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REFERENCE: B-4962

PROJECT: 40174

SEE SHEET 3 FOR PLAN SHEET LAYOUT AT TIME OF INVESTIGATION

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CROSS SECTIONS

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-L-	14+00 - 16+50	8-13
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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

ROADWAY SUBSURFACE INVESTIGATION

COUNTY *ORANGE*

PROJECT DESCRIPTION *REPLACE BRIDGE NO. 46 OVER ENO RIVER ON US 70 BYPASS*

INVENTORY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-4962	1	28

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.

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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.

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DATE *APRIL, 2018*

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4/3/2018

SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE,
VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

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

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

CONSISTENCY OR DENSENESS

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

TEXTURE OR GRAIN SIZE

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

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

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

SOIL MOISTURE - CORRELATION OF TERMS

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

PLASTICITY

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

COLOR

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

GRADATION

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

ANGULARITY OF GRAINS

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

MINERALOGICAL COMPOSITION

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

COMPRESSIBILITY

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

PERCENTAGE OF MATERIAL

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

GROUND WATER

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

MISCELLANEOUS SYMBOLS

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

RECOMMENDATION SYMBOLS

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

ABBREVIATIONS

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

SAMPLE ABBREVIATIONS

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

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] CME-45C
- [X] CME-450
- [X] CME-550X
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [X] 2.25" HOLLOW STEM AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [ ] CASING [ ] W/ ADVANCER
- [ ] TRICONE _____" STEEL TEETH
- [ ] TRICONE _____" TUNG.-CARB.
- [X] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [X] -N Q2

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

ROCK DESCRIPTION

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

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

WEATHERING

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

ROCK HARDNESS

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

FRACTURE SPACING

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

BEDDING

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

INDURATION

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

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

TERMS AND DEFINITIONS

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

AQUIFER - A WATER BEARING FORMATION OR STRATA.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

BENCH MARK:

ELEVATION: FEET

NOTES:

ELEVATIONS OBTAINED FROM B4962_ls_tin.tin (FILE DATED: 9/6/17)
FIAD = FILLED IMMEDIATELY AFTER DRILLING
MnO = Manganese Oxide

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
B–4962	2A

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)

From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.

STRUCTURE

- INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities
- BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets
- VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets
- BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity
- DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces
- LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes

DECREASING INTERLOCKING OF ROCK PIECES ⇩

SURFACE CONDITIONS

DECREASING SURFACE QUALITY ⇨

VERY GOOD	GOOD	FAIR	POOR	VERY POOR
Very rough, fresh unweathered surfaces	Rough, slightly weathered, iron stained surfaces	Smooth, moderately weathered and altered surfaces	Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments	Slickensided, highly weathered surfaces with soft clay coatings or fillings
90	80	N/A	N/A	
70	60	50	40	30
20	N/A	N/A		10

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos. P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

COMPOSITION AND STRUCTURE

- **A.** *Thick bedded, very blocky sandstone The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.*
- **B.** *Sandstone with thin interlayers of siltstone*
- **C.** *Sandstone and siltstone in similar amounts*
- **D.** *Siltstone or silty shale with sandstone layers*
- **E.** *Weak siltstone or clayey shale with sandstone layers*
- **C, D, E,** and **G** - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H.**
- **F.** *Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure*
- **G.** *Undisturbed silty or clayey shale with or without a few very thin sandstone layers* → **H.** ***Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.***

→ Means deformation after tectonic disturbance

SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces	GOOD - Rough, slightly weathered surfaces	FAIR - Smooth, moderately weathered and altered surfaces	POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments	VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings
70	A			
60				
	50			
	B	C	D	E
	40			
		30		F
			20	
		G		H 10

DATE: 8-19-16

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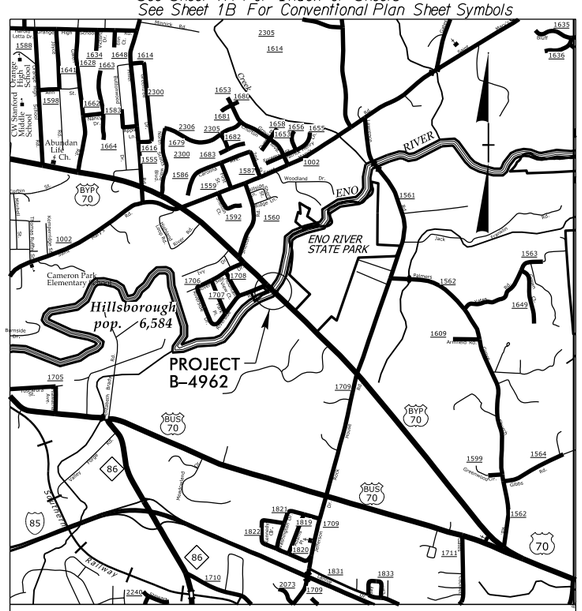
$$$$USERNAME$$$$
09/08/99

CONTRACT: **TIP PROJECT: B–4962**

See Sheet 1A For Index of Sheets
See Sheet 1B For Conventional Plan Sheet Symbols



VICINITY MAP

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

ORANGE COUNTY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B–4962	3	28

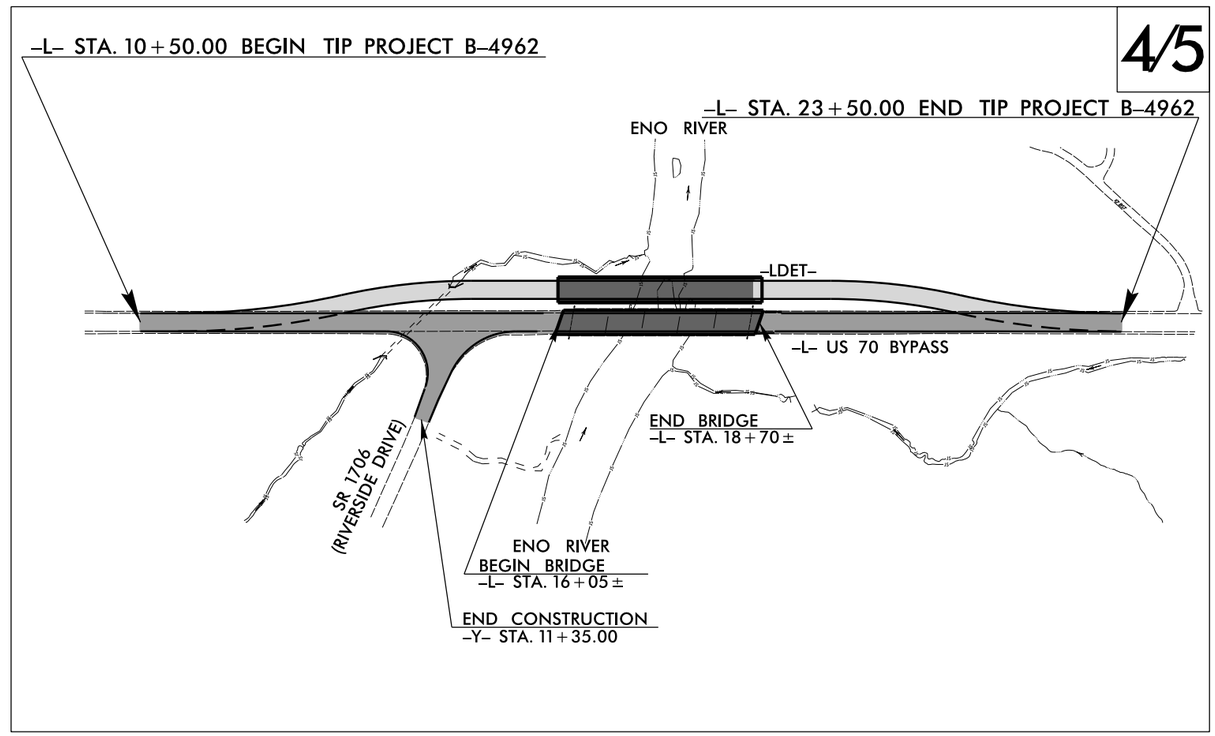
STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
40174.1.1	BRSTP–0070(120)	P.E.

LOCATION: BRIDGE NO. 46 OVER ENO RIVER ON US 70 BYPASS

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

NAD 83/ NSRS 2007

4/5



THIS PROJECT IS NOT WITHIN ANY MUNICIPAL BOUNDARIES.
CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD ___.

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

GRAPHIC SCALES

PLANS: 50 25 0 50 100
PROFILE (HORIZONTAL): 50 25 0 50 100
PROFILE (VERTICAL): 10 5 0 10 20

DESIGN DATA

ADT 2018 = 15000
ADT 2038 = 19000
K = 10 %
D = 70 %
T = 5 % *
V = 50 MPH
V_{DET} = 40 MPH
*TTST=2% DUAL=3%
FUNC CLASS = MINOR ARTERIAL "REGIONAL TIER"

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT B–4962 = 0.196 MILES
LENGTH STUCTURE TIP PROJECT B–4962 = 0.050 MILES
TOTAL LENGTH OF TIP PROJECT B–4962 = 0.246 MILES

Prepared In the Office of:
SUMMIT DESIGN AND ENGINEERING SERVICES FIRM NO. P-0339
504 Meadowland Drive
Hillsborough, NC 27278-8551
Voice: (919) 732-3883
Fax: (919) 732-6776
www.summitde.net

2012 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE:
FEBRUARY 16, 2018

LETTING DATE:
FEBRUARY 19, 2019

JAMES A. SPEER, PE
PROJECT ENGINEER

BRANDON W. JOHNSON, PE
PROJECT DESIGN ENGINEER

HYDRAULICS ENGINEER

P.E.
SIGNATURE:

ROADWAY DESIGN ENGINEER

P.E.
SIGNATURE:

STATE OF NORTH CAROLINA • DEPARTMENT OF TRANSPORTATION

SUMMIT
DESIGN AND ENGINEERING SERVICES
919.732.3883 SUMMIT-ENGINEER.COM
504 Meadowland Drive, Hillsborough, NC 27278

April 2, 2018

WBS Number: 40174.1.1
TIP Number: B-4962
ProjectID: 31220
County: Orange
Description: Replace Bridge No. 46 over Eno River on US 70 Bypass

SUBJECT: Geotechnical Report - Roadway Subsurface Inventory

Project Description

The proposed project is located on US 70 Bypass in Hillsborough and will consist of two phases. The first phase will involve the construction of a new detour alignment and detour bridge over the Eno River. The total length of the proposed detour with associated bridge is approximately 0.238 miles. The construction of the detour will involve some significant earthworks. Proposed embankment heights exceed 25 feet on the west side of the Eno River. Cut sections greater than 20 feet in depth are proposed on the east side of the river. Once completed, the detour will reroute traffic on US 70 Bypass around existing Bridge No. 46. This will allow for the second phase of the project to begin, the replacement of Bridge No. 46. Roadway improvements to the bridge approaches will also be completed during this phase. Once construction of the new bridge and bridge approaches is completed, the detour alignment will be closed down. The bridge, pavement, and some embankment will be removed. However, the toe of the embankment and ditch will be maintained. The total length of the project is 0.246 miles with 0.050 miles of that consisting of the structures. State Route 1706, Riverside Drive, is the only route intersecting with the project.

The geotechnical investigation was conducted from November 21, 2017 to December 7, 2017. Borings were advanced using Central Mine Equipment (CME) - 450, and Central Mine Equipment (CME) - 550X drill machines equipped with automatic hammers. Standard Penetration Tests were performed at all planned boring locations to provide subsurface information for roadbed and slope design/construction. Rock soundings were performed in areas where Crystalline Rock was encountered within 6 feet of proposed grade. Rock core was obtained in two locations within a proposed large cut section for the detour alignment. Preliminary bridge borings were drilled for the proposed structures, and are included in this report. Hand auger borings were performed in areas that our drill rigs were unable to access. Representative soil samples were collected and submitted to Summit's soils laboratory for classification and moisture content testing. Borings were left open for a minimum of 24 hours to collect groundwater data if they intercepted wet or saturated soils. All investigations and reporting were performed in accordance with the NCDOT Geotechnical Engineering Unit's 2016 "Geotechnical Investigation and Recommendations Manual."

The following alignments were investigated for this project:

Alignment	Station(±)
-L-	10+50.00 - 23+50.00
-LDET-	10+00.00 - 22+59.12
-Y-	10+00.00 - 11+35.00

Physiography and Geography

The project corridor is located in north-central North Carolina in the Piedmont Physiographic Province. Topography in the region is characterized by gently rolling, well rounded hills and long low ridges with a few hundred feet of elevation difference between the hills and valleys. In general, the topography within the project corridor would fit this description. The eastern side of the project may even more closely resemble the Blue Ridge Physiographic Province. With steep slopes, narrow valleys, exposed rock, and even some growth of mountain laurel. Elevations within the project corridor range from approximately 573 feet to approximately 480 feet above sea level. The topographic high occurs near the top of the proposed cut on the eastern side of the project. The topographic low occurs within the floodplain of the Eno River.

Geologically, the project area is located within the Carolina Slate Belt. This belt consists of heated and deformed volcanic and sedimentary rocks. All rock units within the project area have been metamorphosed to some degree. However, the relic features of the original rock type have largely been retained and thus the prefix "meta" is not used in the following descriptions. The Eno River basically runs across a geologic contact within the project corridor. The western side of the Eno River is underlain by altered felsic tuffs consisting of sericite-quartz phyllite, pods of pyrophyllite, and quartz pyrophyllite rock. This unit can contain aggregates of cubic pyrite. The eastern side of the Eno River is underlain by Andesitic to dacitic lavas and tuffs and an intrusion of fine-grained granodiorite. Both of these units are highly resistant to weathering which helps explain the steeper slopes and greater rock exposure on the eastern side of the project. All of these units are Cambrian to Late Proterozoic in age (505 - 900 million years old). Measurements taken on bedding and layering features show a northeast strike with a northwest dip between 62 and 83 degrees. Measurements taken on joints show a varied strike from northwest, to northeast, and east with steep southwest to vertical dips.

The Eno River is the only major body of water within the project corridor. A few small unnamed tributaries and drainage features feeding into the Eno River were encountered or observed within the project corridor during the investigation.

Soil Properties

Roadway Embankment soils from the construction of existing US 70 Bypass and State Route 1706 are present within the project corridor. Roadway Embankment soils are very minor on the eastern side of the project, mostly less than a few feet thick. However, on the western side of the project, the bridge approach fills exceed 20 feet in depth in some places. Roadway Embankment soils are quite similar to the local Residual soils that they were sourced from. Roadway Embankment soils consist of mostly sandy silts (A-4), sandy clays (A-6), and

areas of gravel, cobbles, and boulders (A-1-a). Only 1 sample was lab tested and revealed a Plasticity Index (PI) value of 11. Some boulders within the fill are so large, that they produced auger and Standard Penetration Test refusals during the investigation. Roadway Embankment soils often appear similar to the local residual soils in color and composition. However, they often have a “reworked” appearance, with a large variation in grain size. They are typically dry to moist, stiff to very stiff, and can contain trace amounts of organic material and other types of debris.

Alluvial soils occur within the floodplain of the Eno River as well as a few of the smaller tributaries feeding in to it. The tributary on the northwest side of the project was diverted during construction of the US 70 Bypass, and the current channel is not reflective of where the bulk of alluvial deposition associated with this tributary occurred. Alluvial soils primarily consist of sandy silts (A-4) and clayey sands (A-2-6). Gravel, cobbles, and boulders are also present with in these soils. In the samples that were lab tested, PI values ranged from 8 to 11. The alluvial soils are typically moist, soft to medium dense, and trace to highly organic. Specific locations where these soils are believed to be present will be highlighted in the “Areas of Special Geotechnical Interest” section of this text report.

Residual soils, derived from the weathering of rock, are the dominant soil origin within the project corridor. In general, the residual soils follow the typical weathering profile seen throughout the piedmont. The clays, when present, are usually found closer to the ground surface. The silts and sands are typically found deeper and closer to the parent rock source. However, much like the parent rocks that they weather from, the Residual soils can vary significantly in some areas in both composition and vertical/horizontal distribution. Sandy silts (A-4) are the predominate soil type and occur throughout the project corridor, generally immediately above weathered and/or crystalline rock. The sandy silts are generally dry to moist, stiff to hard, and typically saprolitic. They can also contain little to trace amounts of gravel, cobble, and boulder sized crystalline rock fragments. One sandy silt sample was lab tested and revealed a PI value of 4. Some trace amounts of Manganese Oxide (MnO) were observed within the sandy silts. Manganese oxide (MnO) will generate nearly frictionless surfaces of indeterminate orientation throughout the Residual soil profile, which can lead to slope stability issues. However, no significant amounts of MnO were encountered during the geotechnical investigation. Sandy clays (A-6) and silty clays (A-7-5/A-7-6) are present on the western side of the project corridor. They are typically dry to moist, medium stiff to stiff, and occur within 10 feet of the ground surface. The clays are generally slightly to moderately plastic (PI values 15-17), but one area within the project corridor does contain highly plastic clays (PI value of 26) and will be highlighted in the “Areas of Special Geotechnical Interest” section of this text report.

Rock Properties

The Andesitic to dacitic lavas and tuffs that underlie the eastern side of the project will significantly impact construction. Two core holes drilled within this unit revealed the rock type to more specifically be a Metamorphosed Dacite. The Meta-Dacite mostly consists of very fine-grained quartz and plagioclase feldspar, with lesser amounts of chlorite and trace pyrite. These rocks are weakly foliated, very resistant to weathering, and are fractured with as many as 3 identifiable fracture sets. Average Strata Core Recovery (SREC) within this unit was calculated at 90.5%. Average Strata Rock Quality Designation (SRQD) was calculated at 59%, which is considered “Fair Rock.” Geological Strength Index (GSI) values ranged from 65-75 with an average of 70. Additional drilling in the Meta-Dacite showed a consistent and shallow rock line with a few to several feet of weathered rock overlying the rock. Rock line elevations ranged from 508 to 554 feet above sea level. The proposed cut along -LDET- will require excavation of the Meta-Dacite. The altered felsic tuffs underlying the western side of the project corridor were encountered only through Standard Penetration Testing. Drilling and SPT results within this unit show a somewhat consistent rock line that sharply rises and eventually outcrops at the Eno River. Rock line elevations vary from 465 to 487 feet above sea level. The altered felsic tuffs produced the only residual clay soils encountered within the project corridor.

Groundwater Properties

The field investigation as conducted during a period of moderate drought. Groundwater was encountered in several borings within the project corridor. On the western side of the Eno River, groundwater was encountered at an average depth of 6.4 feet below ground surface (average elevation of 487.8 feet). Here groundwater typically occurs within the weathered rock zone under artesian (non-flowing) conditions. Some areas of perched water may be present within alluvial soils. On the eastern side of the Eno River, groundwater was encountered at an average depth of 16.7 feet (average elevation of 539.7 feet). Here groundwater occurs within the Crystalline Rock under artesian (non-flowing) conditions. Specific locations where groundwater is present above or within six feet of proposed grade will be highlighted in the following section, “Areas of Special Geotechnical Interest.”

Areas of Special Geotechnical Interest

Plastic Soils - During the geotechnical investigation, highly plastic clays were encountered in one area within the project corridor. More detailed information on these soils can be found in the “Soil Properties” section of this text report. The following approximate locations listed below show areas where moderate to highly plastic clays are present within the limits of construction:

Alignment	Station(±)	Offset
-L-	10+75 - 12+75	24ft to 32ft LT & 24ft to 44ft RT
-LDET-	10+75 - 11+75	29ft to 38ft LT

Crystalline Rock - During the geotechnical investigation, Crystalline Rock was encountered in several areas. More detailed information on the rocks underlying the project corridor can be found in the “Rock Properties” section of this text report. The following locations listed below show areas where Crystalline Rock is above or within 6 feet of proposed grade:

Alignment	Station(±)	Offset
-L-	19+25 - 23+50	12ft to 42ft LT & 12ft to 26ft RT
-LDET-	18+28 - 22+59.12	22ft to 97ft LT

Alluvial Soils - During the geotechnical investigation, areas of Alluvial soils were encountered. These soils are typically soft, wet or saturated, and may contain higher amounts of organic material. More detailed information on these soils can be found in the “Soil Properties” section of this text report. The following approximate locations listed below show areas where Alluvial soils are present within the limits of construction:

Alignment	Station(±)	Offset
-L-	14+60 - 16+05	55ft to 86ft LT
-LDET-	13+63 - 15+07	55ft to 92ft LT

Groundwater - During the geotechnical investigation, groundwater was encountered in several areas. More detailed information on groundwater can be found in the “Groundwater Properties” section of this text report. The following locations listed below show areas where groundwater is above or within 6 feet of proposed grade:

Alignment	Station(±)	Offset
-L-	19+75 - 21+75	12ft to 42ft LT
-LDET-	18+78 - 20+80	16ft to 90ft LT

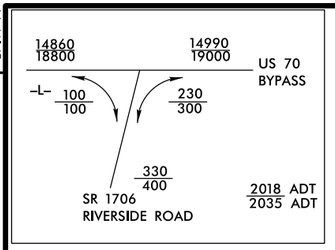
References

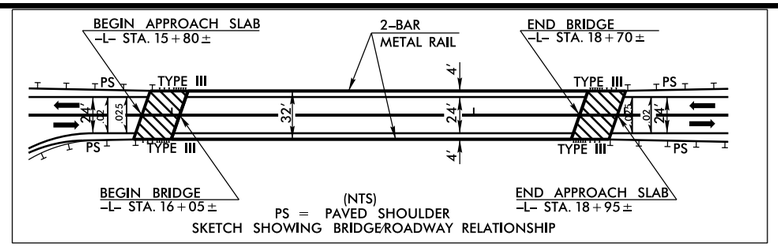
The Geology of the Carolinas, J. Wright Horton, Jr., and Victor A. Zullo
Geologic Map of the Hillsborough 7.5-Minute Quadrangle, Orange County, North Carolina

Respectfully Submitted,

DocuSigned by:
Brett Smith
BE61A49304C542E...

Brett Smith, PG
Project Geologist
Summit Design and Engineering Services, PLLC





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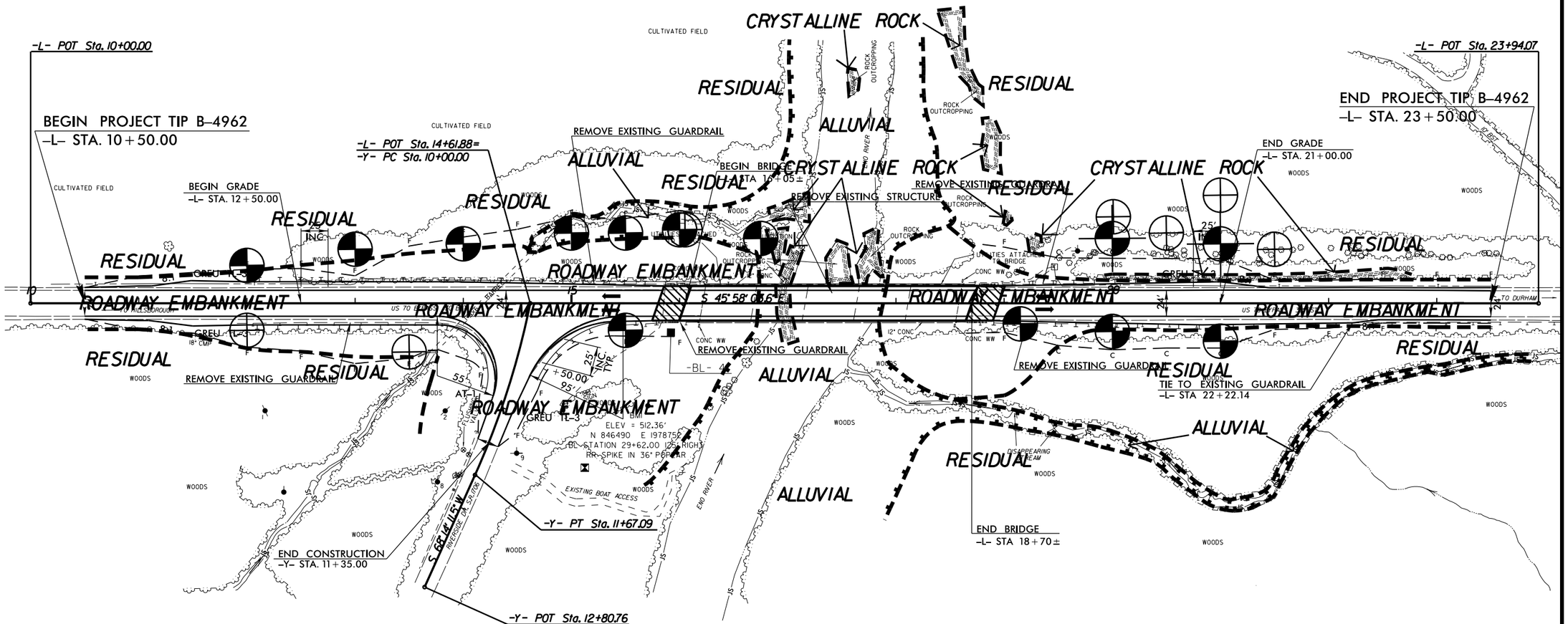
PROJECT REFERENCE NO.	SHEET NO.
B-4962	4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



-Y-
PI Sta 10+83.90
Δ = 12° 45' 52.6" (RT)
D = 7° 38' 22.0"
L = 167.09'
T = 83.89'
R = 750.00'
SE = EXIST.

SEE SHEET 6 FOR -L- AND -Y- PROFILES
SEE SHEETS S-1 THRU S-? FOR STRUCTURE PLANS

REVISIONS

8/17/99

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REVISIONS
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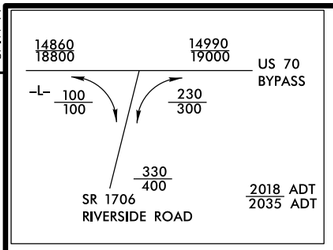
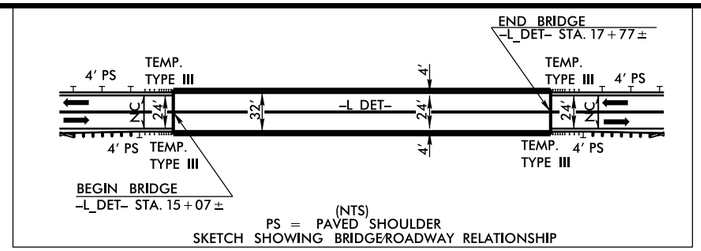




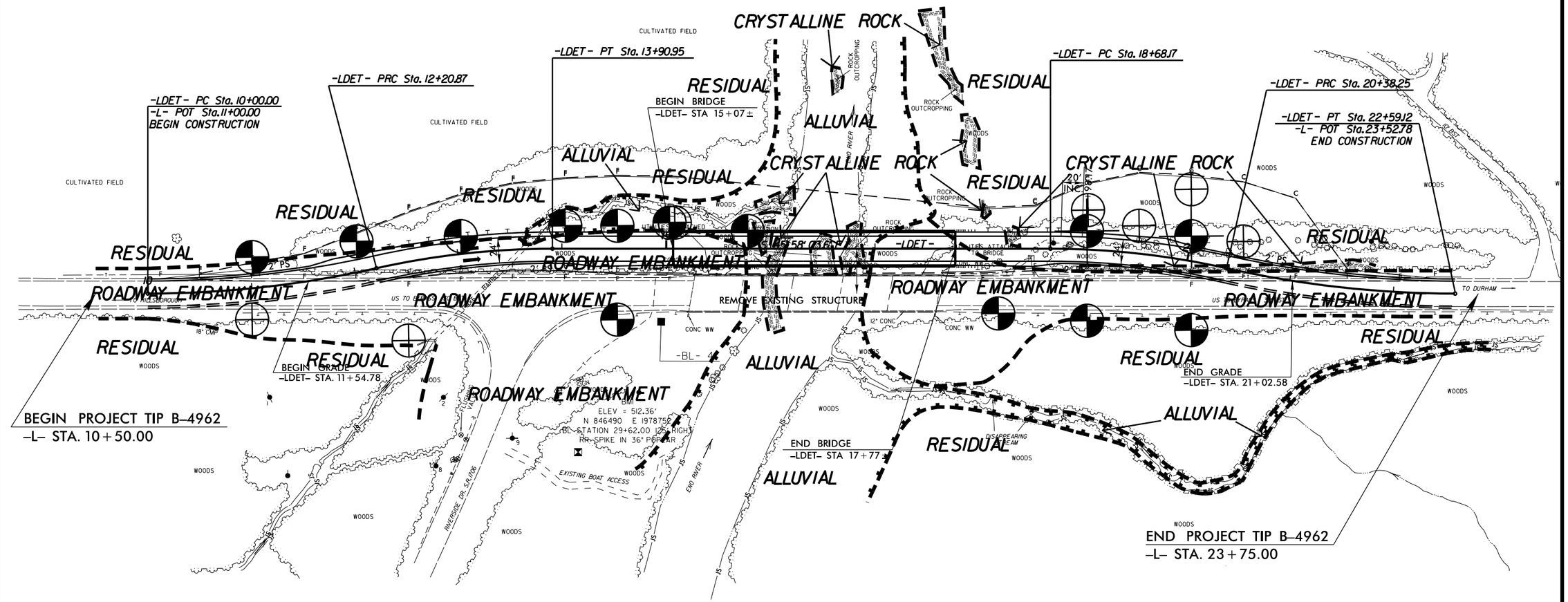
(NTS)
PS = PAVED SHOULDER
SKETCH SHOWING BRIDGE/ROADWAY RELATIONSHIP

NAD 83/NSRS 2007

PROJECT REFERENCE NO.	SHEET NO.
B-4962	5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



NOTE: SR 1706 (RIVERSIDE DRIVE) TO REMAIN CLOSED DURING THE DURATION OF THE ON-SITE DETOUR. ACCESS WILL BE BE PROVIDED BY THE WESTERN ACCESS OF SR 1706 (RIVERSIDE DRIVE) TO US 70 BYPASS.

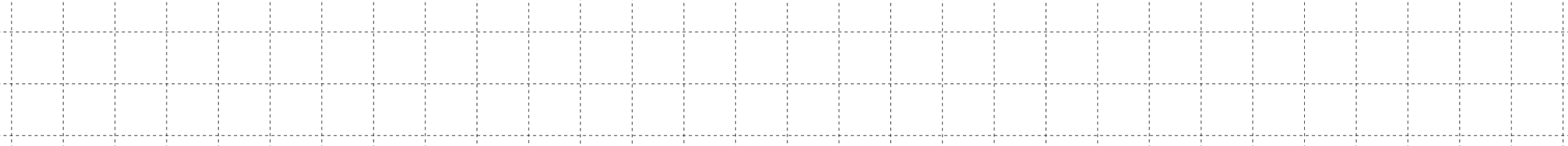
VDET = 40 MPH

-LDET-			
PI Sta 11+10.89	PI Sta 13+06.26	PI Sta 19+53.56	PI Sta 21+49.14
Δ = 12° 39' 18.7" (LT)	Δ = 12° 39' 18.7" (RT)	Δ = 12° 39' 18.7" (RT)	Δ = 12° 39' 18.7" (LT)
D = 5° 43' 46.5"	D = 7° 26' 27.6"	D = 7° 26' 27.6"	D = 5° 43' 46.5"
L = 220.87'	L = 170.07'	L = 170.07'	L = 220.87'
T = 110.89'	T = 85.38'	T = 85.38'	T = 110.89'
R = 1,000.00'	R = 770.00'	R = 770.00'	R = 1,000.00'
SE = .04	SE = .04	SE = .04	SE = .04

SEE SHEET 7 FOR -LDET- PROFILE

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-1	35'LT	12+00	3.3' - 4.8'	A-7-5(28)	69	26	8.8	9.9	21.0	60.4	99	93	83	36.5	N/A



(A) **ROADWAY EMBANKMENT:** *brown to red, moist, sandy CLAY (A-6) with trace gravel and debris*

(B) **RESIDUAL:** *red and orange, moist, medium stiff to stiff, highly plastic, silty CLAY (A-7-5) with little sand*

12+00.00

-L-/-LDET-

6/23/16
19-MAR-2018 14:45
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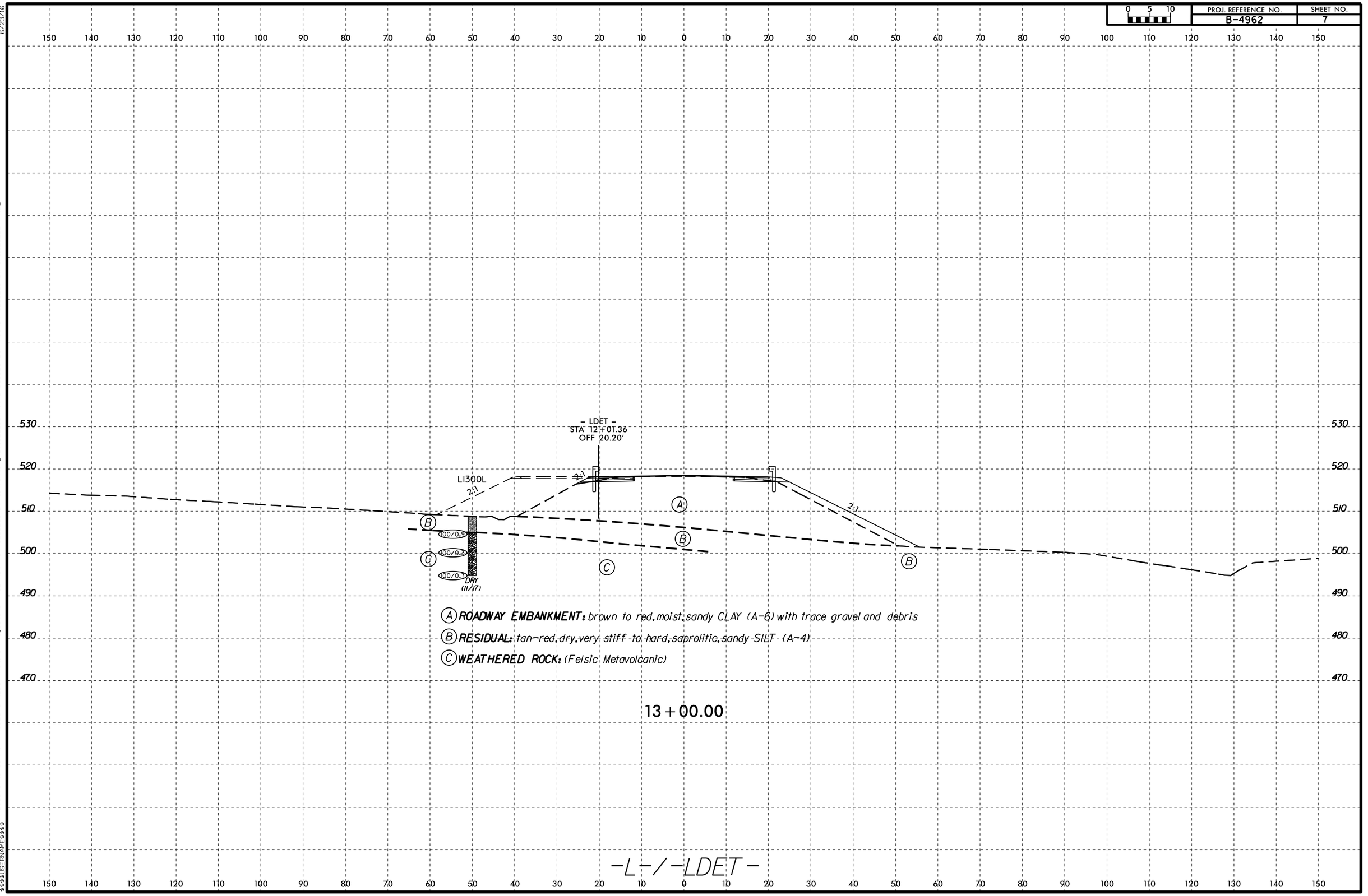

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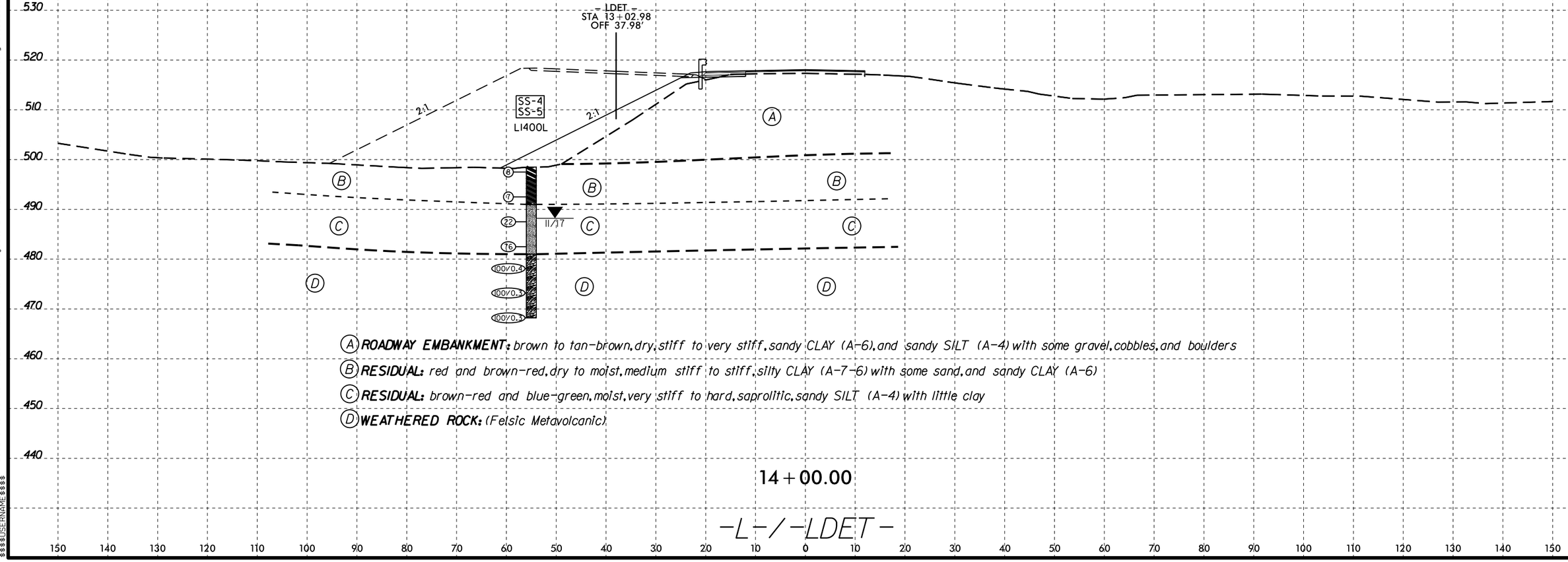
SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-4	55'LT	14+00	0.0' - 1.5'	A-7-6(12)	43	17	9.0	11.2	39.7	40.1	90	85	74	22.8	N/A
SS-5	55'LT	14+00	5.0' - 6.5'	A-6(9)	37	15	15.2	14.9	18.4	51.5	91	82	68	15.1	N/A



(A) **ROADWAY EMBANKMENT:** brown to tan-brown, dry, stiff to very stiff, sandy CLAY (A-6), and sandy SILT (A-4) with some gravel, cobbles, and boulders

(B) **RESIDUAL:** red and brown-red, dry to moist, medium stiff to stiff, silty CLAY (A-7-6) with some sand, and sandy CLAY (A-6)

(C) **RESIDUAL:** brown-red and blue-green, moist, very stiff to hard, saprolitic, sandy SILT (A-4) with little clay

(D) **WEATHERED ROCK:** (Felsic Metavolcanic)

14+00.00

-L-/-LDET-

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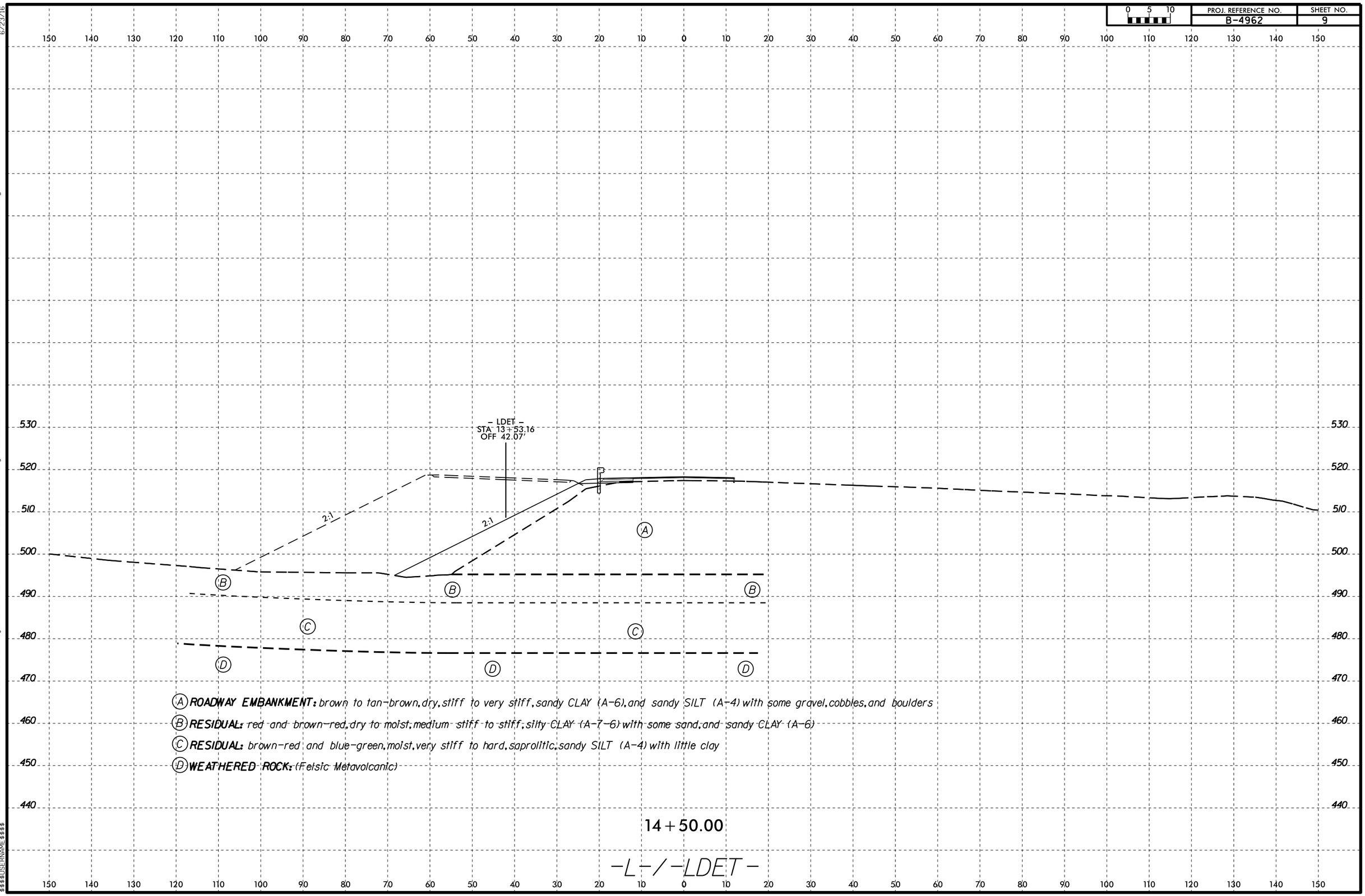
	B-4962	9



(A) **ROADWAY EMBANKMENT:** *brown to tan-brown, dry, stiff to very stiff, sandy CLAY (A-6), and sandy SILT (A-4) with some gravel, cobbles, and boulders*

(B) **RESIDUAL:** *red and brown-red, dry to moist, medium stiff to stiff, silty CLAY (A-7-6) with some sand, and sandy CLAY (A-6)*

(C) **RESIDUAL:** *brown-red and blue-green, moist, very stiff to hard, saprolitic, sandy SILT (A-4) with little clay*

(D) **WEATHERED ROCK:** *(Felsic Metavolcanic)*

14+50.00

-L-/-LDET-

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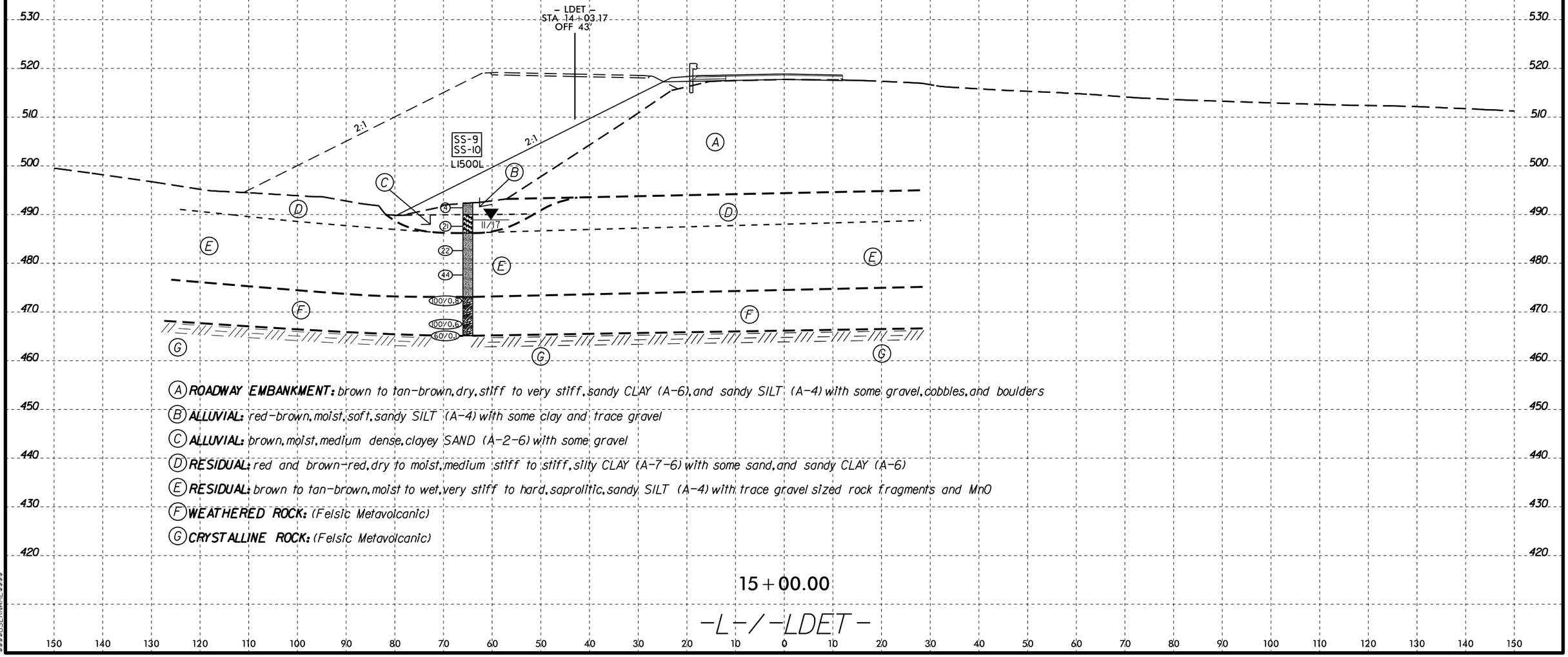
SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-9	65'LT	15+00	0.0' - 1.5'	A-4(5)	33	10	16.3	17.7	35.9	30.1	91	91	63	17.1	N/A
SS-10	65'LT	15+00	3.8' - 5.3'	A-2-6(0)	35	11	24.2	13.7	34.5	27.5	51	42	33	12.4	N/A



(A) **ROADWAY EMBANKMENT:** brown to tan-brown, dry, stiff to very stiff, sandy CLAY (A-6), and sandy SILT (A-4) with some gravel, cobbles, and boulders

(B) **ALLUVIAL:** red-brown, moist, soft, sandy SILT (A-4) with some clay and trace gravel

(C) **ALLUVIAL:** brown, moist, medium dense, clayey SAND (A-2-6) with some gravel

(D) **RESIDUAL:** red and brown-red, dry to moist, medium stiff to stiff, silty CLAY (A-7-6) with some sand, and sandy CLAY (A-6)

(E) **RESIDUAL:** brown to tan-brown, moist to wet, very stiff to hard, saprolitic, sandy SILT (A-4) with trace gravel sized rock fragments and MnO

(F) **WEATHERED ROCK:** (Felsic Metavolcanic)

(G) **CRYSTALLINE ROCK:** (Felsic Metavolcanic)

15+00.00

-L-/-LDET-

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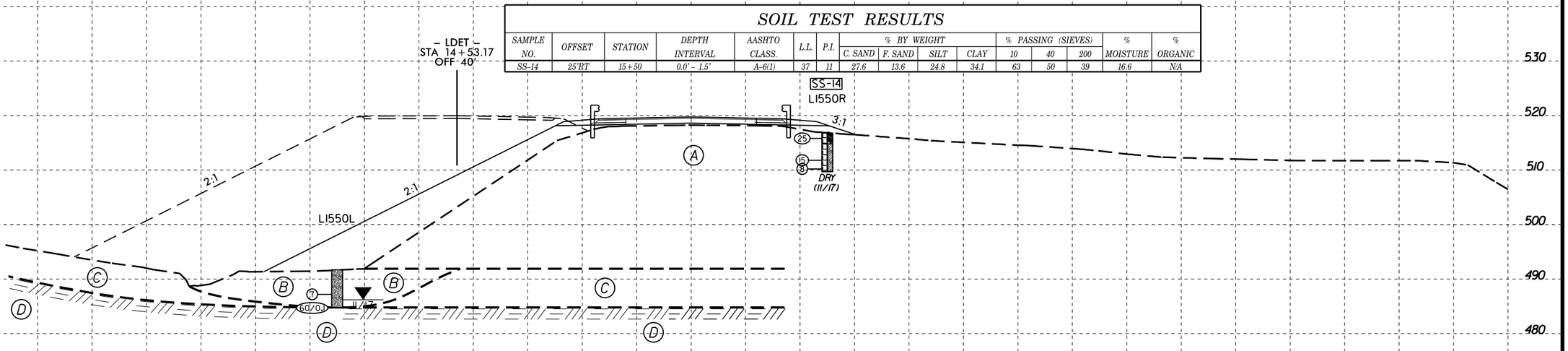
SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-14	25'RT	15+50	0.0' - 1.5'	A-6(1)	37	11	27.6	13.6	24.8	34.1	63	50	39	16.6	N/A



(A) **ROADWAY EMBANKMENT:** *brown to tan-brown, dry, stiff to very stiff, sandy CLAY (A-6), and sandy SILT (A-4) with some gravel, cobbles, and boulders*

(B) **ALLUVIAL:** *red-brown, moist, soft, sandy SILT (A-4) with some clay and trace gravel*

(C) **RESIDUAL:** *brown to tan-brown, moist to wet, very stiff to hard, saprolitic, sandy SILT (A-4) with trace gravel sized rock fragments and MnO*

(D) **CRYSTALLINE ROCK:** *(Felsic Metavolcanic)*

15+50.00

-L-/-LDET-

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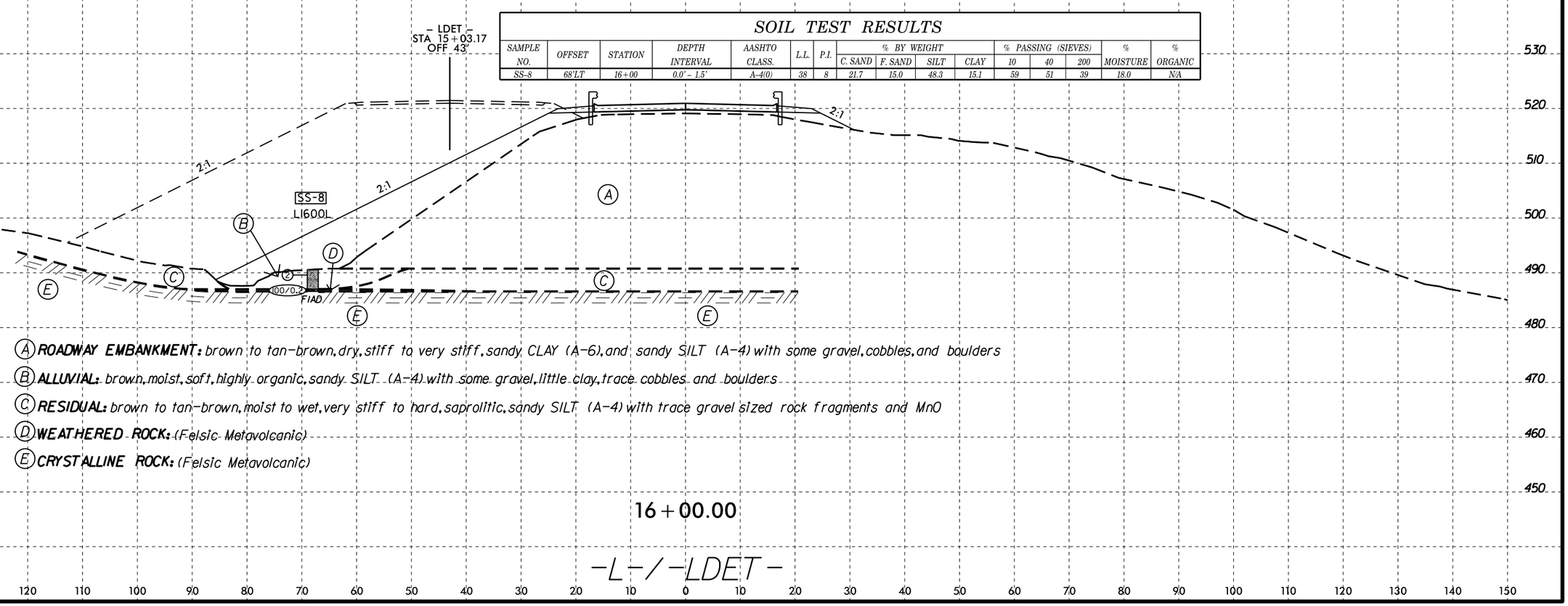
SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT C. SAND	% BY WEIGHT F. SAND	% BY WEIGHT SILT	% BY WEIGHT CLAY	% PASSING (SIEVES) 10	% PASSING (SIEVES) 40	% PASSING (SIEVES) 200	% MOISTURE	% ORGANIC
SS-8	68'LT	16+00	0.0' - 1.5'	A-4(0)	38	8	21.7	15.0	48.3	15.1	59	51	39	18.0	N/A



(A) **ROADWAY EMBANKMENT:** brown to tan-brown, dry, stiff to very stiff, sandy CLAY (A-6), and sandy SILT (A-4) with some gravel, cobbles, and boulders

(B) **ALLUVIAL:** brown, moist, soft, highly organic, sandy SILT (A-4) with some gravel, little clay, trace cobbles and boulders

(C) **RESIDUAL:** brown to tan-brown, moist to wet, very stiff to hard, saprolitic, sandy SILT (A-4) with trace gravel sized rock fragments and MnO

(D) **WEATHERED ROCK:** (Felsic Metavolcanic)

(E) **CRYSTALLINE ROCK:** (Felsic Metavolcanic)

16+00.00

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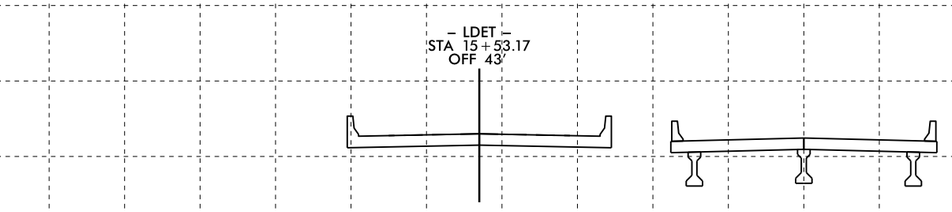

(A) **ROADWAY EMBANKMENT:** *brown to tan-brown, dry, stiff to very stiff, sandy CLAY (A-6), and sandy SILT (A-4) with some gravel, cobbles, and boulders*

(B) **ALLUVIAL:** *brown, moist, soft, highly organic, sandy SILT (A-4) with some gravel, little clay, trace cobbles and boulders*

(C) **RESIDUAL:** *brown to tan-brown, moist to wet, very stiff to hard, saprolitic, sandy SILT (A-4) with trace gravel sized rock fragments and MnO*

(D) **CRYSTALLINE ROCK:** *(Felsic Metavolcanic)*

16+50.00

-L-/-LDET-

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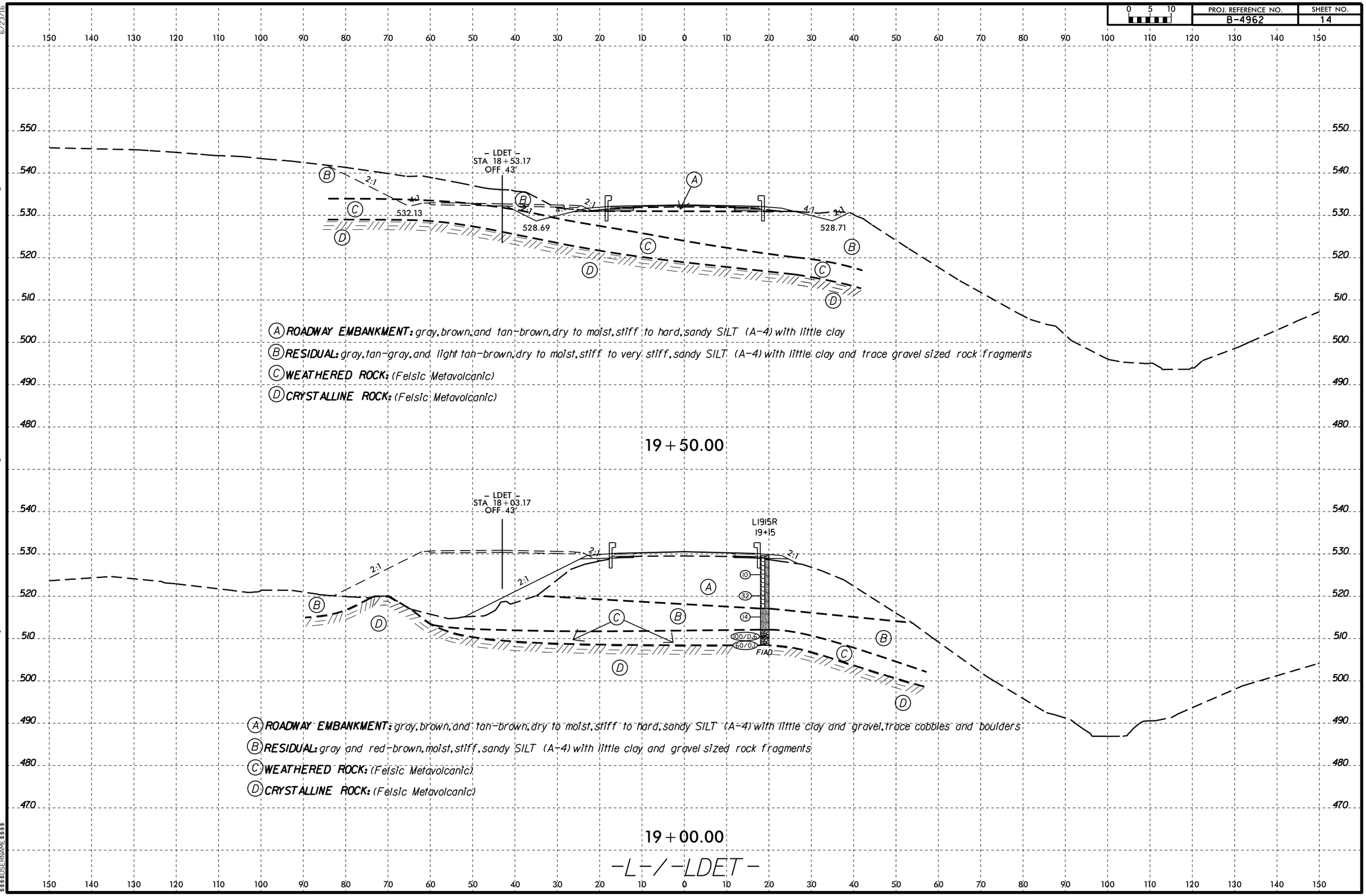

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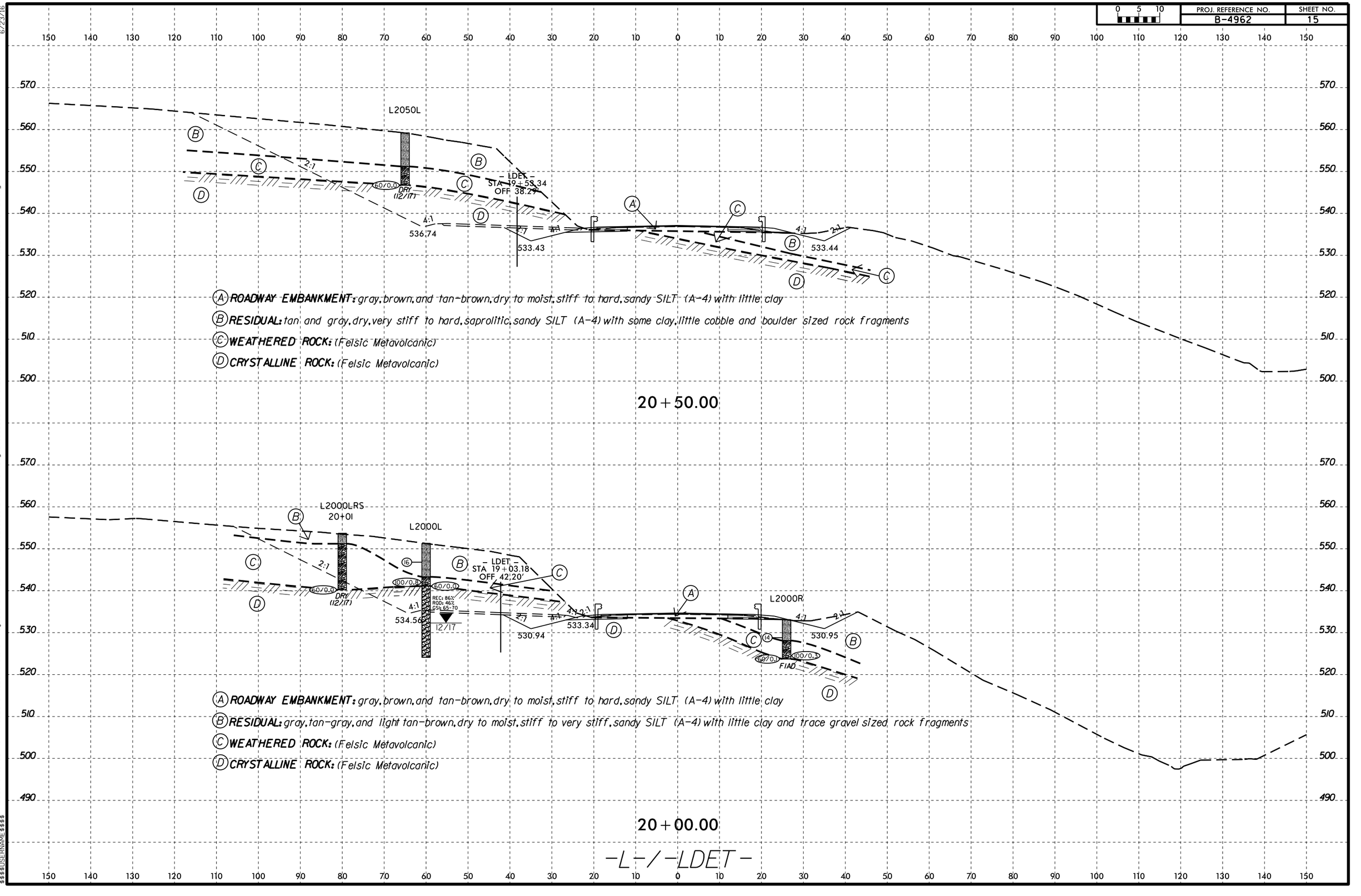

(A) **ROADWAY EMBANKMENT:** *gray, brown, and tan-brown, dry to moist, stiff to hard, sandy SILT (A-4) with little clay*

(B) **RESIDUAL:** *tan and gray, dry, very stiff to hard, saprolitic, sandy SILT (A-4) with some clay, little cobble and boulder sized rock fragments*

(C) **WEATHERED ROCK:** *(Felsic Metavolcanic)*

(D) **CRYSTALLINE ROCK:** *(Felsic Metavolcanic)*

(A) **ROADWAY EMBANKMENT:** *gray, brown, and tan-brown, dry to moist, stiff to hard, sandy SILT (A-4) with little clay*

(B) **RESIDUAL:** *gray, tan-gray, and light tan-brown, dry to moist, stiff to very stiff, sandy SILT (A-4) with little clay and trace gravel sized rock fragments*

(C) **WEATHERED ROCK:** *(Felsic Metavolcanic)*

(D) **CRYSTALLINE ROCK:** *(Felsic Metavolcanic)*

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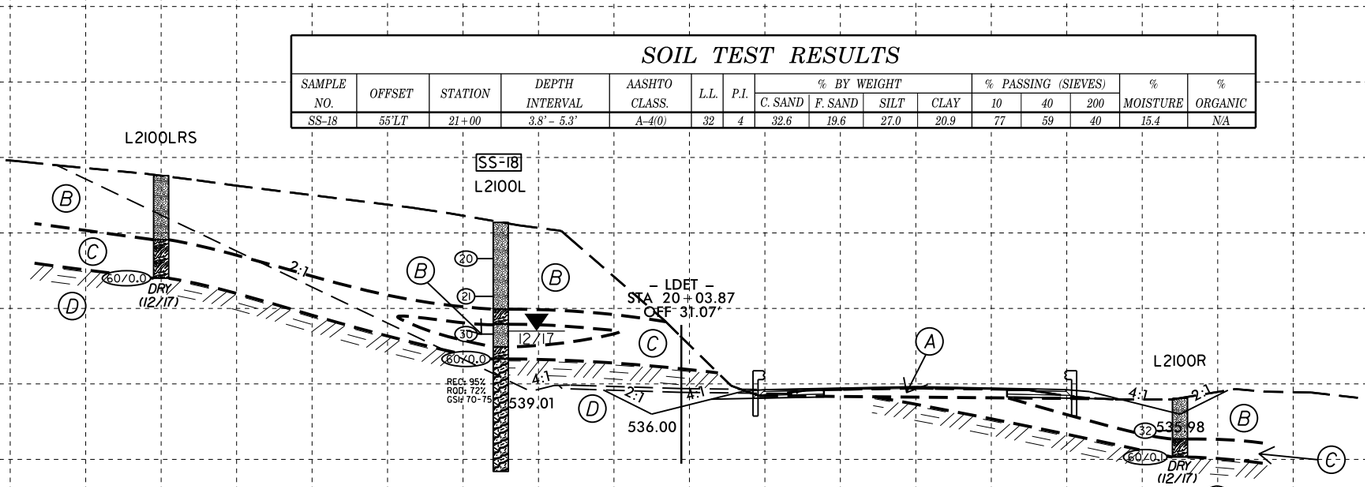
SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-18	55'LT	21+00	3.8' - 5.3'	A-4(0)	32	4	32.6	19.6	27.0	20.9	77	59	40	15.4	N/A



(A) **ROADWAY EMBANKMENT:** gray, brown, and tan-brown, dry to moist, stiff to hard, sandy SILT (A-4) with little clay

(B) **RESIDUAL:** tan and gray, dry, very stiff to hard, saprolitic, sandy SILT (A-4) with some clay

(C) **WEATHERED ROCK:** (Felsic Metavolcanic)

(D) **CRYSTALLINE ROCK:** (Felsic Metavolcanic)

21+00.00

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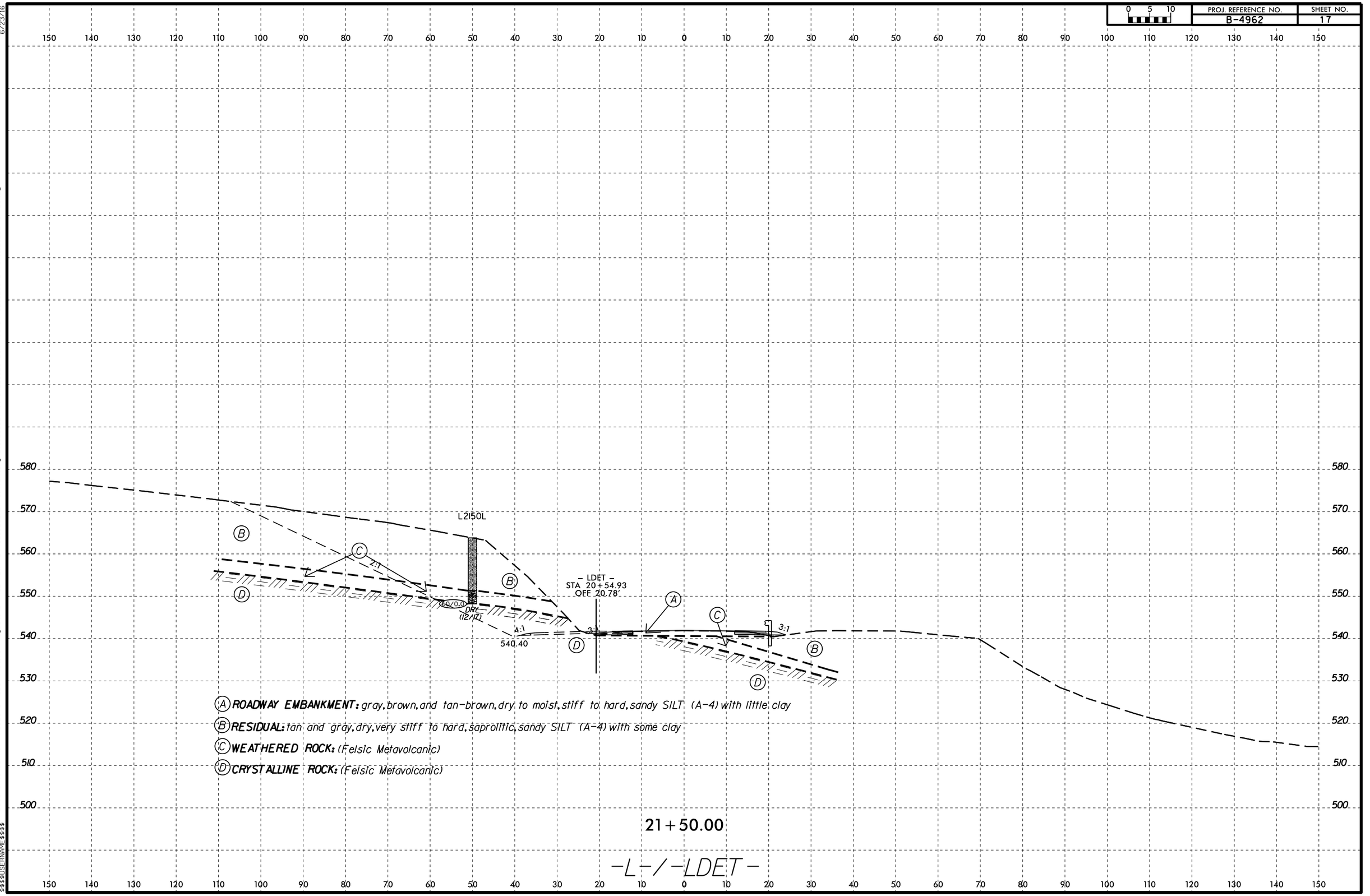

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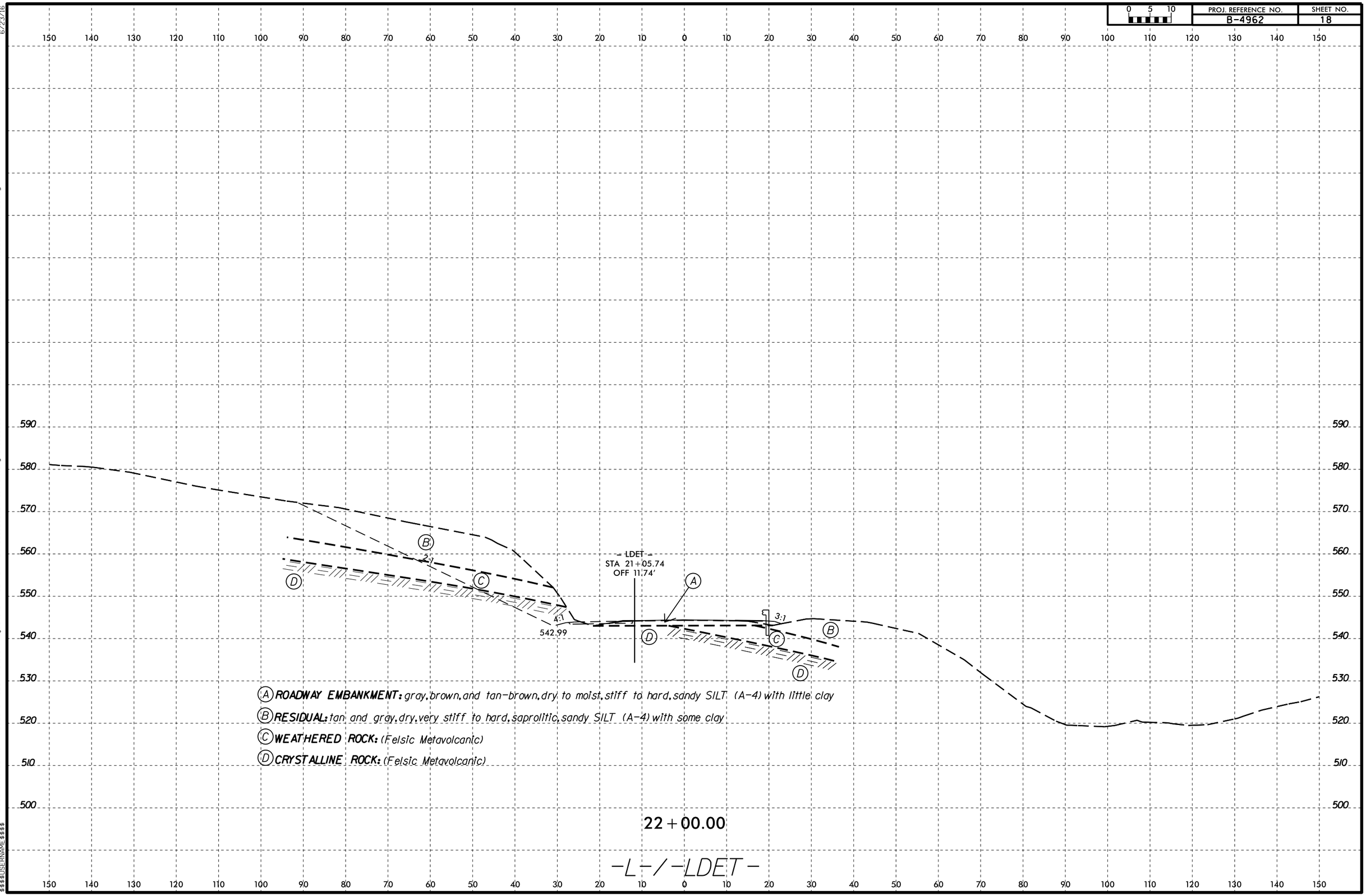

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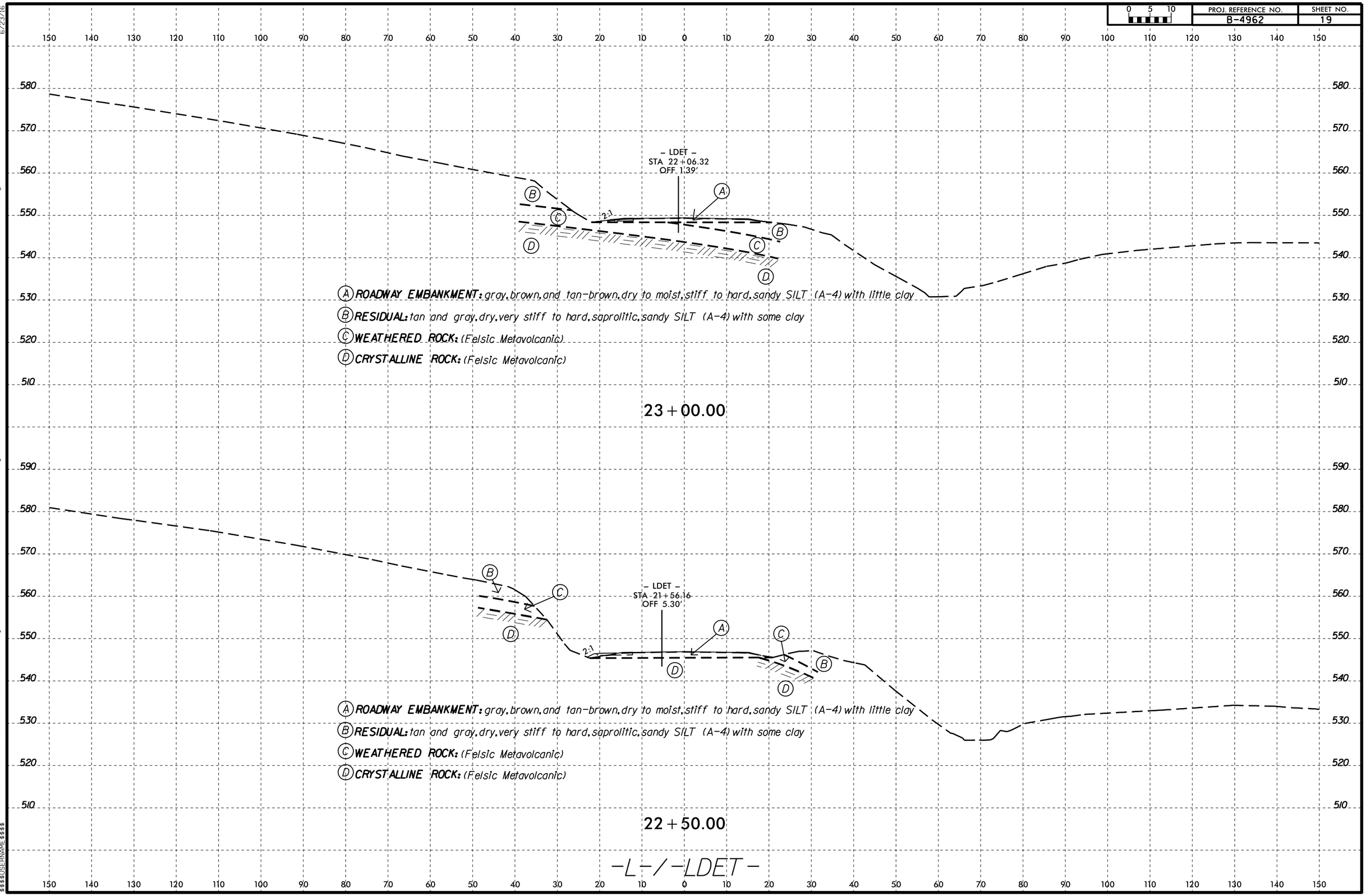

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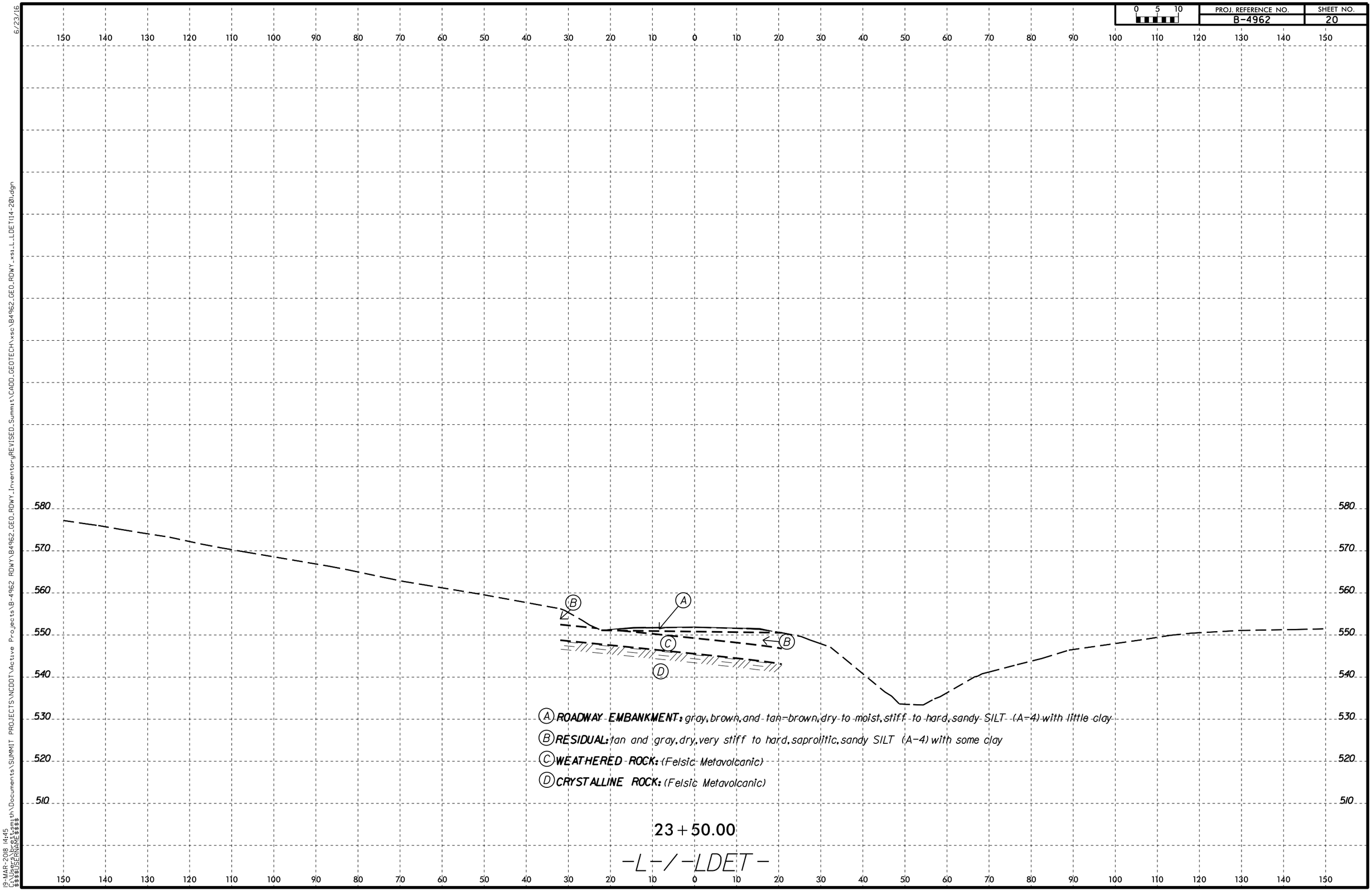

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PROJECT REFERENCE NO.	SHEET NO.
B–4962	21

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

APPENDIX A
BORE LOGS (FOR BORINGS NOT SHOWN IN GRAPHICS), CORE LOGS, & CORE PHOTOS

REFERENCE: B–4962

PROJECT: 40174

Prepared in the Office of:
SUMMIT DESIGN AND ENGINEERING SERVICES
NC FIRM LICENSE No: P-0339 and C-487
504 Meadowlands Drive
Hillsborough, NC 27278
(919) 732-3883
(919) 732-6676 (FAX)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 40174.1.1	**TIP** B-4962	**COUNTY** ORANGE	**GEOLOGIST** Shipman, M.	
SITE DESCRIPTION Replace Bridge No. 46 over Eno River on US 70 Bypass - Roadway Investigation				**GROUND WTR (ft)**
BORING NO. L1605L	**STATION** 16+05	**OFFSET** 68 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 490.5 ft	**TOTAL DEPTH** 5.8 ft	**NORTHING** 846,583	**EASTING** 1,978,972	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE SUM3123 CME-550X 95% 11/30/2017		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Gonzalez, L.	**START DATE** 11/22/17	**COMP. DATE** 11/22/17	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
495										
490										490.5 GROUND SURFACE 0.0
										ALLUVIAL brown, sandy SILT (A-4) with some gravel, little clay, and trace cobbles and boulders
485	484.7	5.8	60/0.0			60/0.0				484.7 5.8
										CRYSTALLINE ROCK (Felsic Metavolcanic) Boring Terminated with Standard Penetration Test Refusal at Elevation 484.7 ft on Crystalline Rock (Felsic Metavolcanic)

NCDOT BORE DOUBLE B4962_GEO_RDWY_GINT_SUMMIT.GPJ NC_DOT.GDT 3/19/18

GEOTECHNICAL BORING REPORT
CORE LOG

WBS 40174.1.1	**TIP** B-4962	**COUNTY** ORANGE	**GEOLOGIST** Gross, A.	
SITE DESCRIPTION Replace Bridge No. 46 over Eno River on US 70 Bypass - Roadway Investigation				**GROUND WTR (ft)**
BORING NO. L2000L	**STATION** 20+00	**OFFSET** 60 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 551.3 ft	**TOTAL DEPTH** 27.2 ft	**NORTHING** 846,303	**EASTING** 1,979,250	**24 HR.** 19.0
DRILL RIG/HAMMER EFF./DATE SUM3359 CME-450 85% 11/30/2017		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic	
DRILLER Moseley, M.G.	**START DATE** 12/04/17	**COMP. DATE** 12/05/17	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 17.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
541.07											Begin Coring @ 10.2 ft
540	541.1 540.1	10.2 11.2	1.0	*N=60/0.0* 6:59/1.0	(0.8) 80%	(0.0) 0%		(14.7) 86%	(7.8) 46%		ELEV. (ft) 541.1 DEPTH (ft) 10.2 **CRYSTALLINE ROCK** dark to light gray, very slightly weathered, hard, very close to moderately close fracture spacing, weakly foliated, Meta-Dacite GSI = 65-70
			5.0	2:01/1.0 2:37/1.0 3:15/1.0 3:42/1.0 4:44/1.0	(3.9) 78%	(1.3) 26%					
535	535.1	16.2									
			5.0	1:54/1.0 3:47/1.0 3:38/1.0 4:50/1.0 3:31/1.0	(4.1) 82%	(1.9) 38%					
530	530.1	21.2									
			5.0	3:13/1.0 4:23/1.0 4:12/1.0 3:33/1.0 3:15/1.0	(5.0) 100%	(4.0) 80%					
525	525.1	26.2									
	524.1	27.2	1.0	3:46/1.0	(0.9) 90%	(0.6) 60%					ELEV. (ft) 524.1 DEPTH (ft) 27.2 Boring Terminated at Elevation 524.1 ft in Crystalline Rock (Felsic Metavolcanic) - Topsoil 0.0 - 0.2 ft

WBS 40174.1.1	**TIP** B-4962	**COUNTY** ORANGE	**GEOLOGIST** Gross, A.	
SITE DESCRIPTION Replace Bridge No. 46 over Eno River on US 70 Bypass - Roadway Investigation				**GROUND WTR (ft)**
BORING NO. L2100L	**STATION** 21+00	**OFFSET** 55 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 561.4 ft	**TOTAL DEPTH** 33.0 ft	**NORTHING** 846,230	**EASTING** 1,979,319	**24 HR.** 14.4
DRILL RIG/HAMMER EFF./DATE SUM3359 CME-450 85% 11/30/2017		**DRILL METHOD** Core Boring	**HAMMER TYPE** Automatic	
DRILLER Moseley, M.G.	**START DATE** 12/05/17	**COMP. DATE** 12/06/17	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 14.9 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
543.32											Begin Coring @ 18.1 ft
	543.3	18.1	2.8	*N=60/0.0* 3:33/0.8 5:46/1.0 5:59/1.0	(2.7) 96%	(1.9) 68%		(14.2) 95%	(10.8) 72%		ELEV. (ft) 543.3 DEPTH (ft) 18.1 **CRYSTALLINE ROCK** gray, fresh, very hard, close to moderately close fracture spacing (some high angle), Meta-Dacite. GSI = 70-75
540	540.5	20.9									
			5.0	4:24/1.0 4:52/1.0 2:16/1.0 3:20/1.0 4:05/1.0	(4.8) 96%	(2.9) 58%					
535	535.5	25.9									
			5.0	4:51/1.0 5:45/1.0 7:20/1.0 8:07/1.0 5:16/1.0	(4.6) 92%	(3.9) 78%					
530	530.5	30.9									
	528.4	33.0	2.1	6:39/1.0 8:06/1.1	(2.1) 100%	(2.1) 100%					ELEV. (ft) 528.4 DEPTH (ft) 33.0 Boring Terminated at Elevation 528.4 ft in Crystalline Rock (Felsic Metavolcanic)

NCDOT CORE DOUBLE B4962_GEO_RDWY_GINT_SUMMIT.GPJ NC_DOT.GDT 3/19/18

SUMMIT
DESIGN AND ENGINEERING SERVICES

CORE PHOTOGRAPHS

L2000L

10.2 - 27.2 FEET

L2100L

18.1 - 33.0 FEET