/A Max. Discharge N/A c.f.s. De Historical Flood Information: (SEE ADDITIONAL INFORM AND COMPUTATIONS) Date 10/08/16 Elev. 127.8 ft. Est. Freq. 500 yr. Source Date 10/08/16 Elev. 128.0 ft. Est. Freq. 500 yr. Source Date _____ Elev. ____ft. Est. Freq. ____yr. Source Allowable HW Elev. 129.13* "FEMA CORRECTED PRELIMINAR WSEL AT HEC-RAS RS 7680.0 (Manning's n: Left O.B. 0.07–0.11 Channel 0.05 Flood Study / Status DETAILED (PRELIMINARY - NO Flood Study 100 yr. Discharge <u>1932</u> c.f.s.; WS DESI SIR 2014–5030 URBAN (Hydrological Method Hydraulic Design Method HEC RAS 6.1.0 *Design Tailwater : Q_{10} 7.1ft.; Q_{25} 7.7 *TAILWATER DEPTHS BASED ON WSEL AT RS 7525.0 (D/S TOE) MINUS INVE INV. IN EL. = 116.1 (TOP OF SILL), INV. OUT EL. = 115 SIZE & TYPE 2 @ 10' X 10' RCBC (BURIED 1 0')

4.24 SQ. MI.

CAPE FEAR

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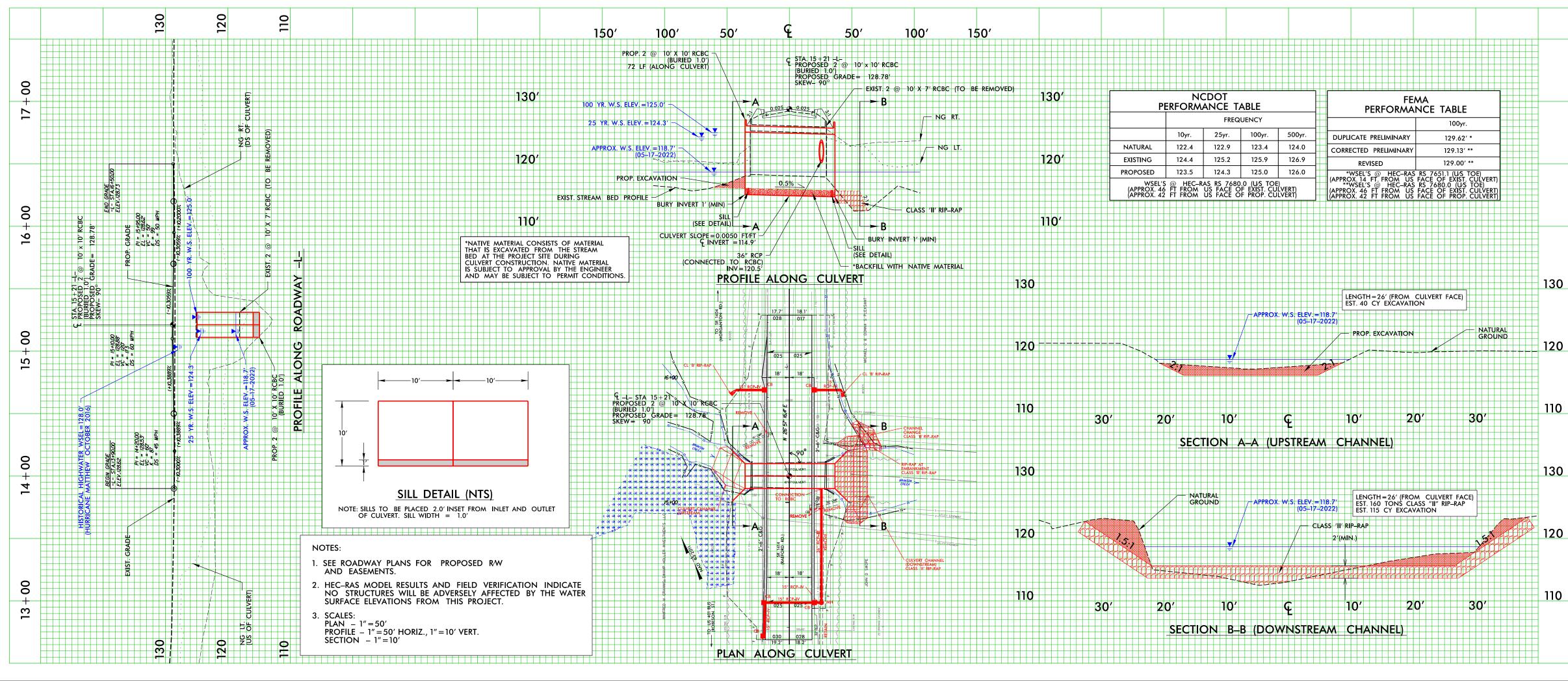
Drainage Area

River Basin

SIZE & ITFE: Z @ 10	A TU KUDU	, (DURIED	, 1.0)	@ KS /C	000.0, AFF	KOX. 42 (JFSTREAM OF CULVERT.	
FREQUENCY	0		Inlet Contro		Outlet	Control	Remarks	
INEQUENCE	Q (cfs)	HW/D	H.W.	WSEL	H.W.	WSEL		
10 YR	800	0.62	5.6	121.7	7.4	123.5	OUTLET CONTROL	
25 YR	950	0.71	6.4	122.5	8.2	124.3	DESIGN, OUTLET CONTROL	
100 YR	1100	0.79	7.1	123.2	8.9	125.0	OUTLET CONTROL	
500 YR	1300	0.89	8.0	124.1	9.9	126.0	OUTLET CONTROL	
Total Proposed Waterw	vay Openir	ng]8	30 s.	f.				

CLASS 'II' RIP-RAP AS SHOWN

Required Outlet Protection



Source	STREAMSTA	TS /USGS QUAD						
Character U	RBAN; COA	STAL PLAIN						
ity Water, etc.)		C						
C; O.A.L. = 60.5′, HT. C	R. TO BED =	=11.0', BUILT 1940						
TT Waterway Openir h	otal Waterv 1g Below 1	vay Opening 140 s.f. 100yr. WS EL. 140 s.f.						
NCDOT STR. #, 2 @	9′ – 6″ X 6	oʻ – 5″ SPPA;						
, NCDOT STR. #25018	31, 2 @ 10'	X 8' RCBC;						
Period of Records		VA						
Date N/A	Fr	equency <u>N/A</u>						
RMATION								
ce (NCDOT BRG MAI JAMES H ce (LOCAL RI	DANIEL LEGGETT Period of ce (NCDOT BRG MAINT SUPERVISOR) Knowledge 7 yrs. JAMES HARPER Period of ce (LOCAL RESIDENT) Knowledge 64 yrs. Period of ce Knowledge yrs.							
(US TOE) Normal W	ater Surfac	e Elev. 118.7 ft.						
	12 Source	FEMA_MODEL/FIELD_OBSERV.						
o fis available)								
	129.95 ft @River St	Without Floodway <u>129.77</u> ft. tation 7857.9						
IGN DATA								
(COASTAL PLAIN; REG	ION 4)							
7ft.; Q ₅₀ N/A /ert out (top of sill)	.ft.;Q ₁₀₀	9.3ft.; Q ₅₀₀						
5.7 (TOP OF SILL)								
@ RS 7680.0, APPROX. 42' UPSTREAM OF CULVERT.								
rol Outlet C		Remarks						
WSEL H.W.	WSEL							
121.7 7.4	123.5	OUTLET CONTROL						

State Floodway Compliance Type SFC TYPE B (MAX DECREASE OF 0.13' FROM RS 8233.9 TO 7680.0)

INFORMATION TO BE SHOWN ON PLANS

HYDRAULIC D	ΑΤΑ	
DESIGN DISCHARGE	= 950	C.F.S.
FREQUENCY OF DESIGN FLOOD	= 25	YRS.
DESIGN HIGH WATER ELEVATION	= 124.3	FT.
DRAINAGE AREA	= 4.2	SQ. MI.
BASIC DISCHARGE (Q100)	= 1100	C.F.S.
BASIC HIGH WATER ELEVATION	= 125.0	FT.
OVERTOPPING FLOC	D DA	ГА
OVERTOPPING DISCHARGE	= N⁄A	C.F.S.
FREQUENCY OF OVERRTOPPING FLOOD	= >500	YRS.
OVERTOPPING FLOOD ELEVATION*	= 128.6	FT
*CL @ -L- STA. 13+90		
WS EL. Taken @ River Station 70	580.0 (U/S	TOE)

ADDITIONAL INFORMATION AND COMPUTATIONS

HISTORICAL FLOOD INFORMATION:

DANIEL LEGGETT, BRIDGE MAINTENANCE SUPERVISOR, STATED DURING HURRICANE MATTHEW (OCTOBER 2016)
WATER GOT UP ON THE SHOULDER BUT NEVER IN THE ROADWAY ON THE INLET SIDE OF THE CROSSING.
JAMES HARPER, LOCAL RESIDENT, STATED DURING HURRICANE MATTHEW WATER WAS UP TO THE
APPARTMENT DRIVE AT RAEFORD ROAD HOMES.
HYDROLOGY:
USGS SIR 2014-5030 URBAN REGRESSION EQUATIONS, HYDROLOGIC REGION 4 (COASTAL PLAIN)
DA=4.24 SQ. MI., %IMP=30%, 24-HR, 50-YR MAX PRECIP.=7.58 IN
$Q_{ig} = 51.8 (DA)^{\circ 4004} * 10^{\circ 00011100MLCD06} * 10^{\circ 0044172/1507} = 792, SAY 800 CFS; Q_{ig}FEMA = 1244 CFS$
$Q_{25} = 67.1 (DA)^{0.0007 * 10^{0.0007 * 1000073*1049007}} = 931, SAY 950 CFS; Q_{25}FEMA = 1524 CFS$
$Q_{s_0} = 78.4 (DA)^{0.6111} * 10^{0.00587 MVMACCON} * 10^{0.073871244507} = 1026, SAY 1000 CFS; Q_{s_0}FEMA = 1745 CFS$
$Q_{100} = 90.5 (DA)^{0.0154} * 10^{0.00431WMNLCOD0} * 10^{0.0762124H50Y} = 1120, SAY 1100 CFS; Q_{100}FEMA = 1932 CFS$
$Q_{500} = 119 (DA)^{0.6761} * 10^{0.00121WPM CD06} * 10^{0.0012124H507} = 1320, SAY 1300 CFS; Q_{500}FEMA = 2449 CFS$
BECAUSE OF THE LARGE DISCREPANCY BETWEEN Q(USGS) AND Q(FEMA) DISCHARGES, Q(USGS) WAS USED
FOR DESIGN AND Q(FEMA) WAS USED FOR FEMA COMPLIANCE.
EXISTING CULVERT NOTES:
WEEP HOLES IN THE ORIGIANL CULVERT ARE 3.2' ABOVE THE INVERT (APPROX. ELEV. = 121.5'). A WATERMARK

WAS SEEN ON THE CULVERT WALLS 1.0' BELOW THESE WEEP HOLES (APPROX. ELEV. = 120.5').

NATIVE MATERIAL SPECIFICATION FOR BACKFILLING NOTE

The Engineer, in consultation with DEO staff, shall review all material to be used as backfill prior to conducting the backfill activity. Backfill shall consist of native material only unless the Engineer, in consultation with DEO staff, determines that (1) the native material is unsuitable, or (2) additional material is required to supplement the native material. The chosen backfill material shall not have adverse effects to aquatic life, aquatic life passage, or water quality. Native material consists of material that is excavated from the stream bed or floodplain at the project site during culvert construction.



CULVERT -L- 15+21.00 - SUPPORTING CALCULATIONS





PROJECT NO.	240022146
SHEET NO.	1/1
DATE	01/23/2023

Bridge No. 245 on SR 1414	(Raeford Road) over
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JOB NAME	Branson Creek	BP6.R006	COMPUTED BY	Robert E. Kral, P.E.
SUBJECT	Culvert Recommendations Calculations		CHECKED BY	D. Matthew Brewer, P.E.

Structure on SR 1414 (Raeford Road) over Branson Creek at -L- Station 15+21.00

PROVIDED INFORMATION				
Station	15+21.00 -L-			
Structure Type	2 @ 10.0 ft Span x 10.0 ft Rise RCBC			
Invert Elevation	@ CL of -L- 114.9 ft			
Length	63.5 ft			
Width	24.0 ft (outside width of culvert) + 4.0 ft (additional width per NCDOT FCM for Box Culvert Memo dated 12/12/2011) = 28.0 ft			
Slope	0.5 %			
ESTIMATED INFORMATION				
Culvert Concrete Thickness	Assumed 1.0 ft			
Bottom of Culvert Elevation along Culvert Centerline	115.1 ft - 1.0 ft Thick Culvert = 114.1 ft (LT)			
(looking upstation)	114.9 ft - 1.0 ft Thick Culvert = 113.9 ft (CT)			
	114.7 ft - 1.0 ft Thick Culvert = 113.7 ft (RT)			
Bottom of Excavation along Culvert Centerline	= 113.1 ft (LT)			
(looking upstation)	= 112.9 ft (CT)			
	= 112.7 ft (RT)			

We anticipate culvert excavation will be within roadway embankment, alluvial, and residual materials. The soils generally consisted of the following:

Roadway embankment - Very soft to medium stiff, sandy clay (A-6), with trace gravel throughout. **Undivided Coastal Plan** - Stiff, sandy silt (A-4) and loose to very dense, silty fine sand (A-3 & A-2-4), with little gravel and cobbles throughout.

Groundwater was encountered between approximate elevations 117.9 ft and 118.5 ft. We anticipate groundwater to impact construction.

We do not anticipate WR and CR to impact construction based on the provided Structure Investigation Report.

Based on Borings B-1 and B-2, the culvert will be founded on very soft silty clay and very loose silty sand. The proposed structure is generally within the existing structure footprint with minimal fill anticipated (< 1 ft). We do not anticipate settlement to be a concern nor the need for a camber in the culvert.

ESTIMATED QUANTITIES

Foundation Condition Material (Class V or VI) – Backfilling in Water, assume up to 1.0 ft of FCM is placed.

Total Estimated Volume of FCM: 63.5 ft (length) * 28.0 ft (outside width of undercut excavation) * 1.0 ft (undercut) = 1,778.0 ft³ / (27 ft³/yd³) = 65.9 yd³, say 70 yd³

Total Weight of FCM: 65.9 yd³ * 1.904 tons/yd³ = 125.4 tons, say 130 tons

