

REFERENCE: B-5345

PROJECT: 46059

SEE SHEET 3 FOR PLAN SHEET LAYOUT  
AT TIME OF INVESTIGATION

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**CROSS SECTIONS**

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**APPENDICES**

<u>APPENDIX</u>	<u>TITLE</u>	<u>SHEETS</u>
A	SOIL TEST RESULTS	10-II

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

**ROADWAY  
SUBSURFACE INVESTIGATION**

COUNTY GUILFORD  
PROJECT DESCRIPTION REPLACE BRIDGE NO. 456 ON  
SR 2136 OVER BRUSH CREEK

**INVENTORY**

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-5345	1	13

**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 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.

GENERAL 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 (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

J. CAIN  
P. DEWIRE  
Z. KIKER

INVESTIGATED BY T. WELLS  
DRAWN BY T. WELLS  
CHECKED BY \_\_\_\_\_  
SUBMITTED BY SCHNABEL  
DATE APRIL 2016



DocuSigned by:  
Mahalingam Bahiradhan 4/26/2016  
4DEAD345C9264A2  
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 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 209, 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					
	A-1	A-1-b	A-2	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7	A-1, A-2	A-3	A-4, A-5	A-6, A-7					
GROUP CLASS.	A-1-a	A-1-b	A-2	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7	A-1, A-2	A-3	A-4, A-5	A-6, A-7					
SYMBOL																				
% PASSING #10 #40 #200	50 MX 30 MX 15 MX	50 MX 25 MX	51 MN 35 MX	40 MX 35 MX	41 MN 35 MX	42 MN 35 MX	43 MN 35 MX	36 MN 36 MN	37 MN 36 MN	38 MN 36 MN	39 MN 36 MN	40 MN 36 MN	41 MN 36 MN	42 MN 36 MN	43 MN 36 MN					
MATERIAL PASSING #40 LL PI	-	-	40 MX 41 MN	40 MX 41 MN	41 MN 41 MN	41 MN 41 MN	41 MN 41 MN	40 MX 41 MN	40 MX 41 MN	40 MX 41 MN	40 MX 41 MN	40 MX 41 MN	40 MX 41 MN	40 MX 41 MN	40 MX 41 MN					
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	UNSATURABLE			

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 RESISTANCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )
GENERALLY GRANULAR MATERIAL (NON-COHESSIVE)	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 OPENING (MM)	4	10	40	60	200	270
	4.76	2.00	0.42	0.25	0.075	0.053
BOULDER (BLDR.)						
COBBLE (COB.)						
GRAVEL (GR.)						
COARSE SAND (CS.E. SD.)						
FINE SAND (F SD.)						
SILT (SL.)						
CLAY (CL.)						
GRAIN SIZE	305	75	2.0	0.25	0.05	0.005
MM						
IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

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

PLASTICITY

NON PLASTIC	PLASTICITY INDEX (PI)	DRY STRENGTH
SLIGHTLY PLASTIC	0-5	VERY LOW
MODERATELY PLASTIC	6-15	SLIGHT
HIGHLY PLASTIC	16-25	MEDIUM
	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
- 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
- DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT TEST BORING
- AUGER BORING
- CORE BORING
- 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
- WGT. - UNIT WEIGHT
- WGT. - DRY UNIT WEIGHT
- 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
  - CME-55
  - CME-550
  - VANE SHEAR TEST
  - PORTABLE HOIST
  - D-50
- 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 2-1/4" TUNG-CARB.
  - CORE BIT
- 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 YIELD 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 SL.): 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 (SL.): 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. FABRIC 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 GROUDED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
- SOFT: CAN BE GROUDED 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 FINGER NAIL.

FRACTURE SPACING

TERM	SPACING	TERM	THICKNESS
VERY WIDE	MORE THAN 10 FEET	VERY THICKLY BEDDED	4 FEET
WIDE	3 TO 10 FEET	THICKLY BEDDED	1.5 - 4 FEET
MODERATELY CLOSE	1 TO 3 FEET	THINLY BEDDED	0.16 - 1.5 FEET
CLOSE	0.16 TO 1 FOOT	VERY THINLY BEDDED	0.03 - 0.16 FEET
VERY CLOSE	LESS THAN 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 DISLOADED 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 (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.
- 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 (SROD) - 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: N/A

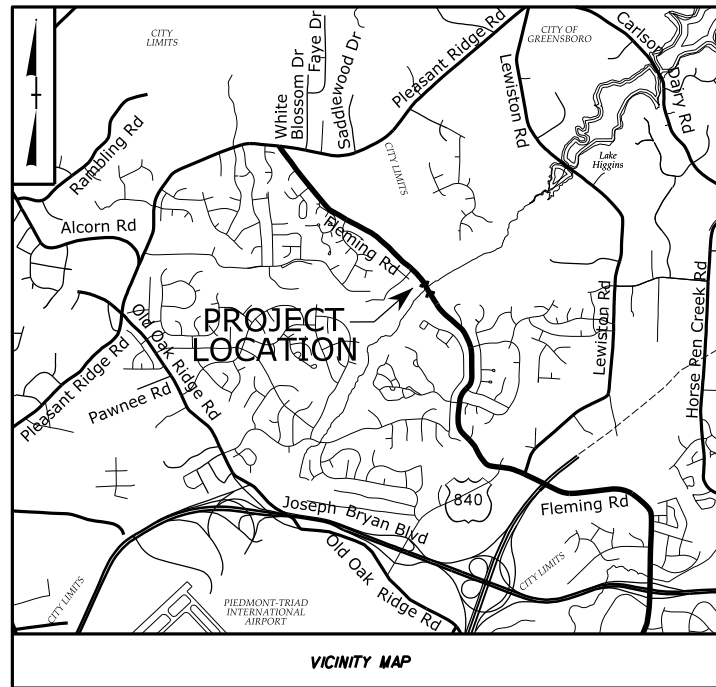
ELEVATION: N/A FEET

NOTES:

TOP OF BORING ELEVATIONS OBTAINED FROM THE PROVIDED PROJECT TIN FILE B5345-LS.TIN.TIN RECEIVED ON JANUARY 15, 2016

FIAD - FILLED IMMEDIATELY AFTER DRILLING

**TIP PROJECT: B-5345**



**CFI PLANS (2/2/16)**

STATE OF NORTH CAROLINA  
DIVISION OF HIGHWAYS  
**GUILFORD COUNTY**

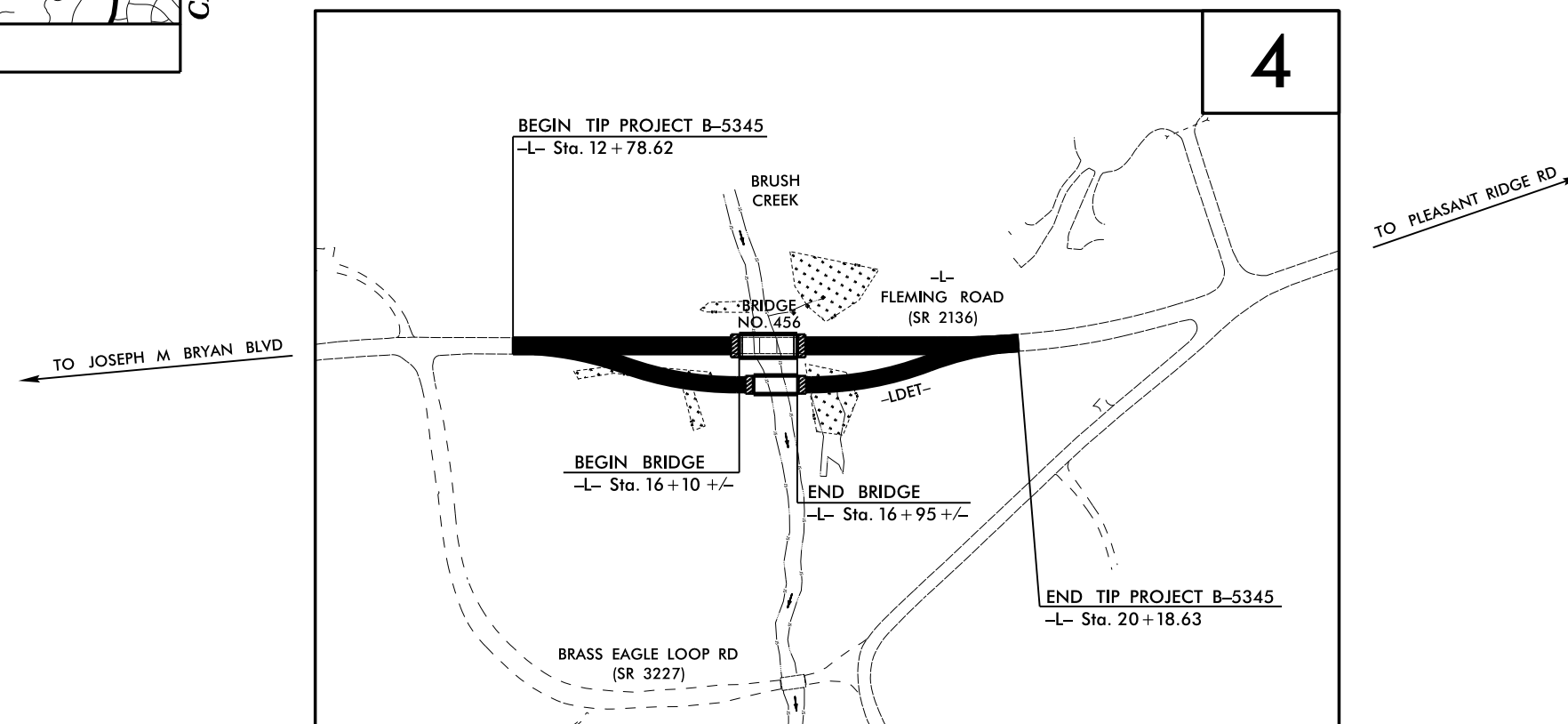
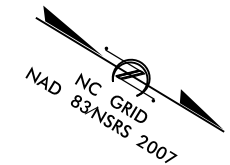
**LOCATION:** BRIDGE NO. 456 OVER BRUSH CREEK  
ON SR 2136 (FLEMING ROAD)

**TYPE OF WORK:** GRADING, DRAINAGE, PAVING, AND STRUCTURE

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-5345	3	13
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
46059.1.1	BRSTP-2136(5)	P.E.	

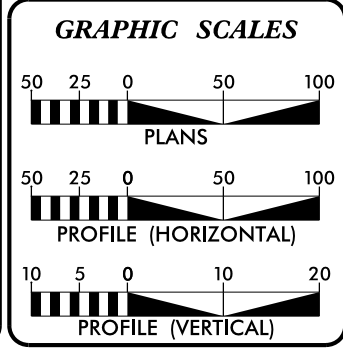
DOCUMENT NOT CONSIDERED FINAL  
UNLESS ALL SIGNATURES COMPLETED

**INCOMPLETE PLANS**  
DO NOT USE FOR R/W ACQUISITION



THIS PROJECT IS WITHIN THE MUNICIPAL BOUNDARIES OF GREENSBORO  
\*DESIGN EXCEPTION REQUIRED FOR SAG VERTICAL CURVE AND ASSOCIATED NIGHTTIME STOPPING SIGHT DISTANCE  
CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD     

**CONTRACT:**



**DESIGN DATA**

ADT 2017	=	6450 vpd
ADT 2040	=	9900 vpd
K	=	11%
D	=	60%
T	=	3%*
V	=	50 MPH
VDET	=	40 MPH
*TTST	=	1% DUAL = 2%
FUNC CLASS	=	RURAL LOCAL "SUBREGIONAL TIER"

**PROJECT LENGTH**

LENGTH ROADWAY TIP PROJECT B-5345	=	0.124 MILES
LENGTH STRUCTURE TIP PROJECT B-5345	=	0.016 MILES
TOTAL LENGTH TIP PROJECT B-5345	=	0.140 MILES

PLANS PREPARED FOR THE NCDOT BY:

**Kimley»Horn**

2012 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: JUNE 17, 2016

LETTING DATE: JUNE 20, 2017

**JEFFREY W. MOORE, P.E.**  
PROJECT ENGINEER

**CATHERINE A. MURRELL, P.E.**  
PROJECT DESIGN ENGINEER

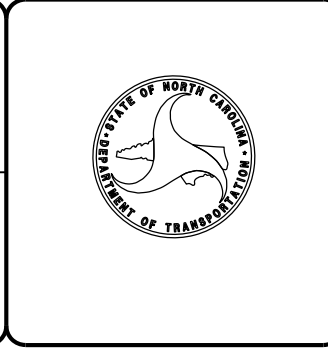
**JAMES A. SPEER, P.E.**  
PROJECT ENGINEER  
NCDOT ROADWAY DESIGN

**HYDRAULICS ENGINEER**

SIGNATURE: \_\_\_\_\_ P.E.

**ROADWAY DESIGN ENGINEER**

SIGNATURE: \_\_\_\_\_ P.E.



\$DATE\$ \$FILE\$



SCHNABEL ENGINEERING SOUTH, P.C.

April 14, 2016

STATE PROJECT: 46059.1.1(B-5345)  
 PROJECT ID: 27388  
 COUNTY: Guilford  
 DESCRIPTION: Replace Bridge No. 456 on SR 2136 (Fleming Road) Over Brush Creek  
 SUBJECT: Geotechnical Report - Inventory

**Project Description**

The project consists of replacing the existing bridge on SR 2136 and constructing a detour road on the east side of the existing roadway to maintain the traffic during construction. The length of the proposed detour road is approximately 555 feet. Fills and cuts up to 7 feet and one foot, respectively, are anticipated to achieve the proposed roadway grades of the detour.

The geotechnical investigation was conducted in February of 2016. Borings were advanced using a D-50 drill rig equipped with an automatic hammer. Standard Penetration Test borings were performed at specific locations to provide subsurface information for design and construction of the proposed roadway. Representative soil samples were collected and submitted to a NCDOT approved laboratory for testing.

The following alignment was investigated for this project. Subsurface profiles and cross sections of this alignment are included in this report.

<u>Line</u>	<u>Station(±)</u>
-LDET-	10+00 to 17+54

**Areas of Special Geotechnical Interest**

1) Alluvial Soils: Loose/soft alluvial soils were present at these locations.

<u>Line</u>	<u>Station (±)</u>	<u>Offset</u>
-LDET-	11+15 to 15+25	Lt. to Rt.

2) Groundwater- The following area exhibit a high water table, seasonal high groundwater or the potential for groundwater related construction problems:

<u>Line</u>	<u>Station(±)</u>
-LDET-	11+10 to 15+25

3) Surface Water - Standing water was encountered at the following locations shown below. Standing water location will vary depending on the rain events and their durations.

<u>Line</u>	<u>Station(±)</u>	<u>Offset</u>
-LDET-	11+67.00 to 13+00.00	Lt. to Rt.
-LDET-	14+43.00 to 14+95.00	Lt. to Rt.

**Physiography, Geology and Surface Water**

The project corridor is located in the central portion of the Piedmont Physiographic Province in Guilford County. Topography in the area is relatively flat. The proposed detour alignment is located within the Brush Creek flood plain, which is about 600 feet wide and is more prominent on the south side of the river. The project area is comprised of isolated wooded areas on both sides of the SR 2136.

Geologically, the project area generally consists of roadway embankment or alluvial deposits at the surface underlain by residual soils over weathered rock, which is derived from Granite (Intrusive Rocks of Carolina Slate Belt).

**Soils Properties**

Soils encountered during the investigation are separated into three categories based on their geologic origin. These are roadway embankment, alluvial and residual soils.

Roadway embankment soils consist of brown very loose fine to coarse sand and soft slightly plastic sandy silt.

Alluvial soils were present below the roadway embankment or from the surface between -LDET- STA 11+20 and STA 15+25. Alluvial soils consist of slightly plastic to highly plastic red, brown and gray, soft to medium stiff, coarse to fine sandy clay to coarse to fine sandy silty clay(A-6 and A-7-5), clayey fine sandy silt (A-4 & A-5), gray, very loose, sand (A-3), gray to brown, very loose to medium dense, fine to coarse sand to silty coarse to fine sand (A-3 and A-2-4) and gray, soft to stiff, sandy silty clay (A-7-5). The PI value of the alluvial clay (A-6) was 9.

Residual soils were encountered near the end of the proposed detour alignment where it ties into the existing roadway. Residual soils consist of moderately plastic brown soft to very stiff sandy clay (A-6) and, brown very soft to soft sandy silt (A-4 and A-5). The PI value of the clay was 21.

**Rock Properties**

Weathered rock was encountered in two borings near elevations 728 feet and 732 feet. The weathered rock was brown and gray to dark brown and gray and gray granite.

**Groundwater**

Groundwater data was collected after recent rainfall event. Water levels across the project can vary due to topographic relief and soil permeability. The 24-hour groundwater was measured at three locations and varied between elevations 774.3 ft. and 776.6 ft. which indicated the groundwater profile dipping towards the creek. Groundwater levels may fluctuate with seasonal variations in precipitation.

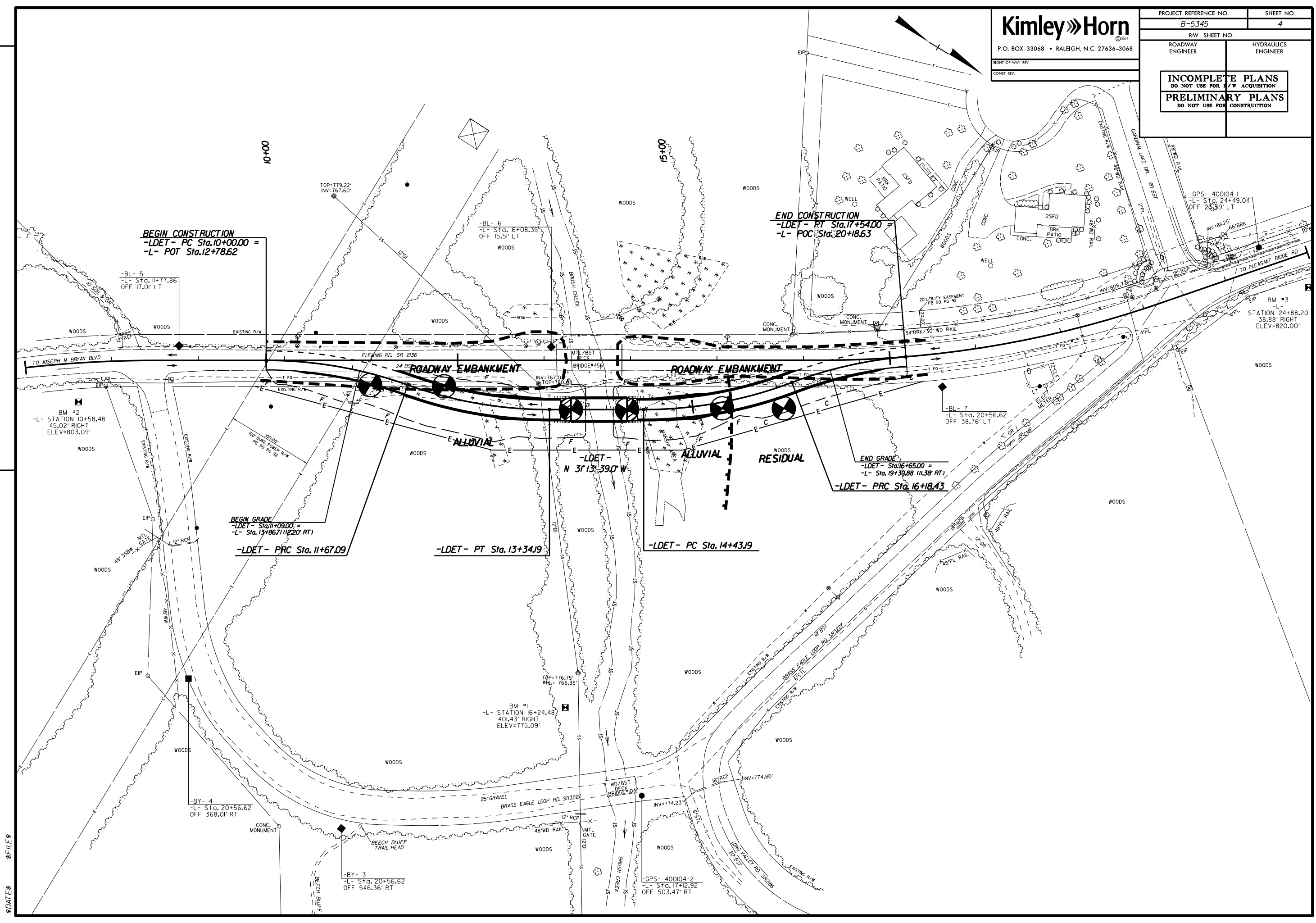
Respectfully Submitted,  
**SCHNABEL ENGINEERING SOUTH, P.C.**



DocuSigned by:  
*Mahalingam Bahiradhan*/26/2016  
4PEAD346C9264A2  
Mahalingam Bahiradhan (Bahi), PE.  
Senior Engineer

PROJECT REFERENCE NO. B-5345	SHEET NO. 4
RW SHEET NO.	HYDRAULICS ENGINEER
ROADWAY ENGINEER	
<b>INCOMPLETE PLANS</b> DO NOT USE FOR I/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	

REVISIONS



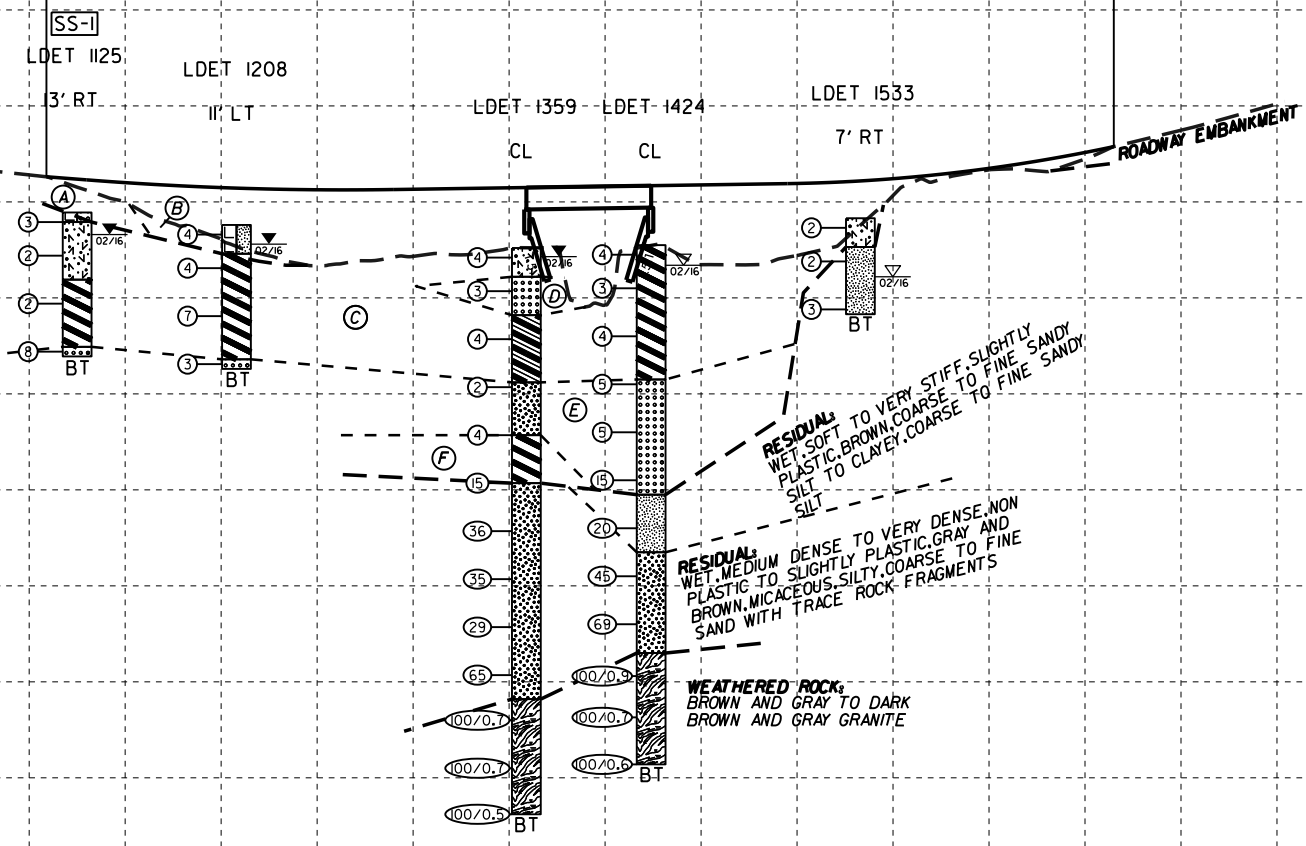
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- (A) ROADWAY EMBANKMENT, MOIST, VERY LOOSE, NON PLASTIC, BROWN, FINE TO COARSE SAND
- (B) ROADWAY EMBANKMENT, WET, SLIGHTLY PLASTIC, SOFT, BROWN, MICACEOUS, COARSE TO FINE SANDY SILT
- (C) ALLUVIAL, WET TO SATURATED, SOFT TO MEDIUM STIFF, SLIGHTLY PLASTIC TO HIGHLY PLASTIC, RED BROWN, BROWN, AND GRAY, MICACEOUS, CLAYEY, FINE SANDY SILT, COARSE TO FINE SANDY CLAY TO COARSE TO FINE SANDY SILTY CLAY
- (D) SATURATED, VERY LOOSE, NON PLASTIC, GRAY AND BROWN, COARSE TO FINE SAND
- (E) WET TO SATURATED, VERY LOOSE TO MEDIUM DENSE, NON PLASTIC TO SLIGHTLY PLASTIC, GRAY AND BROWN, FINE TO COARSE SAND TO MICACEOUS, SILTY, COARSE TO FINE SAND
- (F) WET, SOFT TO STIFF, MODERATELY PLASTIC, GRAY, MICACEOUS, FINE SANDY, SILTY CLAY

SOIL TEST RESULTS															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	LL	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C SAND	F SAND	SILT	CLAY	10	40	200		
SS-1	13' RT	11+25	3.5-5.0	A-5	46	9	16	37	23	24	100	93	53	43.8	N/A

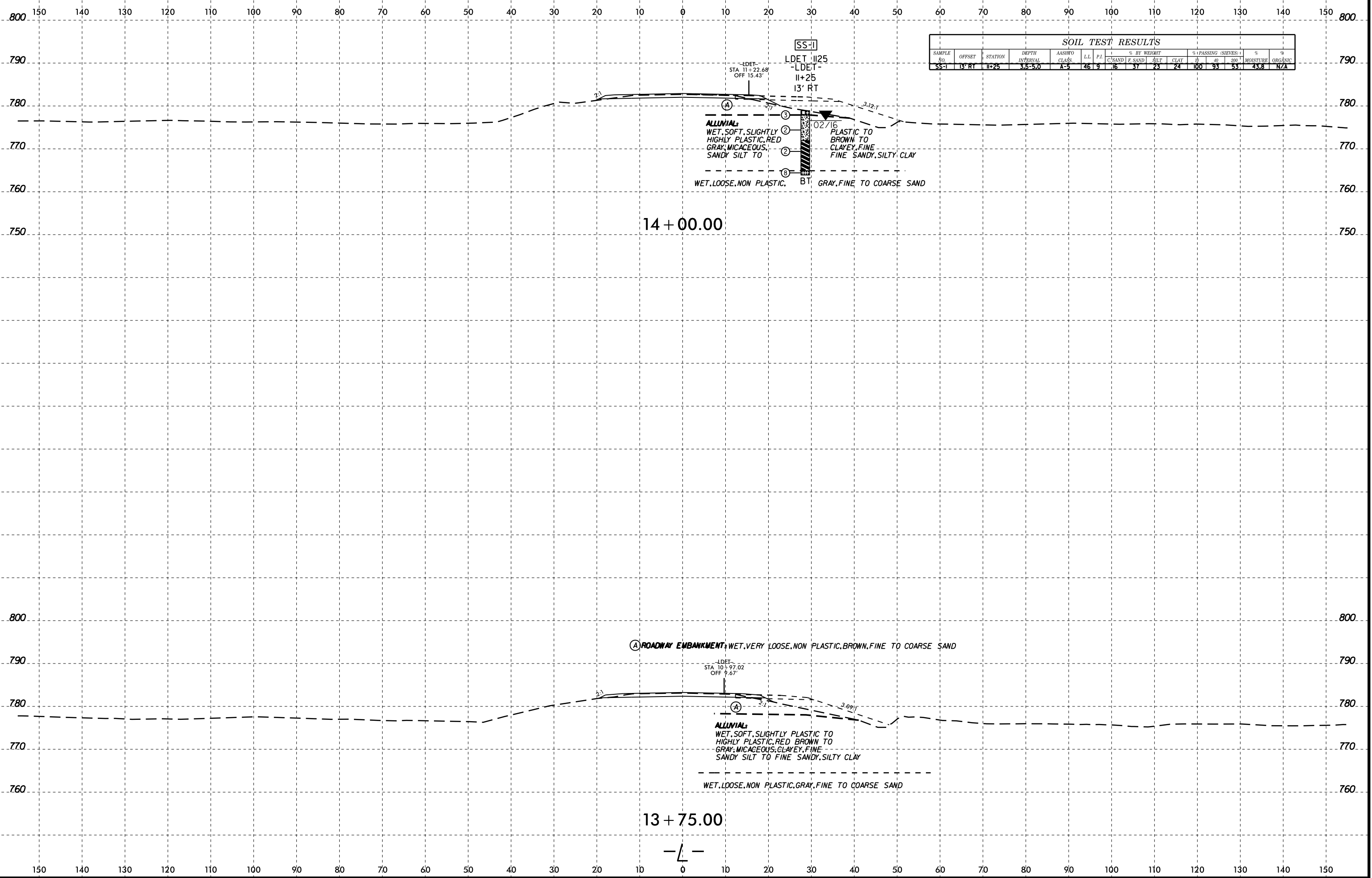
BEGIN GRADE  
 -LDET - Sta. 11+09.00 =  
 -L - Sta. 13+86.71 (12.20' RT)  
 ELEV = 782.62'

END GRADE  
 -LDET - Sta. 16+65.00 =  
 -L - Sta. 19+30.88 (11.38' RT)  
 ELEV = 785.76'



-LDET-

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**SOIL TEST RESULTS**

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	ASHMO CLASS	LL	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C SAND	F SAND	SILT	CLAY	#10	#40	#200		
SS-1	13' RT	14+25	3.5-5.0	A-5	46	9	16	37	23	24	100	93	53	43.8	N/A

SS-1  
LDET 1125  
LDET 1125  
11+25  
13' RT

ALLUVIAL  
WET, SOFT, SLIGHTLY  
HIGHLY PLASTIC, RED  
GRAY, MICACEOUS,  
SANDY SILT TO  
WET, LOOSE, NON PLASTIC,  
GRAY, FINE TO COARSE SAND

PLASTIC TO  
BROWN TO  
CLAYEY, FINE  
FINE SANDY, SILTY CLAY

BT

14 + 00.00

ROADWAY EMBANKMENT WET, VERY LOOSE, NON PLASTIC, BROWN, FINE TO COARSE SAND

LDET  
STA 10+97.02  
OFF 9.67'

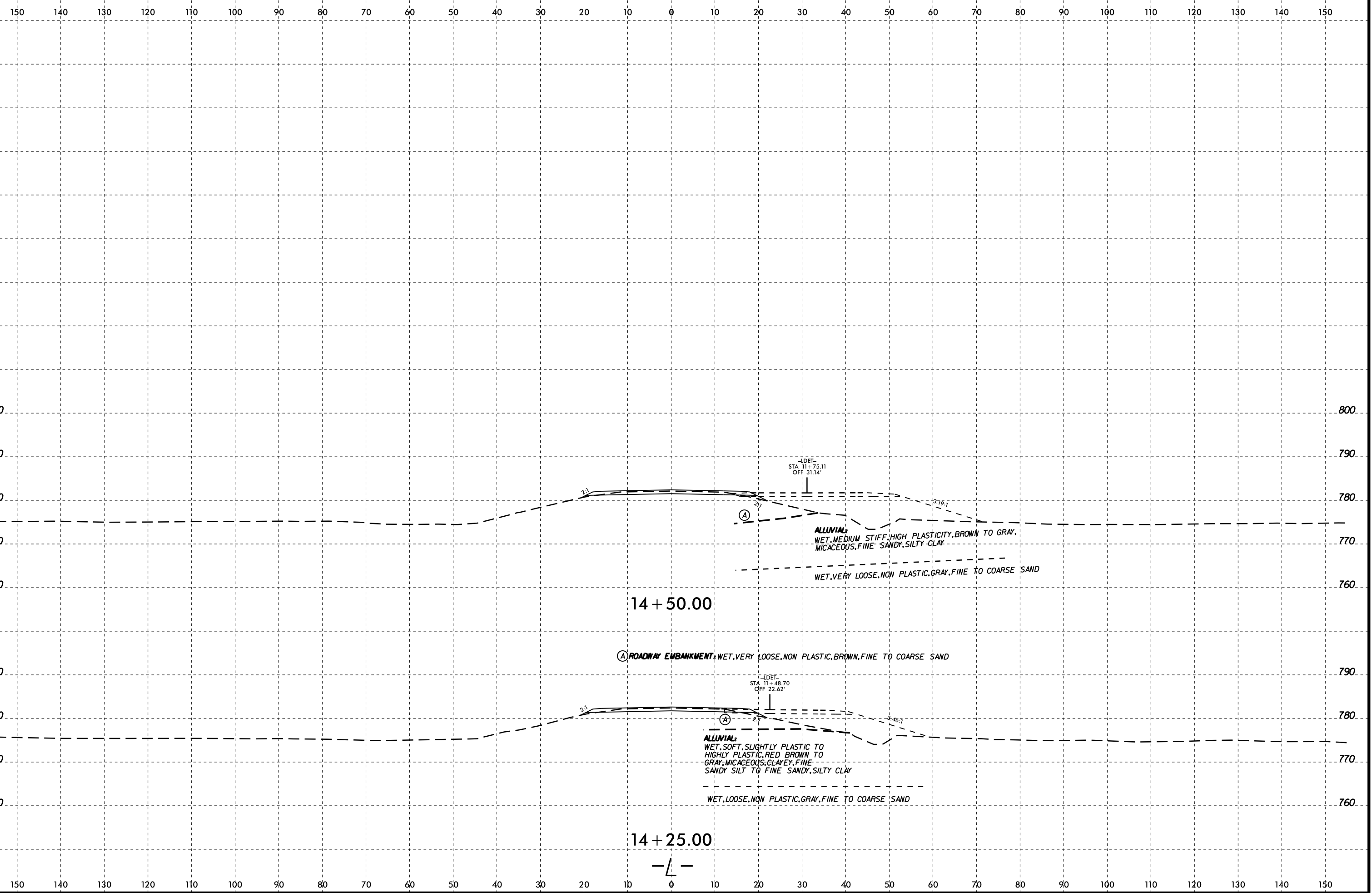
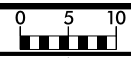
ALLUVIAL  
WET, SOFT, SLIGHTLY PLASTIC TO  
HIGHLY PLASTIC, RED BROWN TO  
GRAY, MICACEOUS, CLAYEY, FINE  
SANDY SILT TO FINE SANDY, SILTY CLAY

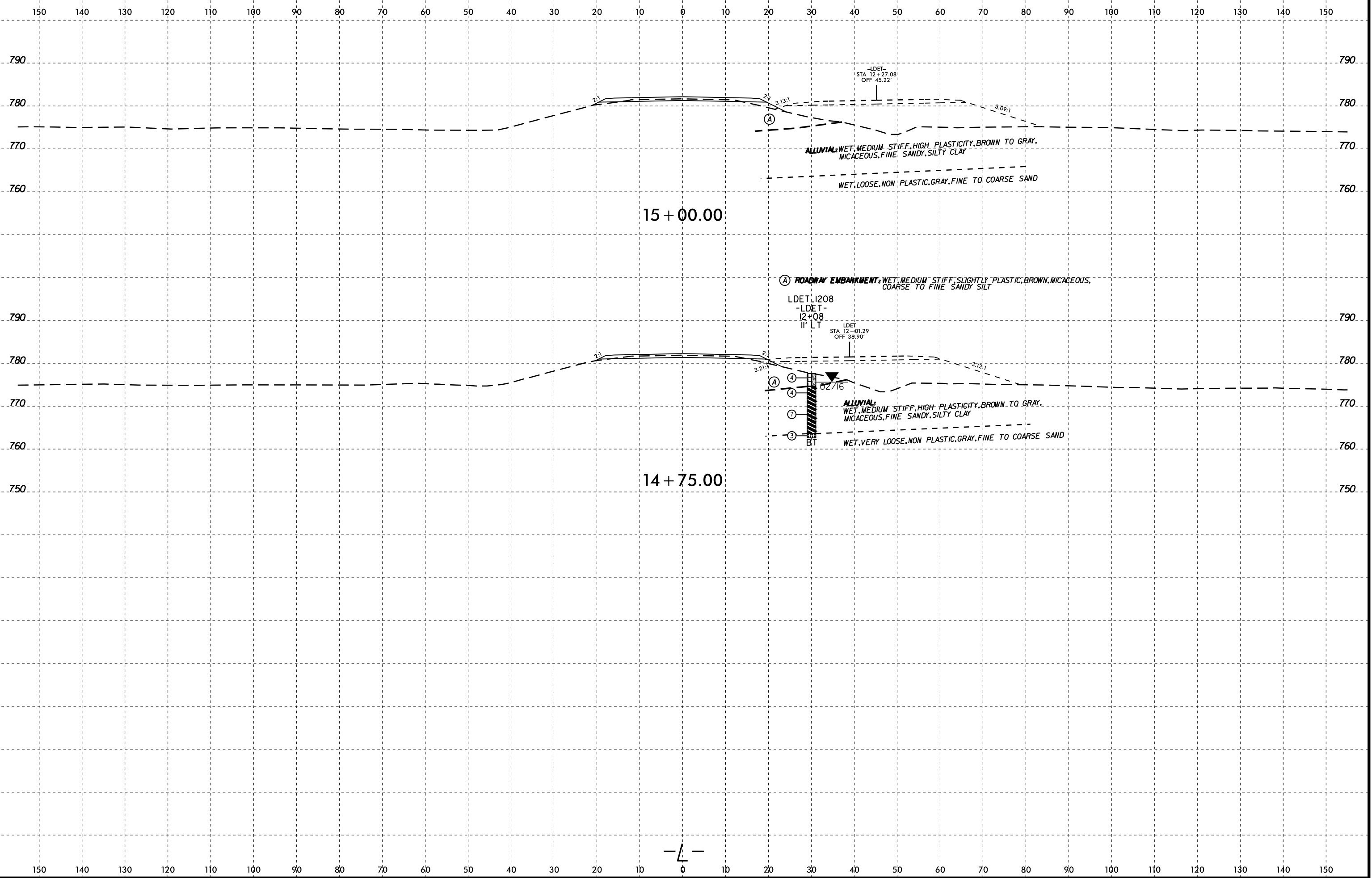
WET, LOOSE, NON PLASTIC, GRAY, FINE TO COARSE SAND

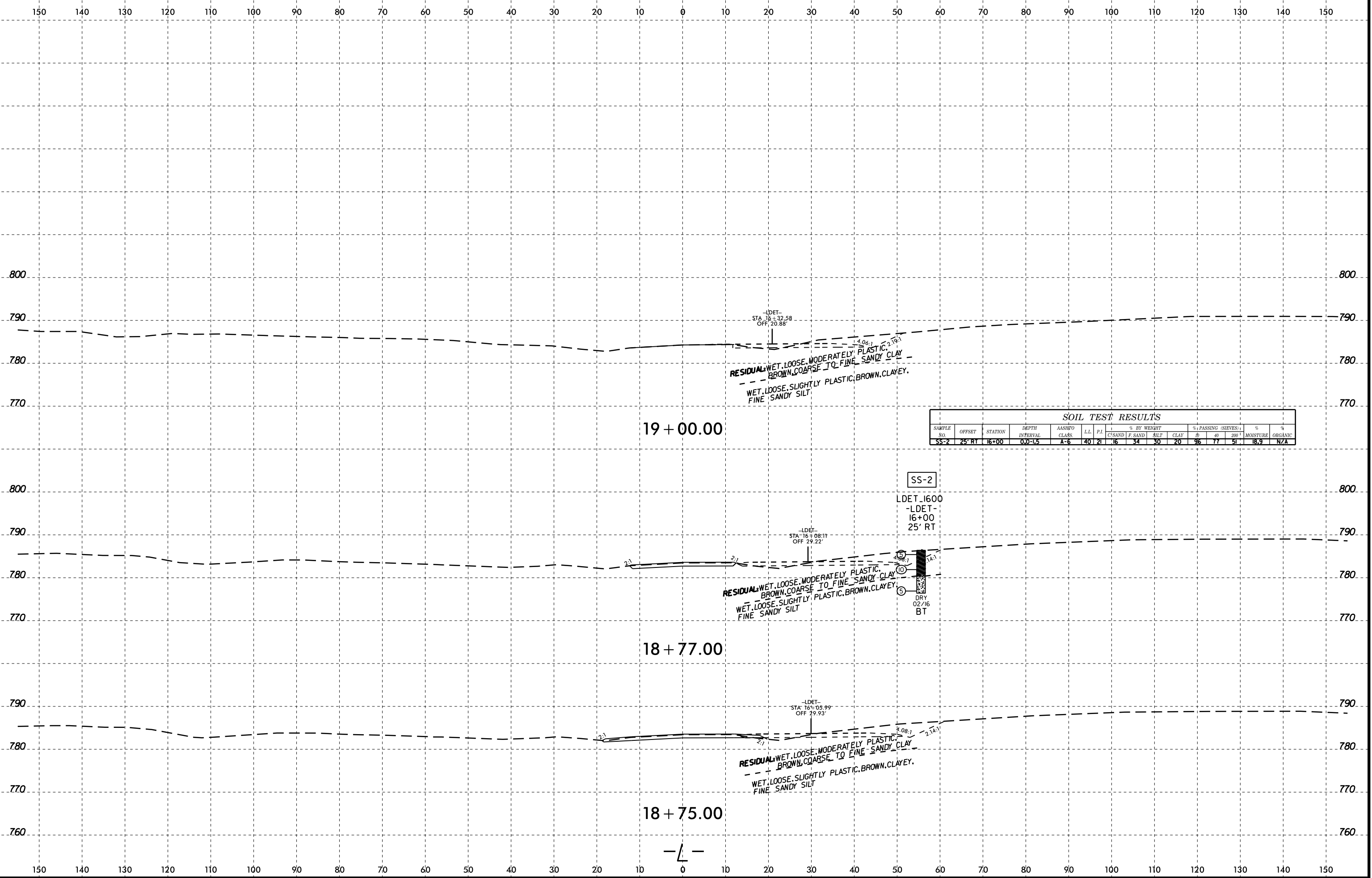
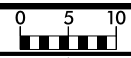
13 + 75.00

-L-









19 + 00.00

SOIL TEST RESULTS															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	LL	PI	% BY WEIGHT				% PASSING (SIEVES)		% MOISTURE	% ORGANIC	
							C SAND	F SAND	SILT	CLAY	#10	#200			
SS-2	25' RT	16+00	0.0-1.5	A-6	40	21	16	34	30	20	96	77	51	18.9	N/A

SS-2

LDET .1600  
-LDET-  
16+00  
25' RT

18 + 77.00

-LDET-  
STA 18+08.11  
OFF 29.22'

15  
10  
5  
DRY  
02/16  
BT

18 + 75.00

-LDET-  
STA 18+08.99  
OFF 29.93'

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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT  
SUBSURFACE INVESTIGATION  
APPENDIX A  
SOIL TEST RESULTS

REFERENCE: B-5345

PROJECT: 46059

**REPLACE BRIDGE NO. 456 ON SR 2136 OVER BRUSH CREEK**

**SOIL TEST RESULTS**

BORING NO.	SAMPLE NO.	STATION	OFFSET	DEPTH INTERVAL (FEET)	AASHTO CLASS.	LIQUID LIMIT	PLASTICITY INDEX	% BY WEIGHT					% PASSING (SIEVES)			% MOISTURE	% ORGANIC
								GRAVEL	C.SAND	F.SAND	SILT	CLAY	10	40	200		
LDET_1125	SS-1	11+25	13' RT.	3.5 - 5.0	A-5	46	9	0	16	37	23	24	100	93	53	43.8	-
LDET_1600	SS-2	16+00	25' RT.	0.0 -1.5	A-6	40	21	0	16	34	30	20	96	77	51	18.9	-