STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

J. ERIC BOYETTE
SECRETARY

July 1, 2020

MEMORANDUM TO: Brenda L. Moore, P.E., CPM
State Roadway Design Engineer

ATTENTION: David Stutts, PE
Project Engineer – PEF/Program Mgt.

FROM: DS CAY DS SLL John L. Pilipchuk, L.G., P.E.
State Geotechnical Engineer
DocuSigned by: John L. Pilipchuk 52C44B94B8BE444...

STATE PROJECT: 45693.1.1 (B-5737)
COUNTY: Rockingham

DESCRIPTION: Replace Bridge No. 108 on US 311 & NC 700 over US 311, NC 14, NC 87 and NC 770

SUBJECT: Geotechnical Recommendations

The Geotechnical Engineering Unit has reviewed and presents the subsurface investigation and foundation recommendations prepared by Kleinfelder Inc. for the above referenced project.

☒ Roadway Subsurface Investigation (18) pages
☒ Geotechnical Report - Recommendations (3) pages
☐ Click here to enter text. (# Of Pages) pages

Please call John McCray at (919) 707-6890 or David Teague, PE at (919) 707-6877 if there are any questions concerning this memorandum.

Attachment

Roadway Subsurface Investigation
Geotechnical Report – Recommendations

Cc:

Jacquelyn K. Bowles. PE – PEF Coordination

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Location:
1020 BIRCH RIDGE DRIVE
RALEIGH, NC 27610

REFERENCE: B-5737

PROJECT: 36637

SEE SHEET 3 FOR PLAN SHEET LAYOUT AT TIME OF INVESTIGATION

CONTENTS

LINE	STATION	PLAN	PROFILE
-L-	17+00.00 - 25+00.00	4	N/A
-RPA-	10+00.00 - 12+54.82	4	N/A
-DET-	17+67.80 - 24+17.64	4	N/A

CROSS SECTIONS

LINE	STATION	SHEETS
-L-	18+00.00 - 23+50.00	5-8
-RPA-	10+50.00 - 12+00.00	9-10
-DET-	18+00.00 - 24+00.00	11-13

APPENDICES

APPENDIX	TITLE	SHEETS
A	LABORATORY RESULTS	14-15

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

ROADWAY SUBSURFACE INVESTIGATION

COUNTY ROCKINGHAM

PROJECT DESCRIPTION REPLACE BRIDGE NO. 108 ON US 311 & NC 700 OVER US 311, NC 14, NC 87 AND NC 770

INVENTORY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-5737	1	15

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.

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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.

PERSONNEL

C. DRISCOLL

TRIGON EXPLORATION

INVESTIGATED BY C. DRISCOLL

DRAWN BY C. DRISCOLL

CHECKED BY D. KUBINSKI

SUBMITTED BY KLEINFELDER, INC

DATE MAY 2020

Prepared in the Office of:

KLEINFELDER
Bright People. Right Solutions.

422 GALLIMORE DAIRY ROAD, SUITE B.
GREENSBORO, NC 27409
NC FIRM LICENSE NO. F-1312

NORTH CAROLINA PROFESSIONAL SEAL 046042 ENGINEER DANIEL H. KUBINSKI

DocuSigned by:
Daniel Kubinski
AB2F7FFB796A411...
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
B-5737	2

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)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL — PLASTIC LIMIT		
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-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [X] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [X] CASING [X] W/ ADVANCER
- [ ] TRICONE _____" STEEL TEETH
- [X] TRICONE 2 15/16" TUNG.-CARB.
- [ ] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [X] -N 02

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: BL-4 AT STA. 19+93.69 -L- 27' LT (1,004,300.90 N., 1,780,953.48 FT.E)
ELEVATION: 659.61 FEET

NOTES:

FIAD - FILLED IMMEDIATELY AFTER DRILLING

BRIDGE AND RETAINING WALL BORING ELEVATIONS WERE OBTAINED USING THE BENCH MARK NOTED ABOVE.

ROADWAY BORING ELEVATIONS WERE OBTAINED USING THE PROJECT TIN FILE, B5737_LS_TIN_170209 RECEIVED ON APRIL 13, 2020.

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
B–5737	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

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

DECREASING SURFACE QUALITY ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

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	GOOD	FAIR	POOR	VERY POOR
Very Rough, fresh unweathered surfaces	Rough, slightly weathered surfaces	Smooth, moderately weathered and altered surfaces	Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments	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				
10			G	H

DATE: 8-19-16

TIP PROJECT: B-5737

CONTRACT:

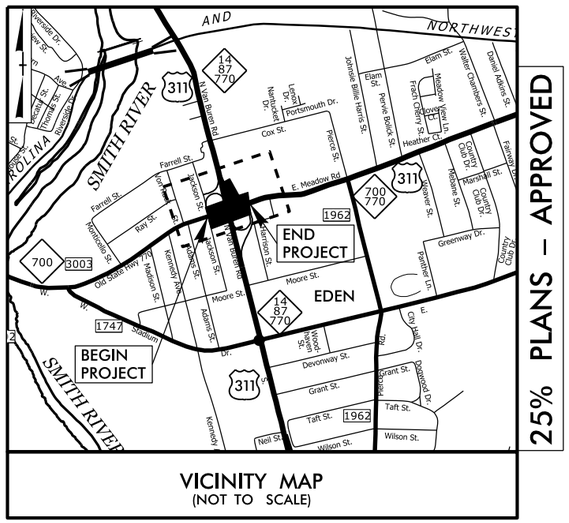
STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

ROCKINGHAM COUNTY

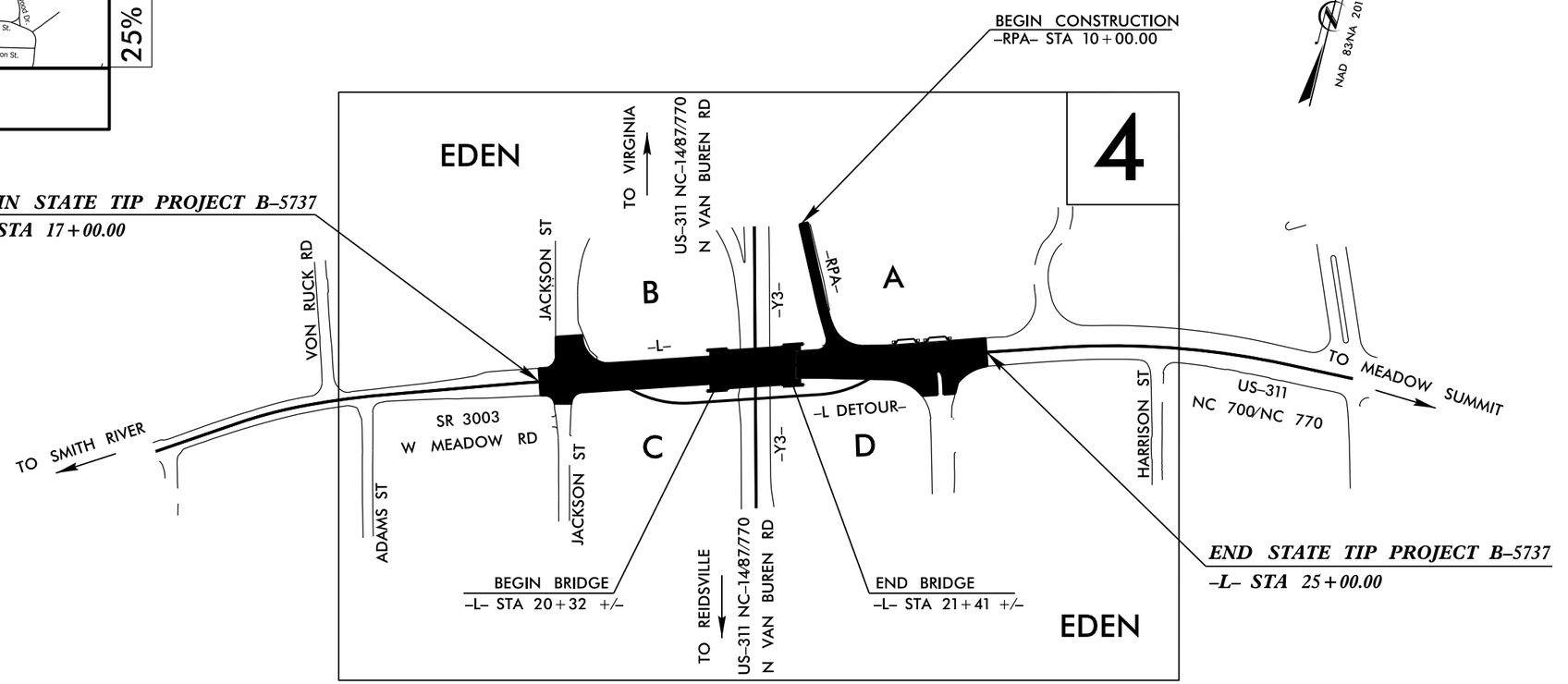
STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-5737	3	15
STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION	
45693.1.1	N/A	PE	

LOCATION: REPLACE BRIDGE NO. 108 OVER US 311 /NC 14 /NC 87 /NC 770 ON US 311 /NC 700 /NC 770, SR 3003 (W. MEADOW RD)

TYPE OF WORK: GRADING, DRAINAGE, PAVING AND STRUCTURE



VICINITY MAP
(NOT TO SCALE)



THERE IS NO CONTROL OF ACCESS ON THIS PROJECT.
CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD _____
THIS PROJECT IS WITHIN THE MUNICIPAL BOUNDARIES OF EDEN

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 2020 = 11,300
ADT 2040 = 12,100
K = 8 %
D = 55%
T = 14% *
V = 40 MPH
* TTST =12% DUAL =2%
FUNC CLASS =
MINOR–ARTERIAL
REGIONAL TIER

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT B–5753 = 0.131
LENGTH STRUCTURE TIP PROJECT B–5753 = 0.021
TOTAL LENGTH TIP PROJECT B–5753 = 0.152

Prepared for NCDOT In the Office of:
moffatt & nichol
4700 FALLS OF NEUSE ROAD, SUITE 300
RALEIGH, NORTH CAROLINA 27609
(919) 781-4626 VOICE (919) 781-4869 FAX
NC License NO.: F-0105

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE:
MAY 19, 2020

LETTING DATE:
MAY 18, 2021

TIM REID, PE
PROJECT ENGINEER

TRENT HUFFMAN, PE
PROJECT DESIGN ENGINEER

DAVID STUTTS, P.E.
NCDOT CONTACT

HYDRAULICS ENGINEER
moffatt & nichol
SIGNATURE: *P.E.*

ROADWAY DESIGN ENGINEER
moffatt & nichol
SIGNATURE: *P.E.*

STATE OF NORTH CAROLINA • DEPARTMENT OF TRANSPORTATION •

May 21, 2020

STATE PROJECT: 45693.1.1 (B-5737)
COUNTY: Rockingham
DESCRIPTION: Replace Bridge No. 108 on US 311 & NC 700 over US 311, NC 14, NC 87 and NC 770

SUBJECT: GEOTECHNICAL REPORT - INVENTORY

PROJECT DESCRIPTION

This project consists of a widening of US 311 & NC 700 (-L-) and replacement of Bridge No. 108 over US 311, NC 14, NC 87 and NC 770 (-Y3-). For Bridge No. 108, retaining walls will be constructed at each end bent. This project will also include the widening of ramp A (-RPA-).

The geotechnical investigation was conducted in April 2020. Standard Penetration Test borings were advanced with a CME-55 drill rig with an automatic hammer. Hand Augers were also performed in areas where the use of a drill rig was restricted or underground and overhead utility conflicts were observed. Representative soil samples were collected for visual classification in the field and selected samples were submitted for laboratory analysis by Kleinfelder, Inc.

The following alignments, totaling 0.32 miles, were investigated. Plan sheets and cross sections of these alignments are included in this report.

LINE	STATIONS
-L-	17+00 to 25+00
-RPA-	10+00 to 12+55
-DET-	17+68 to 24+18

PHYSIOGRAPHY AND GEOLOGY

The project is located in the Piedmont Physiographic Province. The project corridor is comprised primarily of urban properties. The general topography along the project is flat to gently sloping.

Geologically, the project area is located within the Dan River Triassic Basin. The basin consists of the Dan River Group divided into the Stoneville and Cow Branch Formations filled with sedimentary rocks as streams carried mud, silt, sand, and gravel from adjacent highlands into rift valleys. Triassic sedimentary rocks are mapped as conglomerate, sandstone, and mudstone.

Surface water is drained from the corridor by the existing roadway ditches and stormwater drainage grates with outlet culverts.

SOIL PROPERTIES

Soils encountered during this investigation are separated into two categories based on origin. They consist of Artificial Fill and Triassic residual soil.

Artificial Fill soils are present along the existing roadways on the project in landscaping areas. The artificial soils encountered generally consist of moist, loose, non plastic, silty sand (A-2-4). The plasticity index of the Artificial Fill sand tested was 3.

Triassic residual soils are derived from the weathering of underlying Triassic conglomerate, sandstone, and mudstone. The majority of the Triassic residual soils encountered consist of moist, medium stiff, slightly to moderately plastic, sandy silts (A-4) and sandy clays (A-6), wet, loose, non plastic, sands (A-1), and dry to saturated, loose to very dense, non plastic, silty sands (A-2-4) with rock fragments. The plasticity index of the Triassic residual silt and sand tested are 8 and 2, respectively.

ROCK PROPERTIES

Weathered rock was encountered along the existing roadways (-L-) at elevations ranging from 640.6 to 655.7 feet (MSL). Non-crystalline bedrock was encountered along the existing roadways (-L-) at elevations ranging from 630.5 to 654.6 feet (MSL). The weathered rock and non-crystalline bedrock consists of Triassic sandstone, and mudstone.

The weathered rock and non-crystalline bedrock of the Triassic Basin is typically considered degradable rock. Degradable rock will deteriorate when exposed to air and water once exposed in cuts or excavations.

GROUNDWATER

Groundwater was encountered at elevations ranging from 648.0 to 656.2 feet and typically ranges from 3.5 to 3.7 feet below the existing ground surface. Due to the nature of the soils and time of the groundwater readings, the groundwater encountered may be perched groundwater rather than the static groundwater table.

AREAS OF SPECIAL GEOTECHNICAL INTEREST

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

LINE	STATIONS	OFFSETS
-L-	17+00 to 19+00	LT, RT
-RPA-	10+00 to 11+25	LT, RT

2) Artificial Fill: Artificial Fill was encountered on the project at the following locations:

LINE	STATIONS	OFFSETS
-L-	19+95 to 20+50	LT
-L-	20+05 to 20+45	RT
-L-	21+30 to 21+80	LT
-L-	21+15 to 22+80	RT
-L-	23+10 to 23+70	RT

KLEINFELDER 422 Gallimore Dairy Road, Greensboro NC, 27410 p | 336.668.0093 f | 336.668.3868

3) Weathered Rock and Non-Crystalline Rock: The following areas exhibit shallow non-crystalline rock within 6 feet of the proposed grade (including at or above the proposed grades):

LINE	STATIONS	OFFSETS
-L-	21+41 to 22+75	RT
-RPA-	11+25 to 12+25	LT, RT

Prepared by,
KLEINFELDER, INC.
NC License No. F-1312

F. Christopher Driscoll, GIT
Staff Professional

Daniel H. Kubinski, PE
Staff Professional

FCD/DHK:asp

PROJECT REFERENCE NO.	SHEET NO.
B-5737	4

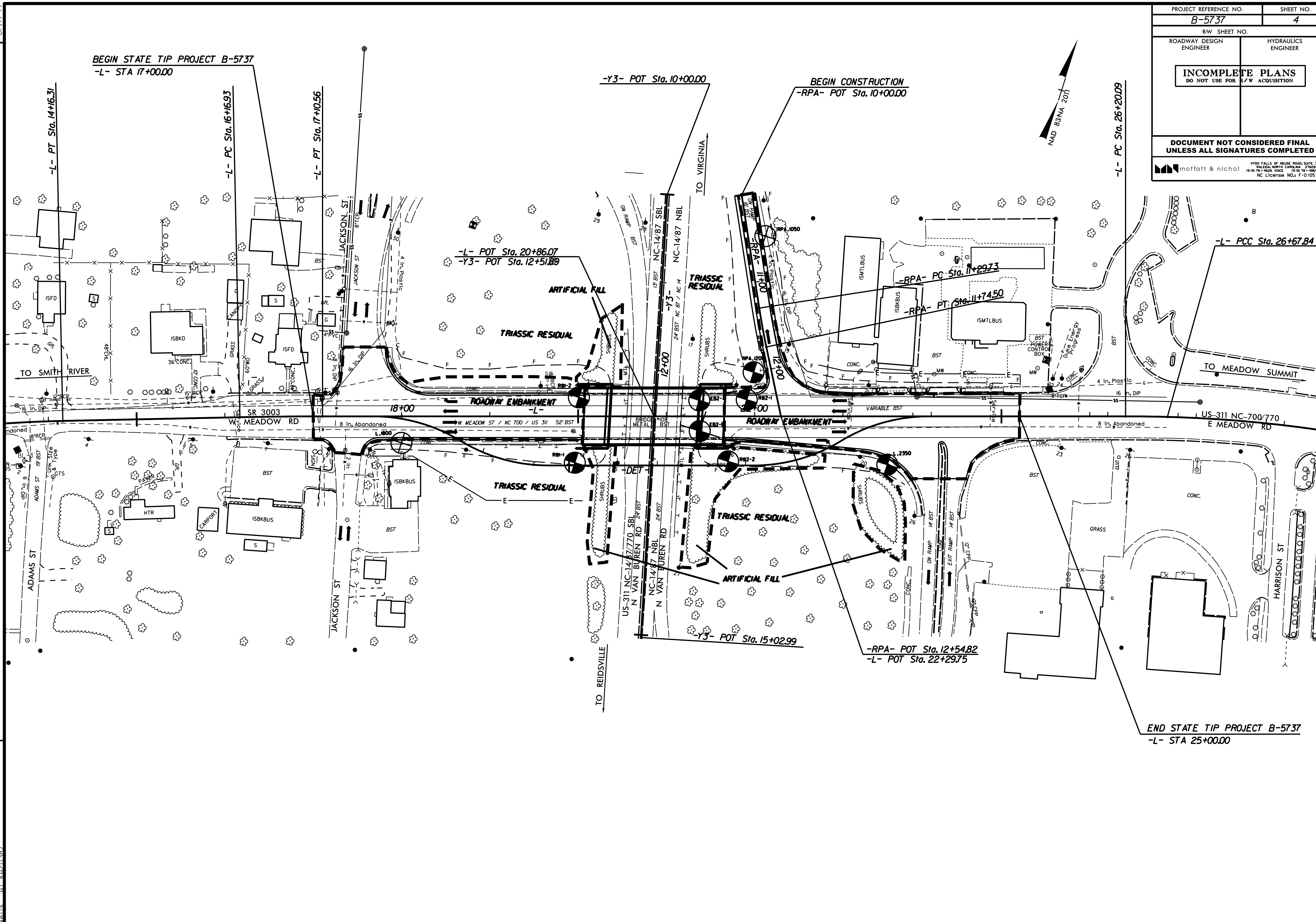
RW SHEET NO.

ROADWAY DESIGN ENGINEER | HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

moffatt & nichol
4700 FALLS OF NEUSE ROAD, SUITE 300
RALEIGH, NORTH CAROLINA 27609
NC License NO.: F-0105



REVISIONS

8/17/99

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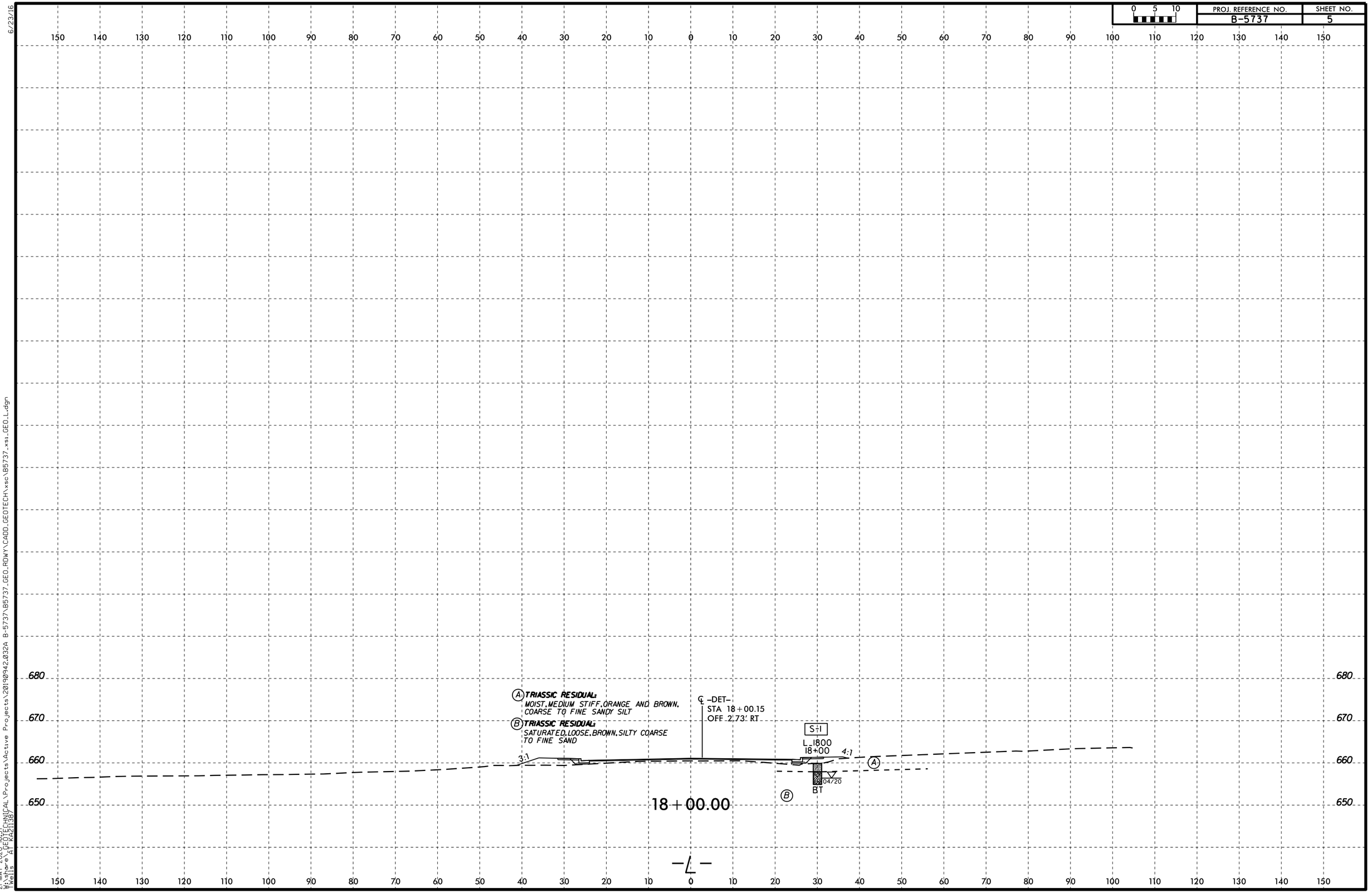
	B-5737	5



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	B-5737	6

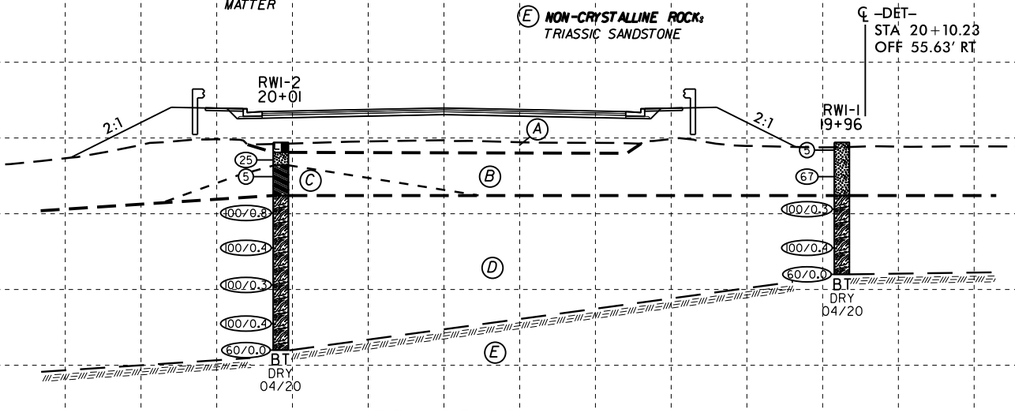
(A) **ROADWAY EMBANKMENT:**
PAVEMENT

(B) **TRIASSIC RESIDUAL:**
MOIST TO DRY, LOOSE TO VERY DENSE, TAN, BROWN, ORANGE, AND WHITE, SILTY COARSE TO FINE SAND WITH A TRACE OF ORGANIC MATTER

(C) **TRIASSIC RESIDUAL:**
MOIST, MEDIUM STIFF, GRAY AND BROWN, COARSE TO FINE SANDY CLAY

(D) **WEATHERED ROCK:**
TAN AND BROWN TRIASSIC SANDSTONE AND SILTSTONE

(E) **NON-CRYSTALLINE ROCK:**
TRIASSIC SANDSTONE



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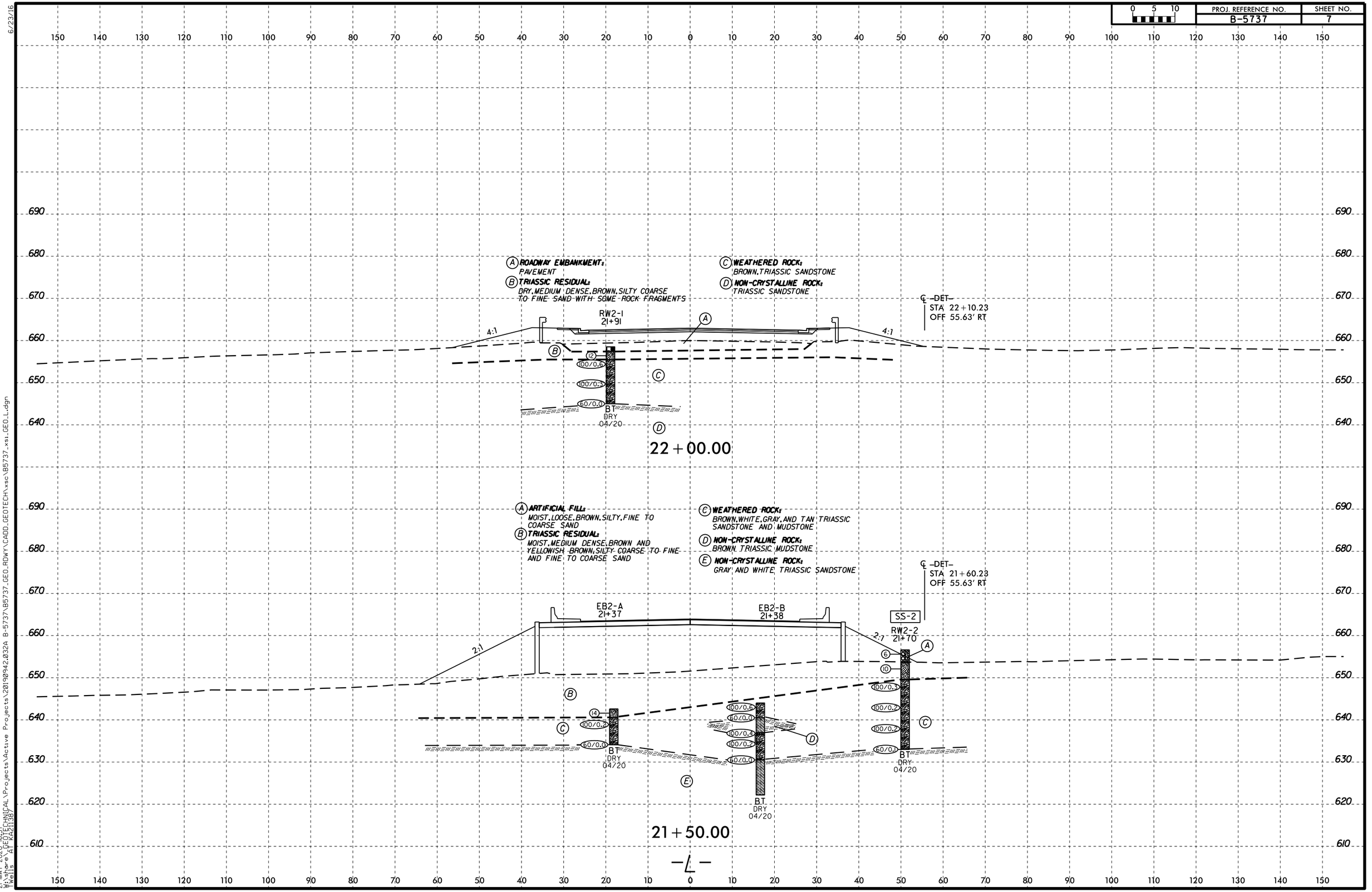
Wells AT KA21138



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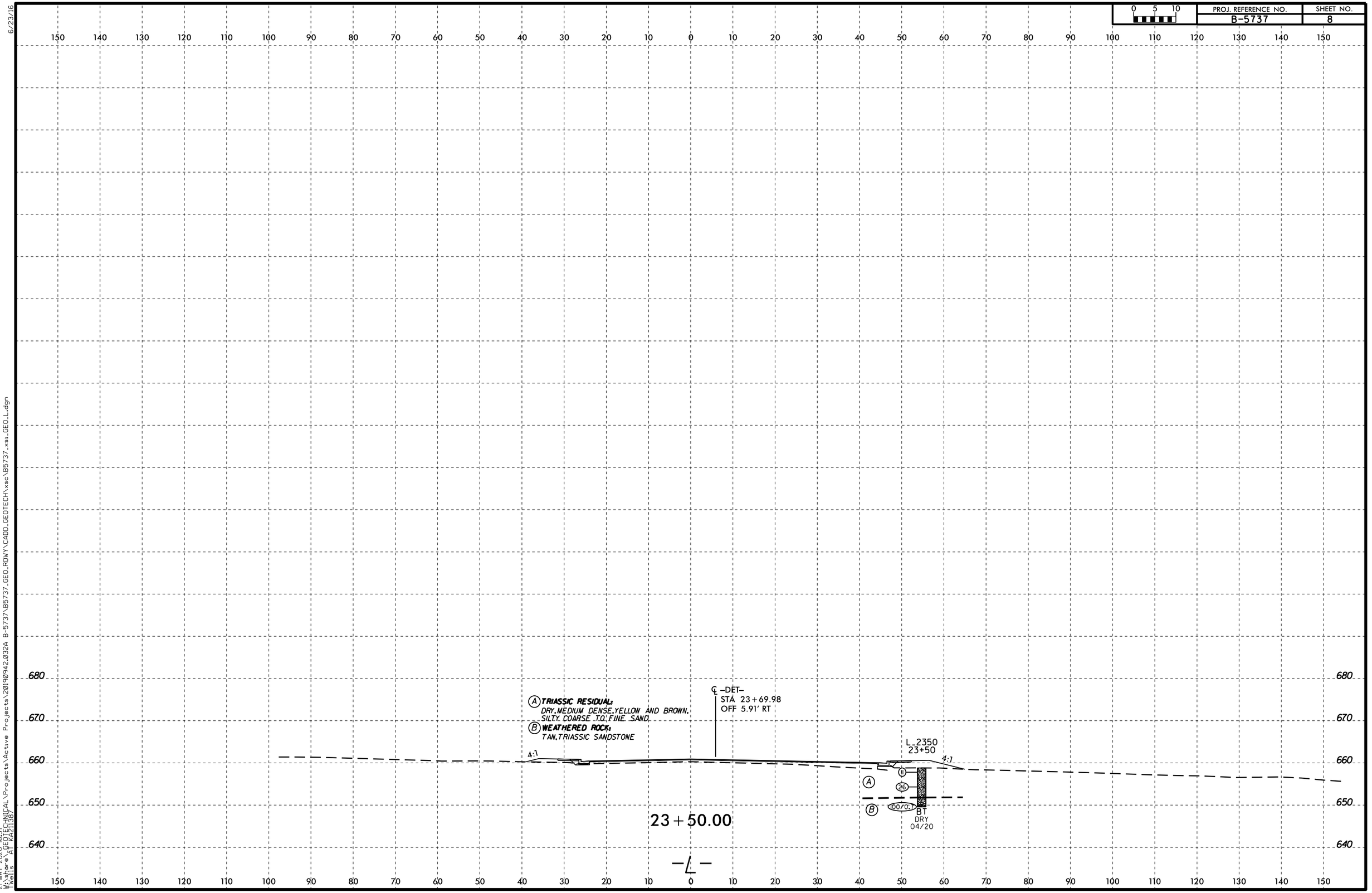

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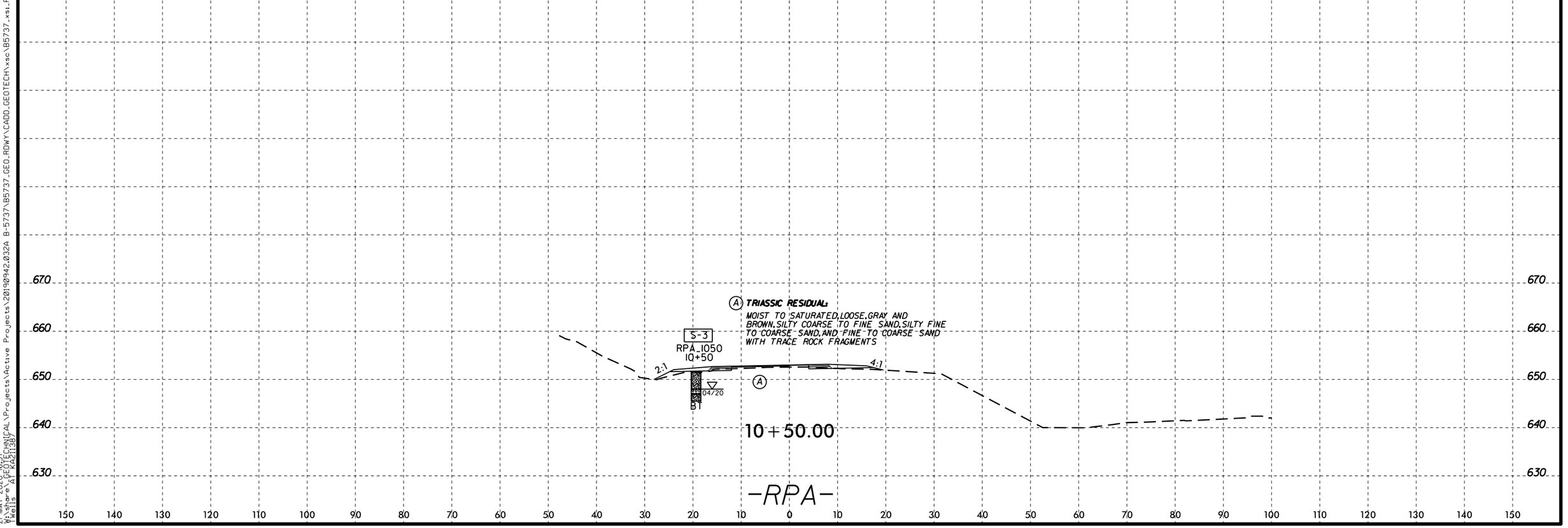

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Wells AT KA21138

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	B-5737	10

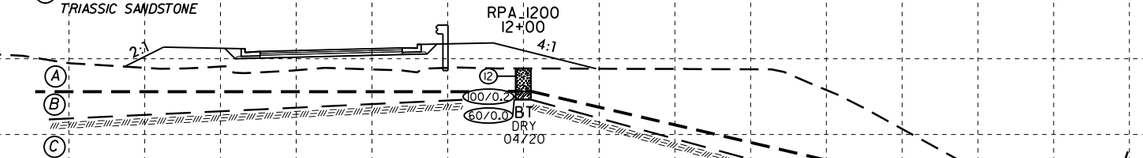
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

690
680
670
660
650
640
630

(A) TRIASSIC RESIDUAL:
DRY, MEDIUM DENSE, BROWN, SILTY COARSE TO FINE SAND WITH SOME ROCK FRAGMENTS

(B) WEATHERED ROCK:
TAN TRIASSIC SANDSTONE

(C) NON-CRYSTALLINE ROCK:
TRIASSIC SANDSTONE



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-RPA-

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Wells AT KA21138

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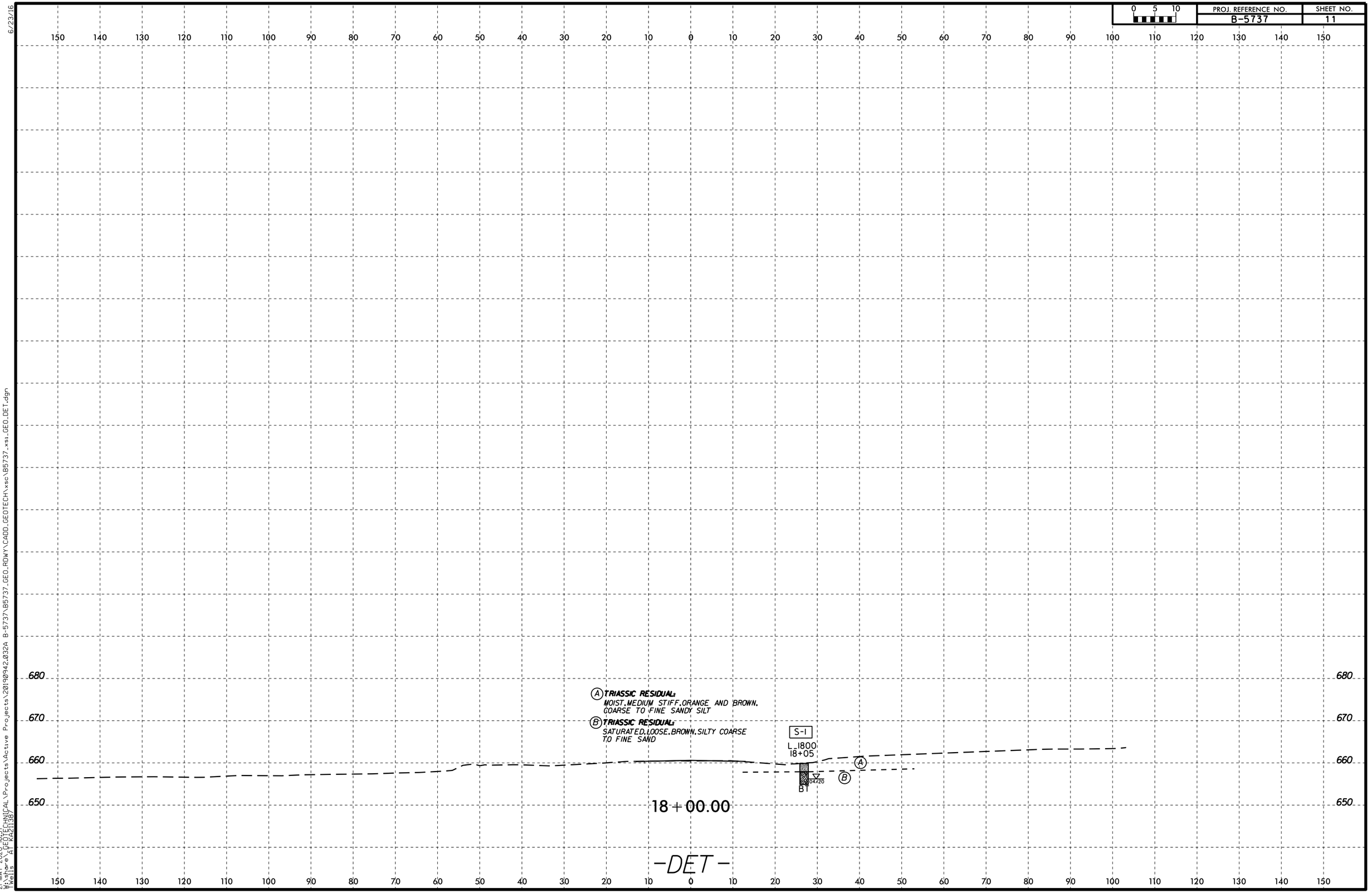

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Wells AT KA21138

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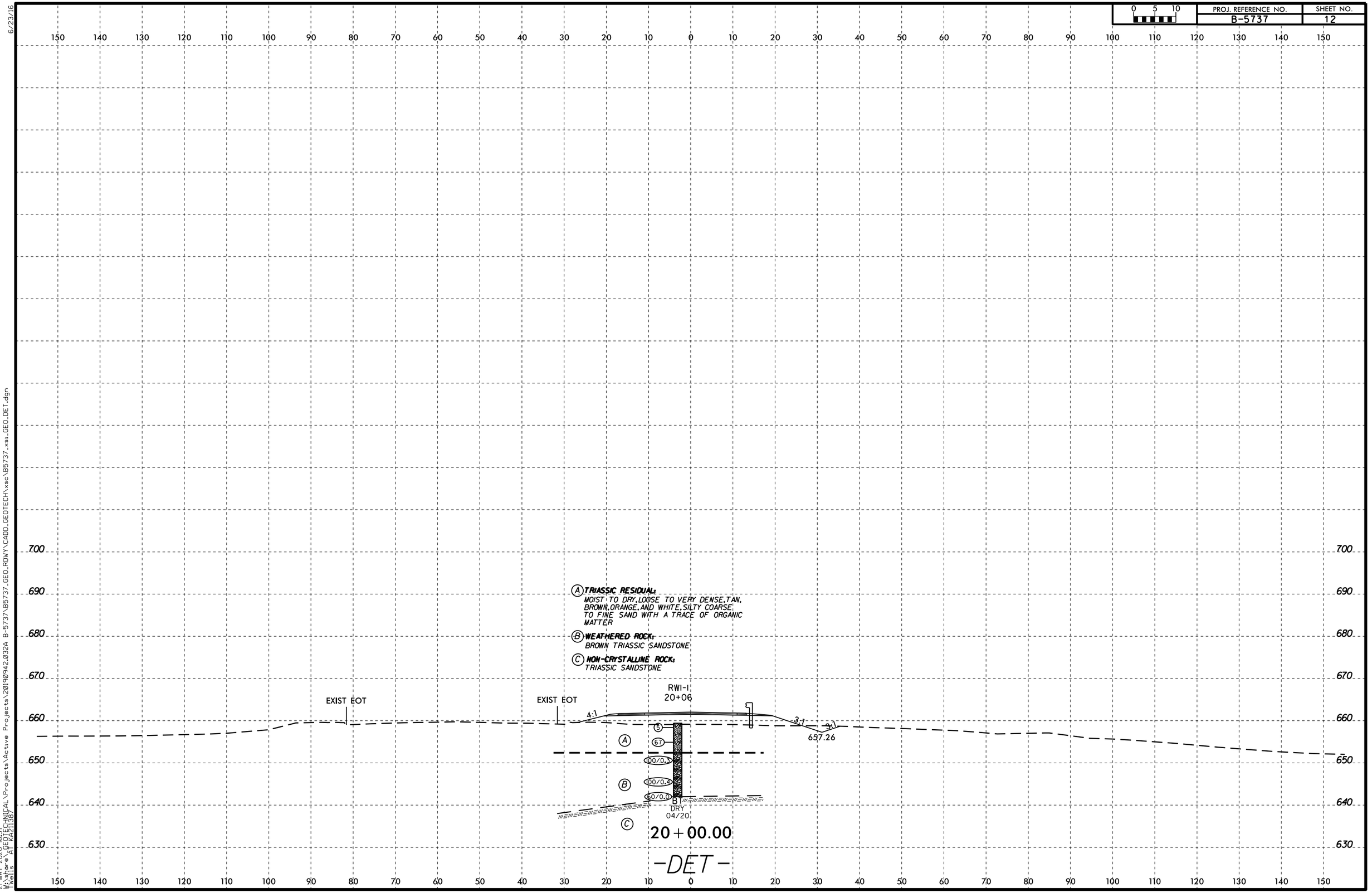
	B-5737	12



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Wells AT KA21138

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	B-5737	13

Ⓐ **ARTIFICIAL FILL:**
MOIST, LOOSE, BROWN, SILTY FINE TO COARSE SAND

Ⓑ **TRIASSIC RESIDUAL:**
MOIST, MEDIUM DENSE, BROWN AND YELLOWISH BROWN, SILTY COARSE TO FINE AND FINE TO COARSE SAND

Ⓒ **WEATHERED ROCK:**
BROWN, WHITE, GRAY, AND TAN TRIASSIC SANDSTONE

Ⓓ **NON-CRYSTALLINE ROCK:**
GRAY AND WHITE TRIASSIC SANDSTONE

SS-2
RW2-2
21+80

EXIST EOT

EXIST EOT

4:1

6:1

Ⓐ
Ⓑ
Ⓒ
Ⓓ

6
10
100/0.3
100/0.2
100/0.2
60/0.1

B
DRY
04/20

22+00.00

-DET-

700
690
680
670
660
650
640
630
620

150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

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Wells AT KA21138

PROJECT REFERENCE NO.	SHEET NO.
B–5737	14

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

APPENDIX A
LABORATORY RESULTS

REFERENCE: B–5737

PROJECT: 36637

Prepared in the Office of:

KLEINFELDER
Bright People. Right Solutions.
422 GALLIMORE DAIRY ROAD, SUITE B.
GREENSBORO, NC 27409
NC FIRM LICENSE NO. F-132

LABORATORY SUMMARY SHEET FOR SOIL SAMPLES

PROJECT NO.: 45693.1.1 (B-5737)
COUNTY: ROCKINGHAM
REPLACE BRIDGE NO. 108 ON US 311 &NC 700 OVER US 311, NC 14, NC 87 AND NC 770

								Atterberg Limits			Gradation Results							
Sample No.	Boring Number	Alignment	Station	Offset	Sample Depth (ft.)	Natural Moisture Content (%)	AASHTO Class.	L.L.	P.L.	P.I.	Retained #4 Sieve	Pass #10 Sieve	Pass #40 Sieve	Pass #200 Sieve	Coarse Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
S-1	L_1800	-L-	18+00	30' RT	0.0 - 2.0	19.5	A-4	27	19	8	0.0	82.0	71.0	52.0	35.0	36.2	11.5	17.3
SS-2	RW2-2	-L-	21+70	51' RT	0.0 - 1.5	--	A-2-4	26	23	3	10.0	54.0	49.0	33.6	55.0	28.9	6.3	9.8
S-3	RPA_1050	-RPA-	10+50	20' LT	0.0 - 3.5	21.5	A-2-4	30	28	2	12.0	54.0	45.0	31.1	58.0	32.8	4.3	4.9

May 11, 2020

MEMORANDUM TO:	John Pilipchuk, LG, PE State Geotechnical Engineer
FROM:	Thomas R. Wells, PE Kleinfelder, Inc.
STATE PROJECT:	45693.1.1 (B-5737)
COUNTY:	Rockingham
DESCRIPTION:	Replace Bridge No. 108 on US 311 & 700 over US 311, NC 14, NC 87, and NC 770

SUBJECT: Geotechnical Report – Design and Construction Recommendations

Kleinfelder, Inc. has completed the subsurface investigation for this project and submits the following recommendations. Roadway recommendation graphics will not be provided for this project.

I. SLOPE AND EMBANKMENT STABILITY

A. Slope Design
Recommend that fill slopes be constructed at a ratio of 2:1 (H:V) or flatter and cut slopes be constructed at a ratio of 3:1 (H:V) or flatter.

B. Undercut for Embankment Stabilization
A quantity of 200 cubic yards of Undercut Excavation is recommended for inclusion in the contract as a contingency item, to be used at the discretion of the Engineer.

C. Geotextile for Soil Stabilization
A quantity of 200 square yards of Geotextile for Soil Stabilization should be included in the project contract as a contingency to be used at the discretion of the Engineer.

II. SUBGRADE STABILITY

A. Subsurface Drainage – Subsurface Drain

Recommend 650 linear feet of 6-inch Perforated Subsurface Drain Pipe (Roadway Standard Drawing No. 815.02) to be included in the project contract for use in the following areas:

LINE	STATIONS	OFFSETS
-L-	17+00 to 19+00	LT, RT
-RPA-	10+00 to 11+25	LT, RT

It is recommended that 200 linear feet of 6-inch Perforated Subsurface Drain Pipe be included in the project contract as a contingency item, to be used at the discretion of the Engineer.

B. Grade Point Undercut

Recommend 100 cubic yards of Grade Point Undercut Excavation for inclusion in the contract as a contingency item to be used at the discretion of the Engineer.

C. Undercut for Subgrade Stability

It is recommended that 200 cubic yards of Undercut Excavation be included in the project contract as a contingency item, to be used at the discretion of the Engineer.

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D. Aggregate Subgrade Type 1

It is recommended that 100 cubic yards of shallow undercut be included in the project contract as a contingency, to be used at the discretion of the Engineer.

It is recommended that 200 tons of Class IV material be included in the project contract as a contingency, to be used at the discretion of the Engineer.

It is recommended that 200 square yards of geotextile for soil stabilization be included in the project contract, to be used at the discretion of the Engineer.

E. Geotextile for Soil Stabilization

It is recommended that 200 square yards of Geotextile for Soil Stabilization be included in the project contract as a contingency to be used at the discretion of the Engineer. This contingency quantity is for use with Section II C.

III. BORROW SPECIFICATIONS

A. Borrow Criteria

Common borrow for embankment construction to subgrade shall meet Piedmont and Western criteria outlined in the Standard Specifications, Article 1018-2(A).

B. Shrinkage Factor

Recommend a 20% shrinkage factor be used for earthwork calculations.

C. Select Granular Material

Select Granular Material for embankment construction on geotextile for soil stabilization shall meet the criteria outlined in Standard Specifications, Article 1016-3 Class II or III. It is recommended that 200 cubic yards of Select Granular Material be included in the project contract as a contingency to be used at the discretion of the Engineer.

IV. MISCELLANEOUS

A. Reduction of Unclassified Excavation - Clearing and Grubbing

A loss of 50 cubic yards is estimated on the project due to clearing and grubbing of cut sections.

Prepared by,
KLEINFELDER, INC.
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Daniel H. Kubinski PE
Staff Professional

FCD/DHK:asp

DocuSigned by:
Daniel Kubinski
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT
Summary of Quantities

WBS Number: 45396.1.1 County: Rockingham Project Engineer: D. Kubinski
TIP Number: B-5737 Field Office: Kleinfelder, Inc. Project Geologist:
Description: Replace Bridge No. 108 on US 311 & 700 over US 311, NC 14, NC 87, and NC 770

Pay Item No.	Pay Item/ Quantity Adjustment	Spec Book Section No. or Special Provision (SP) Reference	Report Section	Alignment	Begin Station	End Station	Quantity	Units / %
0036000000-E	Undercut Excavation	225 - Roadway Excavation	I. B	Contingency	N/A	N/A	200	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. B	Contingency	N/A	N/A	100	CY
0036000000-E	Undercut Excavation	225 - Roadway Excavation	II. C	Contingency	N/A	N/A	200	CY
						Total Quantity of Undercut Excavation =	**500**	**CY**
0195000000-E	Select Granular Material	265 - Select Granular Material	III. C	Contingency	N/A	N/A	200	CY
						Total Quantity of Select Granular Material =	**200**	**CY**
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	I. C	Contingency	N/A	N/A	200	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. D	Contingency	N/A	N/A	200	SY
0196000000-E	Geotextile for Soil Stabilization	270 - Geotextile for Soil Stabilization	II. E	Contingency	N/A	N/A	200	SY
						Total Quantity of Geotextile for Soil Stabilization =	**600**	**SY**
1099500000-E	Shallow Undercut	505 - Aggregate Subgrade	II. D	Contingency	N/A	N/A	100	CY
						Total Quantity of Shallow Undercut =	**100**	**CY**
1099700000-E	Class IV Subgrade Stabilization	505 - Aggregate Subgrade	II. D	Contingency	N/A	N/A	200	TON
						Total Quantity of Class IV Subgrade Stabilization =	**200**	**TON**
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. A	Contingency	N/A	N/A	200	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. A	-L-	17+00.00	19+00.00	400	LF
2044000000-E	6" Perforated Subdrain Pipe	815 - Subsurface Drainage	II. A	-RPA-	10+00.00	11+25.00	250	LF
						Total Quantity of 6" Perforated Subdrain Pipe =	**850**	**LF**

These Items Only Impact Earthwork Totals								
N/A	Loss Due to Clearing & Grubbing	200 - Clearing and Grubbing	IV. A	N/A	N/A	N/A	50	CY
N/A	Shrinkage Factor	235 - Embankments	III. B	N/A	N/A	N/A	20	%