

SEE SHEET 2A FOR PLAN SHEET LAYOUT  
AT TIME OF INVESTIGATION

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

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	50079.1.1	1	20

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LINE	STATION	PLAN	PROFILE	CROSS SECTION
-L-	11+28.53 - 245+23.91	4 - 8	9 - 11	12 - 16

**ROADWAY  
SUBSURFACE INVESTIGATION**

COUNTY CUMBERLAND  
PROJECT DESCRIPTION SR-2220 (TOM STARLING RD)  
FROM US-301 TO NC-87

**INVENTORY**

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

- NOTES:
1. THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
  2. BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

PERSONNEL

F. WRIGHT

J. WHITE

T. WILLIAMS

INVESTIGATED BY S&ME, INC.

DRAWN BY B. RATTI

CHECKED BY A.F. RIGGS, JR P.E.

SUBMITTED BY S&ME, INC.

DATE JAN. 2015

REFERENCE: W-5512

PROJECT: 50079.1.1

SIGNATURE	DATE
SIGNATURE	DATE

**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, <i>VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i>															
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-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7	A-1, A-2	A-3	A-4, A-5	A-6, A-7
SYMBOL															
% PASSING #10 #40 #200	50 MX 30 MX 15 MX	50 MX 25 MX	51 MN 35 MX 35 MX	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 10 MX	41 MN 11 MN	40 MX 11 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT	
MATERIAL PASSING #40 LL PI	— 6 MX	— NP	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 11 MN	40 MX 41 MN 10 MX 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	UNSATURABLE						
PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30															

CONSISTENCY OR DENSENESS			
PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )
GENERALLY GRANULAR MATERIAL (NON-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 (MM)	4	10	40	60	200	270
	4.75	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 IN. 12	75 3	2.0	0.25	0.05	0.005

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

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

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

GRADATION			
WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.			
UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE.			
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.			
ANGULARITY OF GRAINS			
THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.			
MINERALOGICAL COMPOSITION			
MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.			
COMPRESSIBILITY			
SLIGHTLY COMPRESSIBLE	LL < 31		
MODERATELY COMPRESSIBLE	LL = 31 - 50		
HIGHLY COMPRESSIBLE	LL > 50		
PERCENTAGE OF MATERIAL			
ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE 1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE 10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME 20 - 35%
HIGHLY ORGANIC	> 10%	> 20%	HIGHLY 35% AND ABOVE
GROUND WATER			
	WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING		
	STATIC WATER LEVEL AFTER 24 HOURS		
	PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA		
	SPRING OR SEEP		

MISCELLANEOUS SYMBOLS			
	ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION		DIP & DIP DIRECTION OF ROCK STRUCTURES
	SOIL SYMBOL		TEST BORING
	ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT		AUGER BORING
	INFERRED SOIL BOUNDARY		CORE BORING
	INFERRED ROCK LINE		MONITORING WELL
	ALLUVIAL SOIL BOUNDARY		PIEZOMETER INSTALLATION
	SLOPE INDICATOR INSTALLATION		CONE PENETROMETER TEST
	SOUNDING ROD		TEST BORING WITH CORE
	SPT N-VALUE		

RECOMMENDATION SYMBOLS			
	UNDERCUT EXCAVATION		UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE
	SHALLOW UNDERCUT		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	MED. - MEDIUM	VST - VANE SHEAR TEST
BT - BORING TERMINATED	MICA - MICACEOUS	WEA. - WEATHERED
CL. - CLAY	MOD. - MODERATELY	W - UNIT WEIGHT
CPT - CONE PENETRATION TEST	NP - NON PLASTIC	W <sub>d</sub> - DRY UNIT WEIGHT
CSE. - COARSE	ORG. - ORGANIC	
DMT - DILATOMETER TEST	PMT - PRESSUREMETER TEST	SAMPLE ABBREVIATIONS
DPT - DYNAMIC PENETRATION TEST	SAP. - SAPROLITIC	S - BULK
e - VOID RATIO	SD. - SAND, SANDY	SS - SPLIT SPOON
F - FINE	SL. - SILT, SILTY	ST - SHELBY TUBE
FOSS. - FOSSILIFEROUS	SLI. - SLIGHTLY	RS - ROCK
FRAC. - FRACTURED, FRACTURES	TCR - TRICONE REFUSAL	RT - RECOMPACTED TRIAXIAL
FRAGS. - FRAGMENTS	w - MOISTURE CONTENT	CBR - CALIFORNIA BEARING RATIO
HI. - HIGHLY	V - VERY	

EQUIPMENT USED ON SUBJECT PROJECT		
DRILL UNITS:	ADVANCING TOOLS:	HAMMER TYPE:
<input type="checkbox"/> CME-45C	<input type="checkbox"/> CLAY BITS	<input checked="" type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL
<input type="checkbox"/> CME-55	<input type="checkbox"/> 6" CONTINUOUS FLIGHT AUGER	
<input type="checkbox"/> CME-550	<input type="checkbox"/> 8" HOLLOW AUGERS	CORE SIZE:
<input type="checkbox"/> VANE SHEAR TEST	<input type="checkbox"/> HARD FACED FINGER BITS	<input type="checkbox"/> -B <input type="checkbox"/> -H
<input type="checkbox"/> PORTABLE HOIST	<input type="checkbox"/> TUNG-CARBIDE INSERTS	<input type="checkbox"/> -N
<input checked="" type="checkbox"/> DIEDRICH D-50	<input type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER	HAND TOOLS:
	<input type="checkbox"/> TRICONE * STEEL TEETH	<input type="checkbox"/> POST HOLE DIGGER
	<input type="checkbox"/> TRICONE * TUNG-CARB.	<input checked="" type="checkbox"/> HAND AUGER
	<input type="checkbox"/> CORE BIT	<input type="checkbox"/> SOUNDING ROD
	<input checked="" type="checkbox"/> 3-1/4" H.S.A.	<input type="checkbox"/> VANE SHEAR TEST
		<input checked="" type="checkbox"/> 1/2" STEEL ROD

ROCK DESCRIPTION	
HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED, AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL. THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:	
WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.
WEATHERING	
FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V 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. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i>
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. <i>IF TESTED, WOULD YIELD SPT N VALUES &gt; 100 BPF</i>
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. <i>IF TESTED, WOULD YIELD SPT N VALUES &lt; 100 BPF</i>
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 GROUDED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROUDED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGER NAIL.

FRACTURE SPACING		BEDDING	
TERM	SPACING	TERM	THICKNESS
VERY WIDE	MORE THAN 10 FEET	VERY THICKLY BEDDED	4 FEET
WIDE	3 TO 10 FEET	THICKLY BEDDED	1.5 - 4 FEET
MODERATELY CLOSE	1 TO 3 FEET	THINLY BEDDED	0.16 - 1.5 FEET
CLOSE	0.16 TO 1 FOOT	VERY THINLY BEDDED	0.03 - 0.16 FEET
VERY CLOSE	LESS THAN 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET
		THINLY LAMINATED	< 0.008 FEET

INDURATION	
FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.	
FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS	
ALLUVIUM (ALLUV.)	SOILS THAT HAVE BEEN TRANSPORTED BY WATER.
AQUIFER	A WATER BEARING FORMATION OR STRATA.
ARENACEOUS	APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.
ARGILLACEOUS	APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC.
ARTESIAN	GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.
CALCAREOUS (CALC.)	SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.
COLLUVIUM	ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.
CORE RECOVERY (REC.)	TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.
DIKE	A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.
DIP	THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.
DIP DIRECTION (DIP AZIMUTH)	THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.
FAULT	A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.
FISSILE	A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.
FLOAT	ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND 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 (ROD)	A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.
SAPROLITE (SAP.)	RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.
SILL	AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.
SLICKENSIDE	POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.
STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)	NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.
STRATA CORE RECOVERY (SREC.)	TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.
STRATA ROCK QUALITY DESIGNATION (SROD)	A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.
TOPSOIL (TS)	SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: BM2 RAIL ROAD SPIKE IN BASE OF 15' PINE	
STATION 66+60 93' LEFT -BL-	ELEVATION: 96.68 FEET
N 438309 E 2032308	
NOTES:	
FIAD - FILLED IN AFTER DRILLING	

DATE January 19, 2015

TO: Parsons Transportation Group  
5540 Centerview Drive  
Suite 217  
Raleigh, North Carolina 27606

ATTENTION: Mr. David L. Wilver, P.E.

FROM: S&ME, Inc.  
3201 Spring Forest Road  
Raleigh, North Carolina 27616

STATE PROJECT: 50079.1.1  
F. A. PROJECT: N/A  
TIP NUMBER: W-5512  
COUNTY: Cumberland  
DESCRIPTION: SR 2220 (Tom Starling Road ) From US 301 to NC 87  
SUBJECT: Roadway Subsurface Investigation – Inventory Report

**Project Description**

S&ME, Inc. has completed the authorized roadway inventory report for the above referenced project. This report was performed in accordance with our Subconsultant Professional Services Agreement between Parsons Transportation Group, Inc. and S&ME, Inc. dated June 15, 2014 and the terms and conditions stated within.

The project is located about 3 miles south of Fayetteville, North Carolina in Cumberland County. The project consists of approximately 3.5 miles of widening, resurfacing and realigning portions of the existing roadway along SR 2220 (Tom Starling Road) from US 311 to NC 87. The typical roadway section will consist of two lanes with added turn lanes and 8 to 11 foot wide shoulders with guardrails as needed.

A subsurface investigation was conducted by S&ME between October 27, 2014 and October 28, 2014 by performing 12 soil test borings. Drilling consisted of advancing 3-1/4 inch diameter hollow stem augers with standard penetration testing utilizing a Diedrich D-50 drill rig mounted on a track rig equipped with an automatic hammer. The borings were advanced to depths of 10 feet (elevations 81.6 to 91.1 feet) at ground surface elevations ranging from about 91.6 to 101.1 feet.

Additionally the subsurface soils were probed with a 4 foot long, 1/2 inch diameter, steel, T-handled, probe rod to help identify soft/loose soils. A hand auger bucket was also used to obtain near surface soil samples for visual classification at soil test boring locations.

Representative split-spoon and bulk soil samples were collected for visual classification and selected soil samples were submitted for laboratory analysis. Laboratory testing was performed in accordance with the AASHTO Soil Classification System.

The following alignment totaling 3.46 miles was investigated. Subsurface profiles and cross sections of the alignment are included in this report.

<u>Line</u>	<u>Station</u>
-L-	11+28.53 to 245+23.91

**Areas of Special Geotechnical Interest**

1. Loose Soils: The following area contains relatively loose non-cohesive soils (N-values less than 4) which may impact subgrade construction and may require stabilization.

<u>Line</u>	<u>Station</u>
-L-	143+50 to 148+00

2. Ground Water: The following interval was found to exhibit a high water table, seasonal high ground water or the potential for ground water related construction problems :

<u>Line</u>	<u>Station</u>
-L-	141+50 to 150+00

**Physiography and Geology**

The project site is located within the Coastal Plain physiographic and geologic province of North Carolina. The Coastal Plain geologic region has been formed during past transgressive and regressive movements of the ocean into and out of North Carolina. As such, the Coastal Plain province is characterized by subdued topographic features and flat, low lying terrain.

Based on the 1985 Geologic Map of North Carolina, the primary geologic formation at this location is the Cape Fear Formation. The Cape Fear Formation consists of gray, sandy mudstone and blocky clay. The bedding of soils within the Cape Fear formation can be described as laterally continuous with some faint cross bedding. The Middendorf Formation is mapped nearby and lies above the Cape Fear Formation. The Middendorf Formation typically consists of sands, poorly indurated sandstone, and thin beds of sandy mudstone and clay. The lateral continuity of bedding within the Middendorf Formation is poor and cross bedding is common. The near surface soils at this site, within the boring termination depths, appear to be more recent Undifferentiated Coastal Plain sands eroded from the adjacent Middendorf Formation.

**Soil Properties**

Soils present on this project include roadway embankment fill and Undifferentiated Coastal Plain deposits and soils of the Middendorf and Cape Fear Formations.

Roadway embankment fill materials were not encountered in the soil test borings performed for this investigation.

Undifferentiated Coastal Plain deposits were present at the ground surface in all soil test borings B-1 through B-12. The Undifferentiated Coastal Plain deposits consist of very loose to medium dense white, tan and gray to dark gray and black silty to clayey fine to coarse sand (A-2-4, A-2-7 and A-1-b) with trace amounts of organic matter. The organic content of the soil samples tested were less than 3%. The clayey sands (A-2-7) are highly plastic with a plastic index (P.I.) of 30. These soils appear to be moist to saturated.

The Cape Fear Formation was encountered in boring B-10 at depth of about 8 feet (elevation 83.8 feet) beneath the ground surface. These soils consist of highly plastic hard gray fine sandy silty clay (A-7-6). The plastic index of the sampled clay was 30. These clays appear to be moist.

**Groundwater**

Groundwater was measured in borings B-8, B-9, B-10, and B-11 at depths of 3.9 to 6.5 feet (elevations 86.4 to 88.9 feet) beneath the ground surface at completion of drilling. Stabilized water levels measured in open bore holes after 24 hours from completion of drilling ranged from 3.5 to 5.8 feet (elevations 86.8 to 88.1 feet) beneath the ground surface. Soil test boring B-8 was backfilled at completion of drilling and the remaining borings caved at depths of 4.3 to 6.3 feet beneath the ground surface. Based on these measurements and the depths at which saturated sands were encountered in the borings, groundwater is anticipated to be present within 3.5 to 6.3 feet beneath existing grades. The depth of water beneath the ground surface will fluctuate with seasonal precipitation and may occur at higher elevations at other times of the year. Perched ground water conditions may exist during the typically wetter months above less permeable clayey soils.

**APPENDIX A**

The following bulk samples were obtained to perform laboratory testing to determine the engineering properties of the on-site soils:

<u>SAMPLE</u>	<u>LINE</u>	<u>STATION</u>	<u>DEPTH</u>	<u>TEST PERFORMED</u>
S-1	-L-	39+30 5' RT	1.0'-5.0'	Standard Proctor and CBR
S-2	-L-	133+80 10' LT	1.0'-5.0'	Standard Proctor and CBR

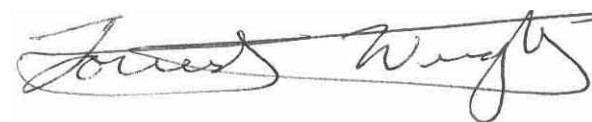
**QUALIFICATIONS OF REPORT**

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. Any wetland, environmental, or contaminant assessment efforts are beyond the scope of this geotechnical exploration; and therefore, those issues are not addressed in this report. The conclusions and findings contained in this report were based on the applicable standards of our profession at the time this report was prepared. No other warranty, express or implied, is made.

Conclusions and findings submitted in this report are based, in part, upon the data obtained from the geotechnical exploration. The nature and extent of variations between and outside of the SPT borings may not become evident until construction. If variations appear evident, then it will be necessary to re-evaluate the recommendations of this report. In the event that any changes in the grades, nature, design, or location of the proposed development are planned, the conclusions and findings contained in this report should be reviewed and modified or confirmed in writing.

S&ME appreciates the opportunity to be your geotechnical consultant on this project. If you have any questions or need additional information in regard to this report, please contact us.

Very truly yours,



Forrest E. Wright, EIT  
Staff Professional



Abner F. Riggs, Jr., P.E.  
Senior Geotechnical Engineer  
N.C. Registration No. 14155

8/17/99

REVISIONS

17-JAN-2015 17:21  
D:\PROJECTS\2014\1305-14-979\W5512\_GEO\_RDWY\TOM\_STARLING\CADD\GEO\TECH\Site&Sub\W-5512\_Rdy\_PSH\_04.DGN  
PLOT AT 11:25:00

**-L-**  
 PI Sta 34+10.96  
 $\Delta = 23^\circ 27' 35.8''$  (RT)  
 $D = 4' 46' 28.7''$   
 $L = 491.34'$   
 $T = 249.16'$   
 $R = 1200.00'$   
 $R.D. = 320'$   
 $SE = 0.08$

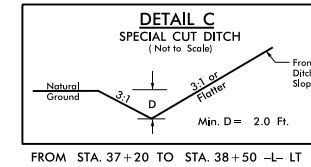
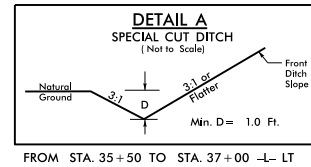
**-DRIVE 1-**  
 PI Sta 10+64.07  
 $\Delta = 32^\circ 12' 21.2''$  (LT)  
 $D = 114' 35' 29.6''$   
 $L = 28.10'$   
 $T = 14.43'$   
 $R = 50.00'$

**-DRIVE 2-**  
 PI Sta 10+33.95  
 $\Delta = 6^\circ 56' 10.0''$  (LT)  
 $D = 114' 35' 29.6''$   
 $L = 6.05'$   
 $T = 3.03'$   
 $R = 50.00'$

**-DRIVE 3-**  
 PI Sta 10+34.17  
 $\Delta = 23^\circ 33' 47.7''$  (LT)  
 $D = 114' 35' 29.6''$   
 $L = 20.56'$   
 $T = 10.43'$   
 $R = 50.00'$

**PARSONS**  
 3540 CENTER DR., SUITE 301  
 RALEIGH, NORTH CAROLINA 27606  
 NC LICENSE NO. P1284  
 FOR NORTH CAROLINA DEPT. OF TRANSPORTATION

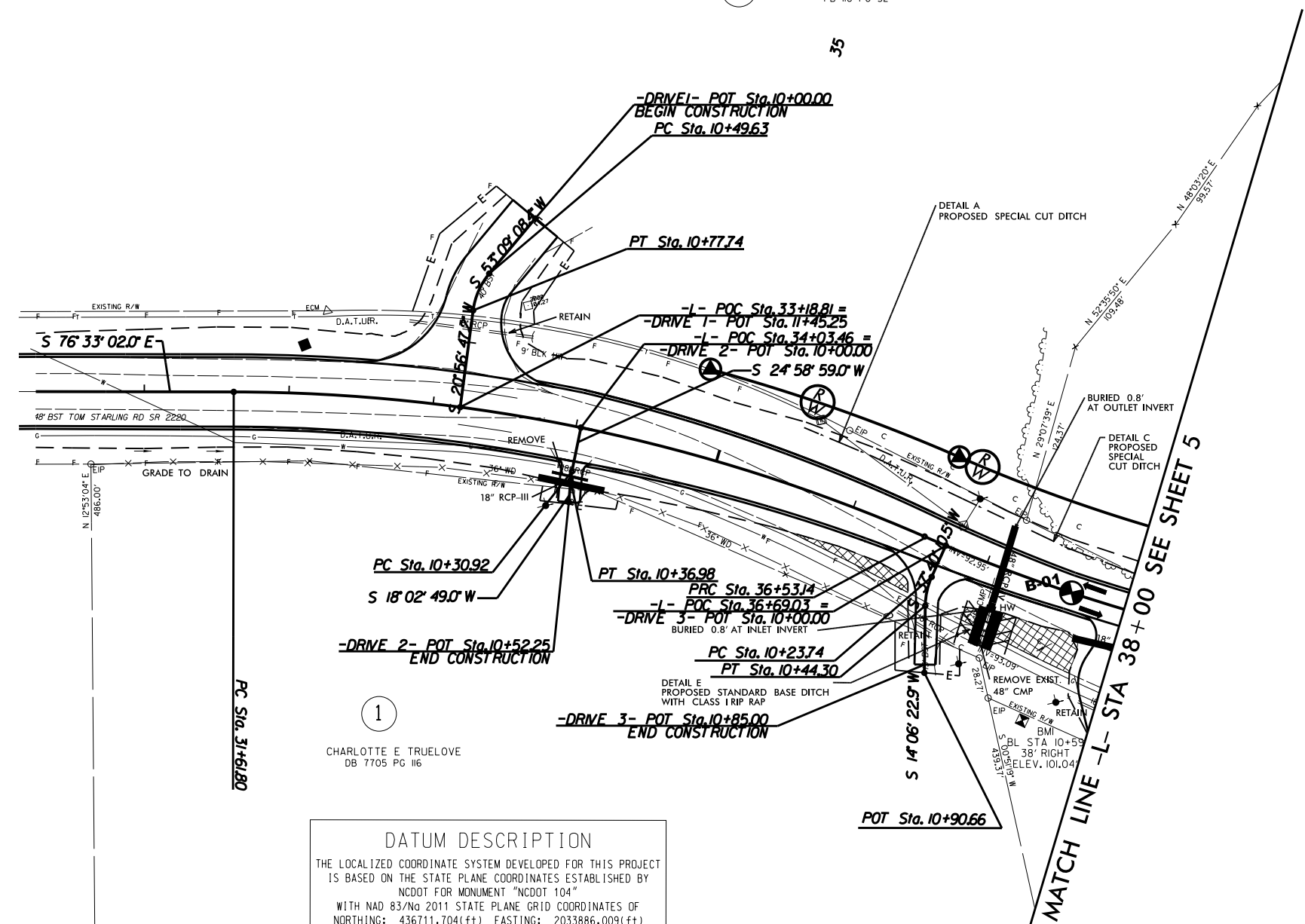
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R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	



30

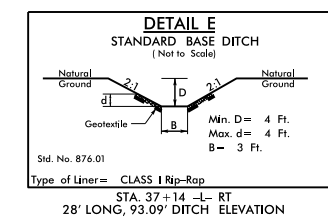
2  
 GCCFC 2006-GG7  
 STARLING INDUSTRIAL LLC  
 DB 8956 PG. 35  
 PB 116 PG. 32

35



1  
 CHARLOTTE E TRUELOVE  
 DB 7705 PG 116

**DATUM DESCRIPTION**  
 THE LOCALIZED COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON THE STATE PLANE COORDINATES ESTABLISHED BY NCDOT FOR MONUMENT "NCDOT 104" WITH NAD 83/NO 2011 STATE PLANE GRID COORDINATES OF NORTHING: 436711.7041(±) EASTING: 2033886.0091(±) ELEVATION: 95.61(±)  
 THE AVERAGE COMBINED GRID FACTOR USED ON THIS PROJECT (GROUND TO GRID) IS: 0.99988681  
 THE N.C. LAMBERT GRID BEARING AND LOCALIZED HORIZONTAL GROUND DISTANCE FROM "104" TO -L- STATION 11+28.53 IS N 62° 41' 23.84" W (10,096.771')  
 ALL LINEAR DIMENSIONS ARE LOCALIZED HORIZONTAL DISTANCES  
 VERTICAL DATUM USED IS NAVD 88



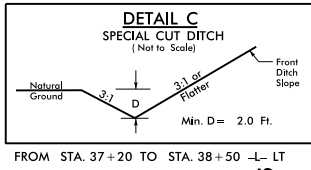
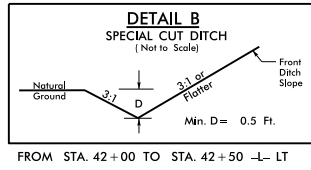
**NOTE:**  
 SEE SHEET 17 FOR -L- PROFILE  
 SEE SHEET 24 FOR -DRIVE 1-, -DRIVE 2-, & -DRIVE 3- PROFILE

8/17/99

PARSONS  
5843 CANTRELL DR., SUITE 301  
RALEIGH, NORTH CAROLINA 27606  
NC LICENSE NO. F-5084  
FOR NORTH CAROLINA DEPT. OF TRANSPORTATION

PROJECT REFERENCE NO. <b>W-5512</b>	SHEET NO. <b>5</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	

<b>-L-</b>	<b>-DRIVE 4-</b>
PI Sta 34+10.96 Δ = 23° 27' 35.8" (RT) D = 4' 46" 28.7" L = 491.34' T = 249.16' R = 1,200.00' R.O. = 220.00' S.E. = .08	PI Sta 40+18.60 Δ = 33° 52' 34.8" (LT) D = 4' 46" 28.7" L = 709.50' T = 365.46' R = 1,200.00' R.O. = 220.00' S.E. = .08
	PI Sta 10+41.18 Δ = 17° 19' 26.3" (LT) D = 229' 10" 59.2" L = 7.56' T = 3.81' R = 25.00'

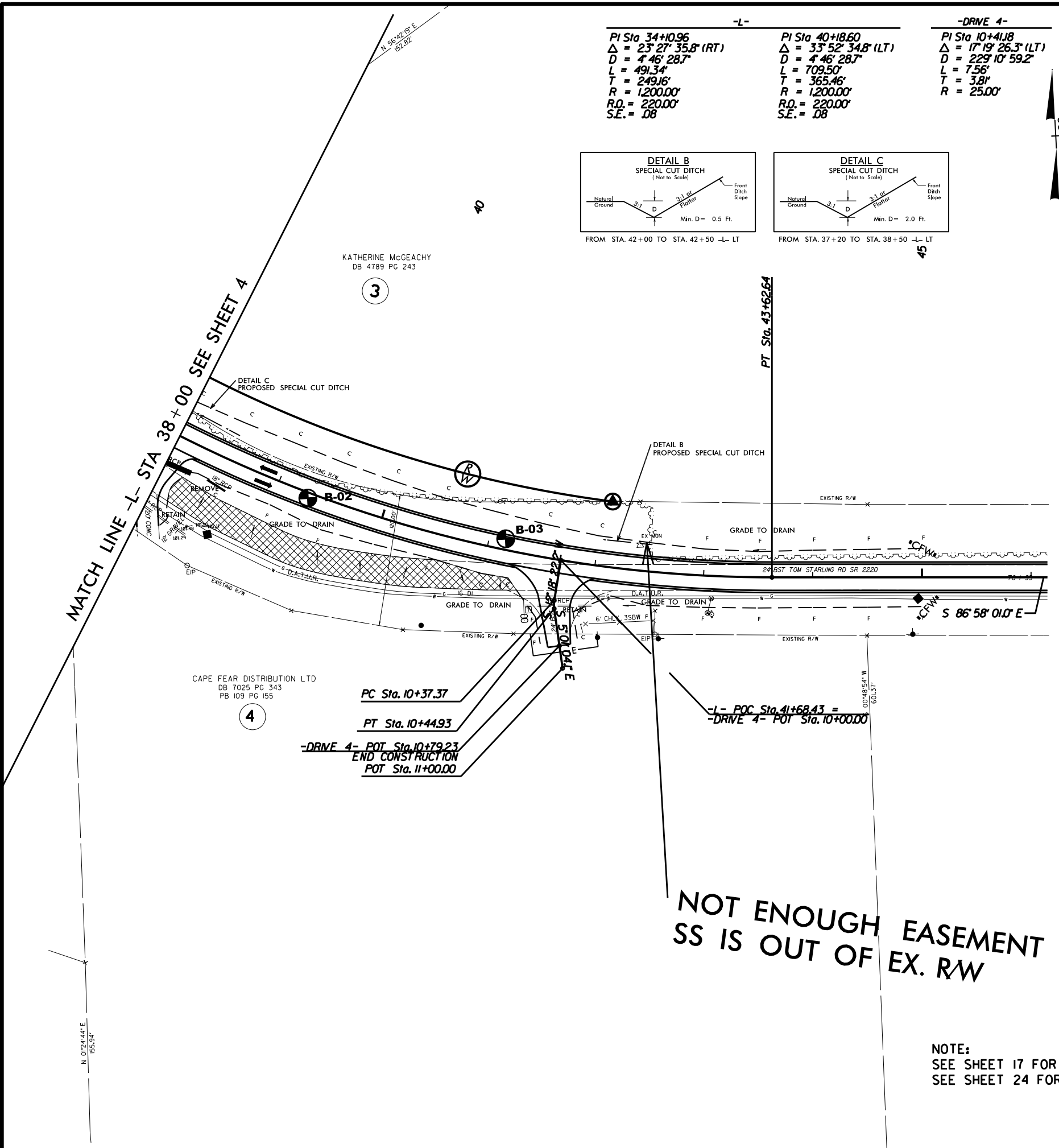


REVISIONS

17-JAN-2015 17:20  
D:\PROJECTS\2014\1305-14-079\W5512\_GEO\_RDWY\TOM\_STARLING\CADD\_GEO\TECH\Site&Sub\W-5512\_Rdy\_PSH\_05.DGN  
PROJECTS\2014\1305-14-079\W5512\_GEO\_RDWY\TOM\_STARLING\CADD\_GEO\TECH\Site&Sub\W-5512\_Rdy\_PSH\_05.DGN  
8/17/99

MATCH LINE -L- STA 38+00 SEE SHEET 4

MATCH LINE -L- STA 50+00 SEE SHEET 6

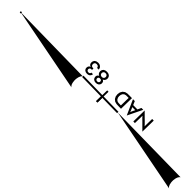


**NOT ENOUGH EASEMENT  
SS IS OUT OF EX. RW**

NOTE:  
SEE SHEET 17 FOR -L- PROFILE  
SEE SHEET 24 FOR -DRIVE 4- PROFILE

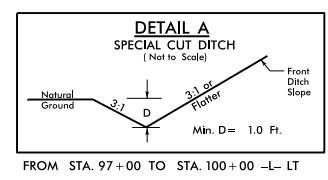
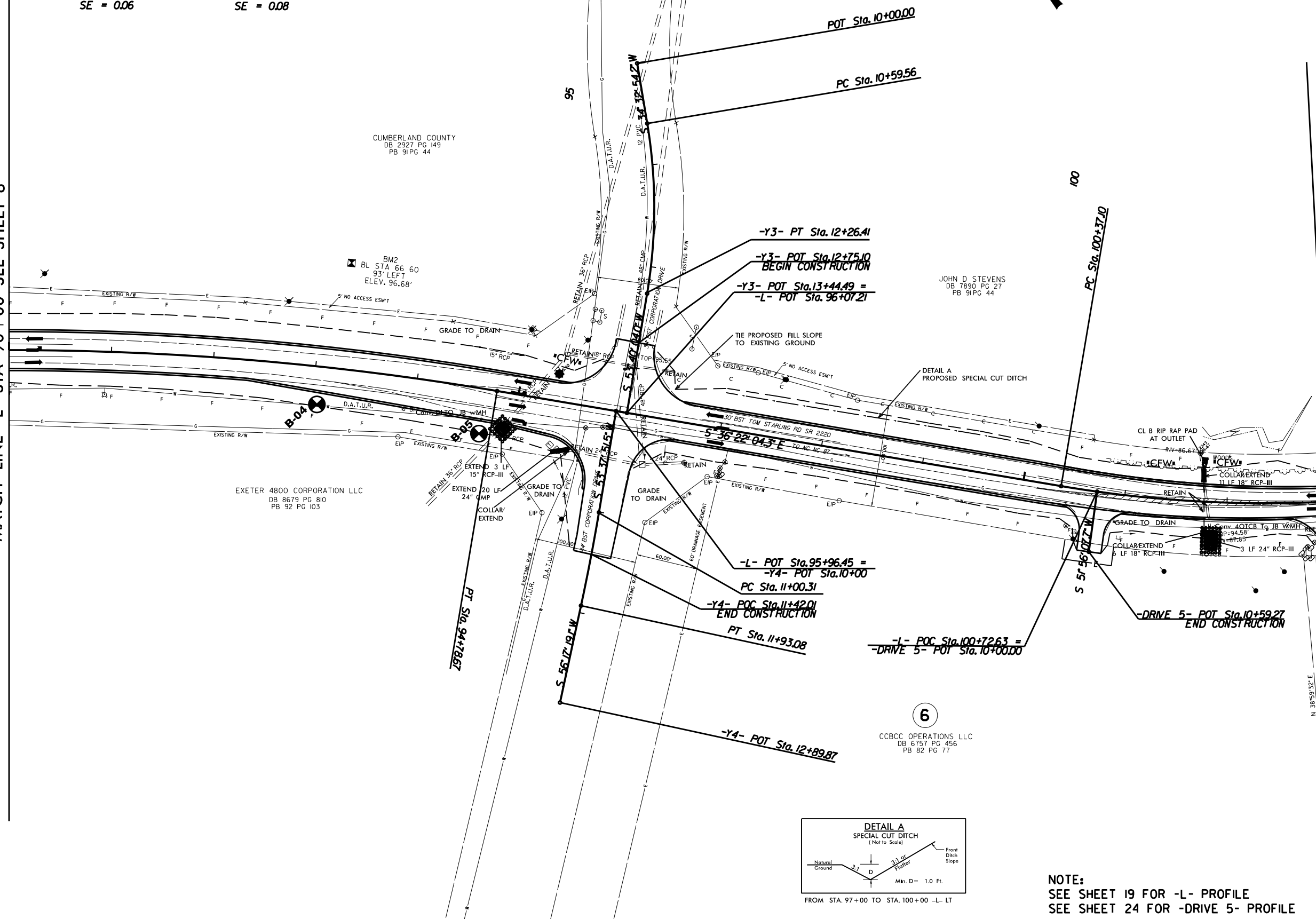
PROJECT REFERENCE NO. <b>W-5512</b>	SHEET NO. <b>6</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	

<b>-L-</b>	<b>-Y3-</b>	<b>-Y4-</b>
PI Sta 90+89.36 $\Delta = 15' 40" 10.6'$ (RT) $D = 1' 59' 59.5"$ $L = 783.54'$ $T = 394.23'$ $R = 2,865.00'$ $R.D. = 220'$ $SE = 0.06$	PI Sta 102+37.69 $\Delta = 18' 58' 47.3'$ (LT) $D = 4' 46' 28.7"$ $L = 397.51'$ $T = 200.59'$ $R = 1,200.00'$ $R.D. = 220'$ $SE = 0.08$	PI Sta 11+43.76 $\Delta = 19' 07' 09.9'$ (RT) $D = 1' 27' 33.0"$ $L = 166.85'$ $T = 84.21'$ $R = 500.00'$
PI Sta 11+46.71 $\Delta = 2' 39' 27.6'$ (RT) $D = 2' 51' 53.2"$ $L = 92.77'$ $T = 46.39'$ $R = 2,000.00'$		



MATCH LINE -L- STA 90+00 SEE SHEET 8

MATCH LINE -L- STA 103+00 SEE SHEET 10



**NOTE:**  
 SEE SHEET 19 FOR -L- PROFILE  
 SEE SHEET 24 FOR -DRIVE 5- PROFILE

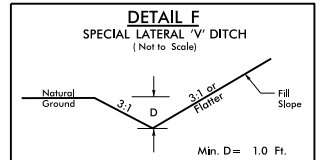
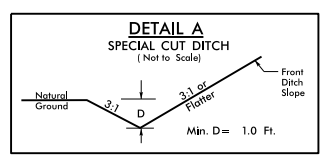
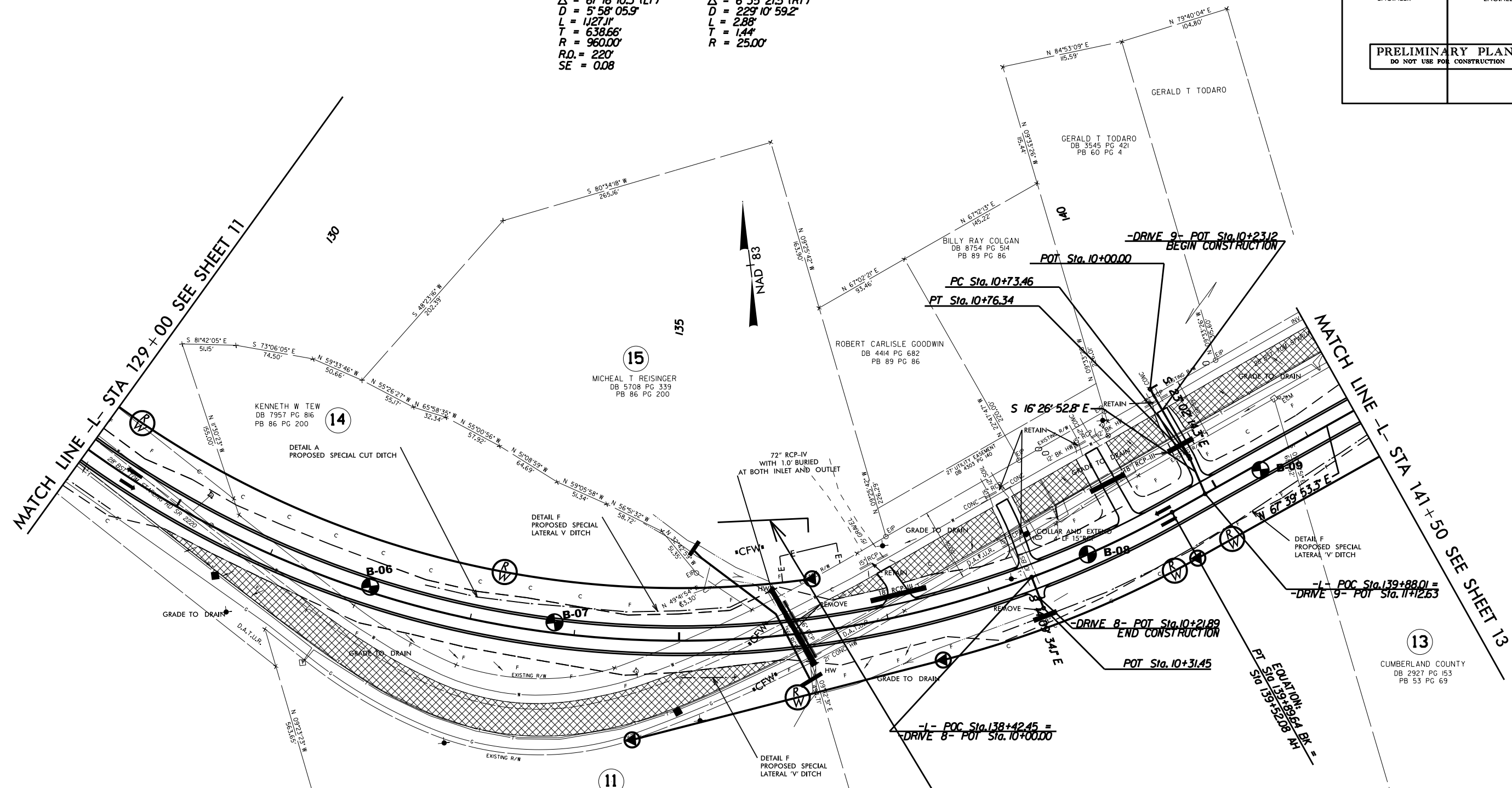
REVISIONS  
 17-JAN-2015 17:25  
 06-PROJECTS\2014\1305-14-079\W5512\_GEO\_RDWY-TOM\_STARLING\_CADD\_GEO\TECH\Site&Sub\W-5512\_Rdy\_PSH\_06.DGN  
 8/17/99

PROJECT REFERENCE NO. <b>W-5512</b>	SHEET NO. <b>7</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	

**-L-**  
 PI Sta 135+01.9  
 $\Delta = 67^{\circ}16'10.3"$  (LT)  
 $D = 5'58'05.9"$   
 $L = 1127.1'$   
 $T = 638.66'$   
 $R = 960.00'$   
 $R.O. = 220'$   
 $SE = 0.08$

**-DRIVE 10-**  
 PI Sta 10+74.90  
 $\Delta = 6^{\circ}35'21.5"$  (RT)  
 $D = 229'10'59.2"$   
 $L = 2.88'$   
 $T = 1.44'$   
 $R = 25.00'$

REVISIONS  
 R/W REV: ELIMINATED PARCELS 16, 17, & 18 FROM ORIGINAL R/W PLANS DUE TO ALIGNMENT SHIFTING, NO R/W NEEDED. TDG 8-25-14  
 17-JAN-2015 [r16]  
 05-PROJECTS\2014\1305-14-979\W5512-GEO-ROADWAY-TOM\_STARLING\CADD\GEO\TECH\Site&Sub\W-5512\_Rdy\_PSH\_07.DGN  
 08-11-2014 11:53:00



**NOTE:**  
 SEE SHEET 20 FOR -L- PROFILE  
 SEE SHEET 25 FOR -DRIVE 8- & -DRIVE 9- PROFILE

**NEED EXTRA EASEMENT**



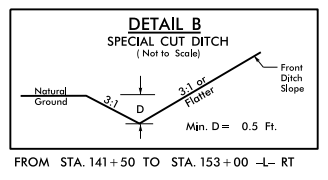
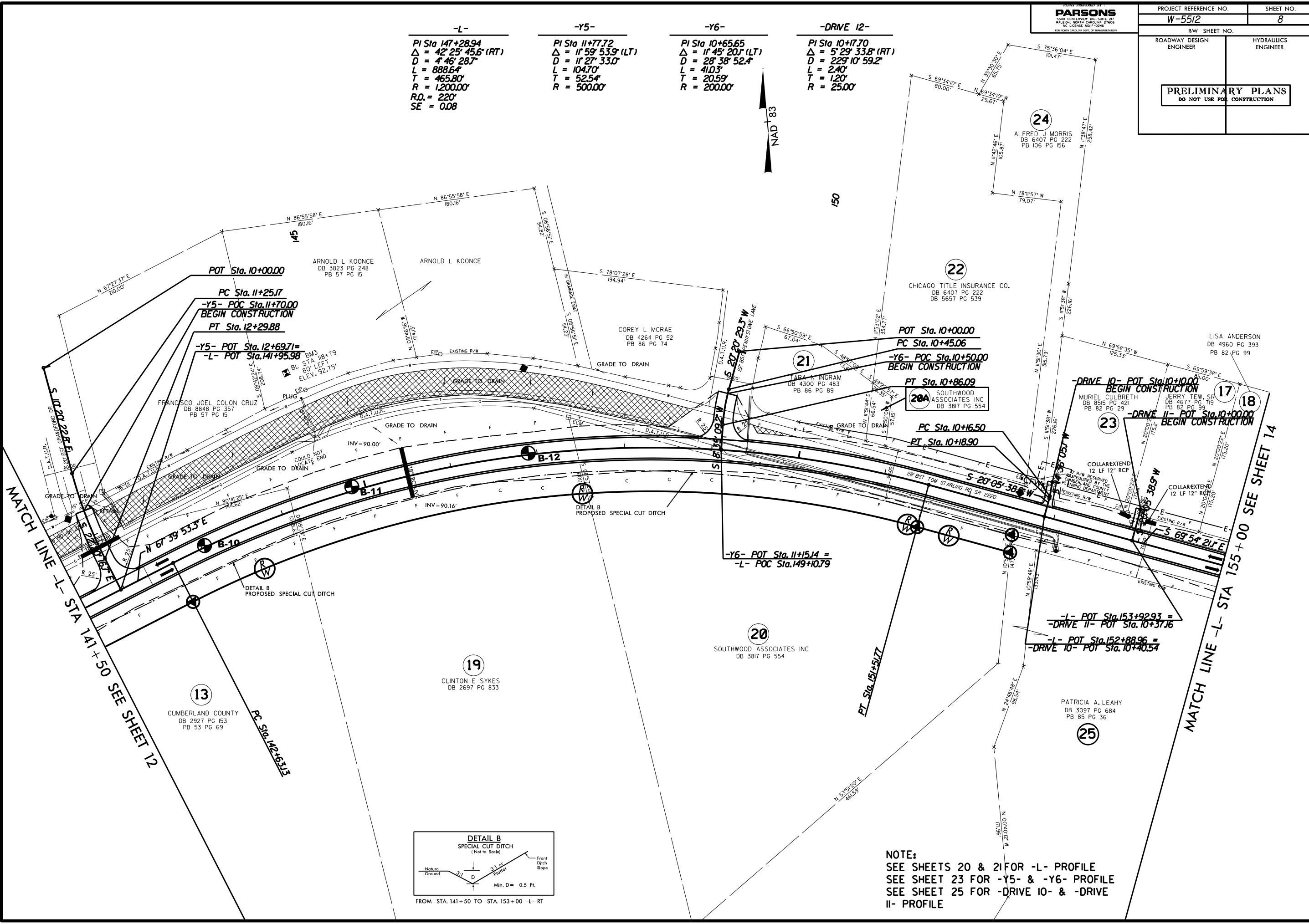
PROJECT REFERENCE NO.	SHEET NO.
W-5512	8
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	

-L-	-Y5-	-Y6-	-DRIVE 12-
PI Sta 147+28.94 Δ = 42° 25' 45.6" (RT) D = 4' 46" 28.7" L = 888.64' T = 465.80' R = 1,200.00' R.O. = 220' SE = 0.08	PI Sta 11+77.72 Δ = 11° 59' 53.9" (LT) D = 11' 27" 33.0" L = 104.70' T = 52.54' R = 500.00'	PI Sta 10+65.65 Δ = 11° 45' 20.1" (LT) D = 28' 38" 52.4" L = 41.03' T = 20.59' R = 200.00'	PI Sta 10+17.70 Δ = 5° 29' 33.8" (RT) D = 229' 10" 59.2" L = 2.40' T = 1.20' R = 25.00'



REVISIONS  
 RW REV. REV. / ADDED PROP. OWNER NAME & DEED BOOK INFO TO PARCEL 20A (SOUTHWOOD ASSOCIATES, INC.), TDC 9-15-14

17-JAN-2015 11:45  
 D:\PROJECTS\2014\1305-14-079\W5512\_GED\_RDWY\_TOM\_STARLING\_CADD\_GEO\TECH\Site&Sub\W-5512\_Rdy\_PSH\_08.DGN  
 8.17/99



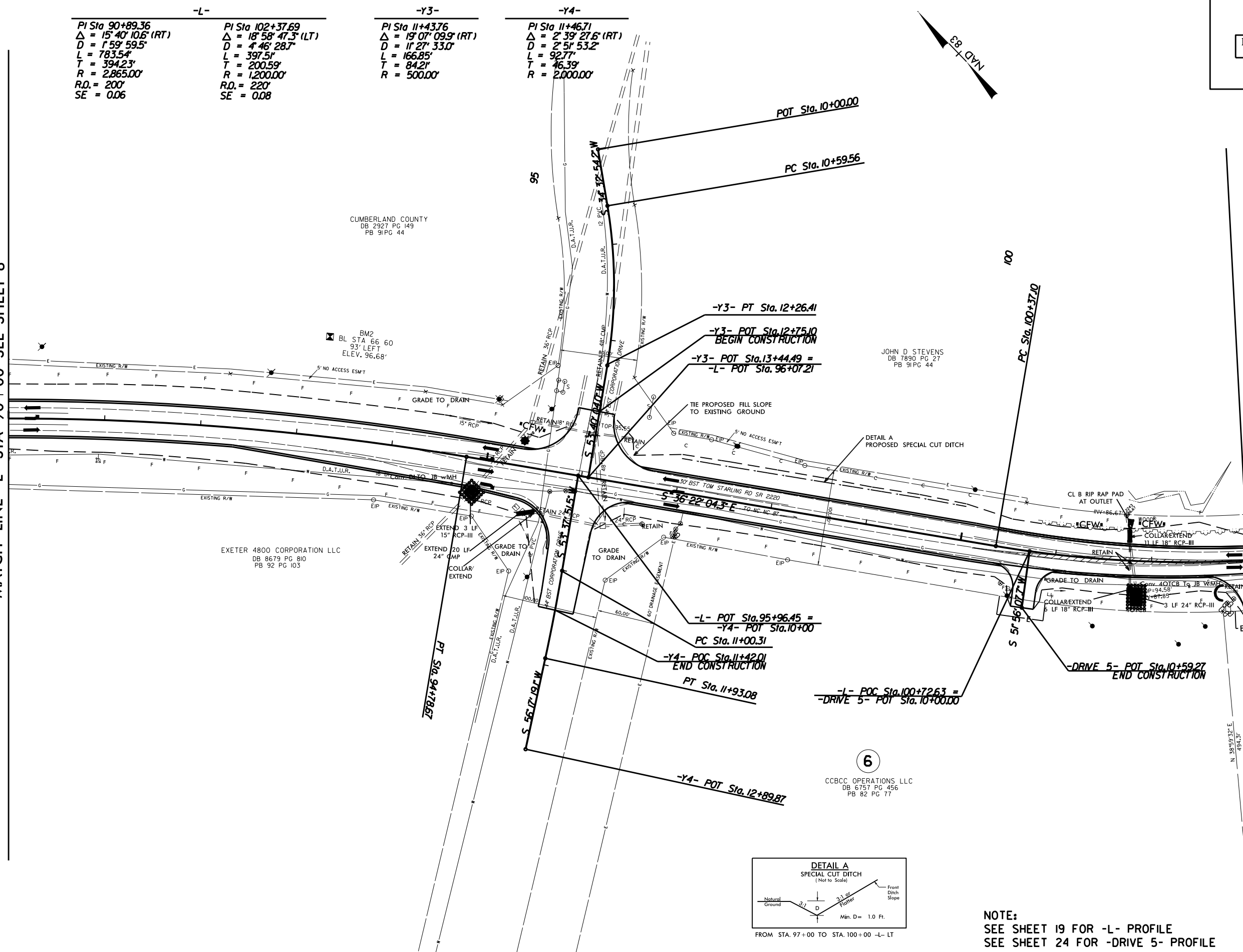
**NOTE:**  
 SEE SHEETS 20 & 21 FOR -L- PROFILE  
 SEE SHEET 23 FOR -Y5- & -Y6- PROFILE  
 SEE SHEET 25 FOR -DRIVE 10- & -DRIVE 11- PROFILE

-L-	-Y3-	-Y4-
PI Sta 90+89.36	PI Sta 11+43.76	PI Sta 11+46.71
$\Delta = 15' 40" 10.6'$ (RT)	$\Delta = 19' 07" 09.9'$ (RT)	$\Delta = 2' 39' 27.6'$ (RT)
D = 1' 59' 59.5"	D = 1' 27' 33.0"	D = 2' 51' 53.2"
L = 783.54'	L = 166.85'	L = 92.77'
T = 394.23'	T = 84.21'	T = 46.39'
R = 2,865.00'	R = 500.00'	R = 2,000.00'
R.O. = 220'		
SE = 0.06		



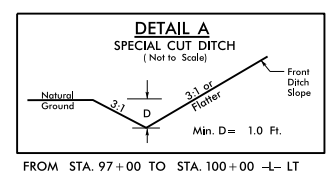
MATCH LINE -L- STA 90+00 SEE SHEET 8

MATCH LINE -L- STA 103+00 SEE SHEET 10



REVISIONS

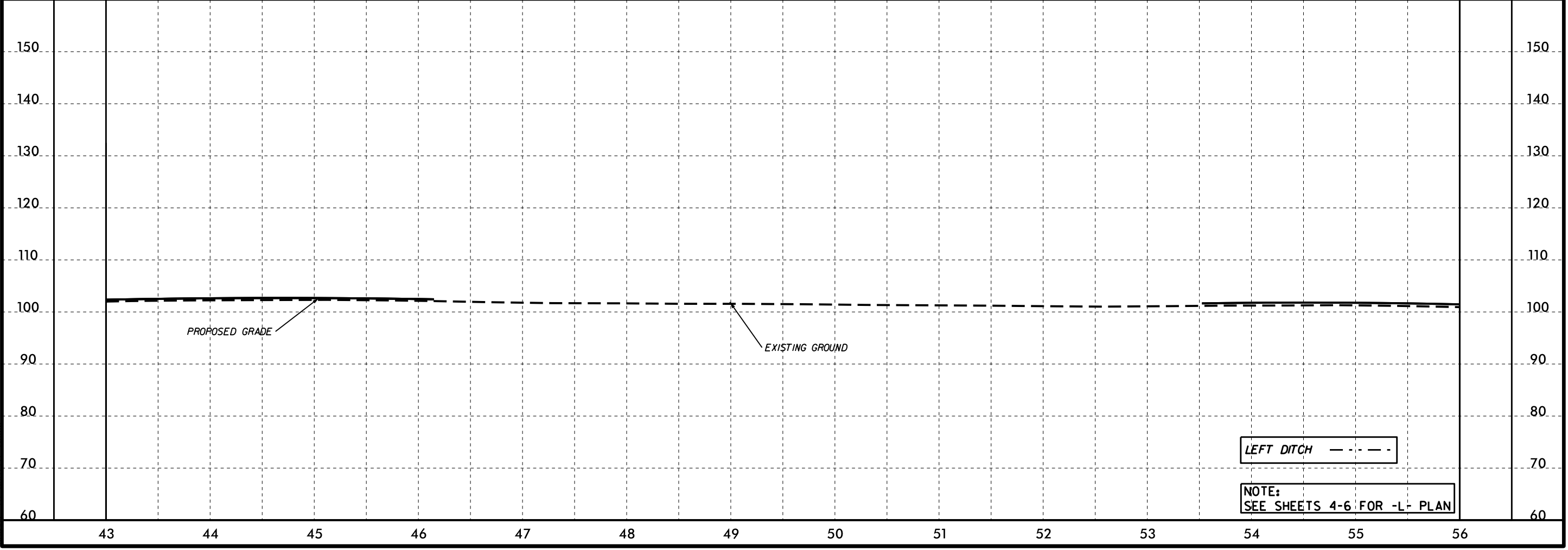
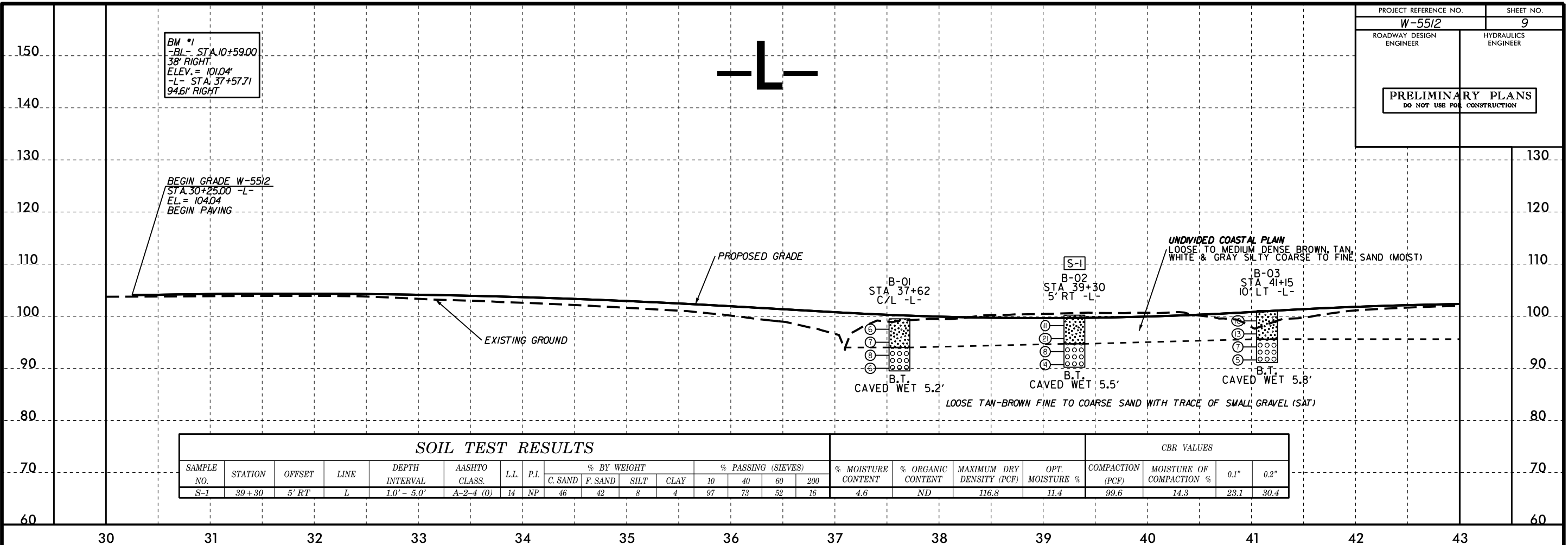
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 8/17/99



**NOTE:**  
 SEE SHEET 19 FOR -L- PROFILE  
 SEE SHEET 24 FOR -DRIVE 5- PROFILE

5/28/99

PROJECT REFERENCE NO. <b>W-5512</b>	SHEET NO. <b>9</b>
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	

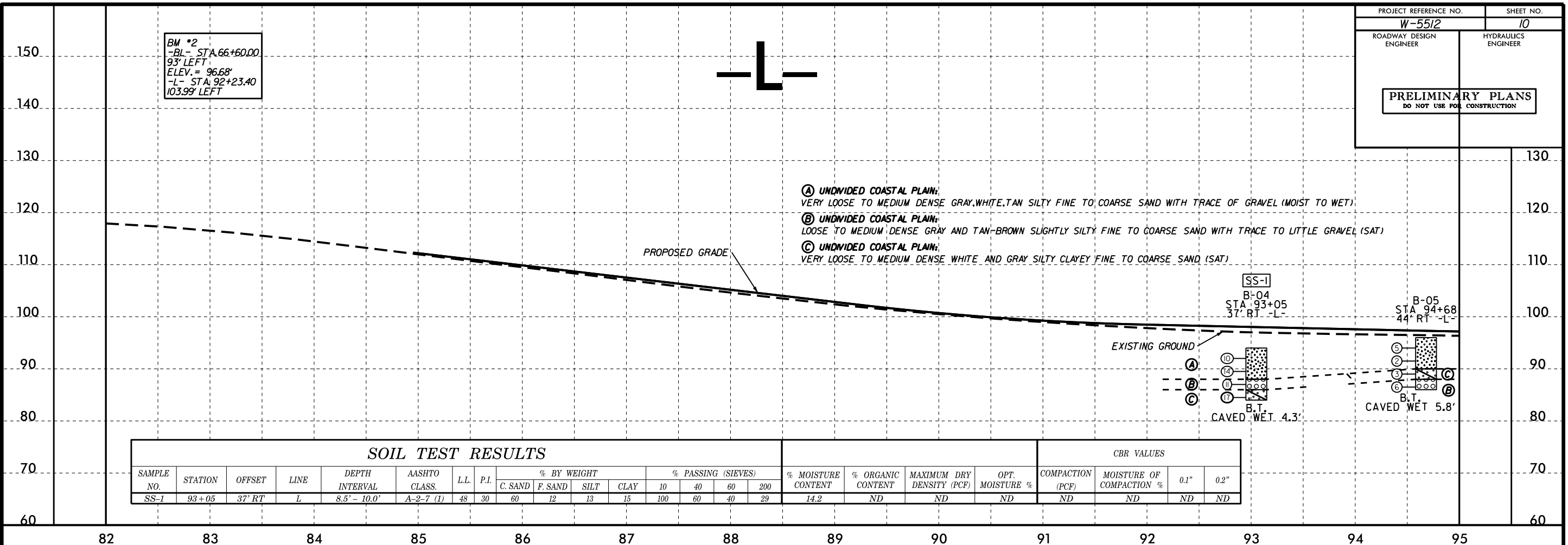
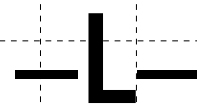


10-JAN-2015 10:25 AM  
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5/28/99

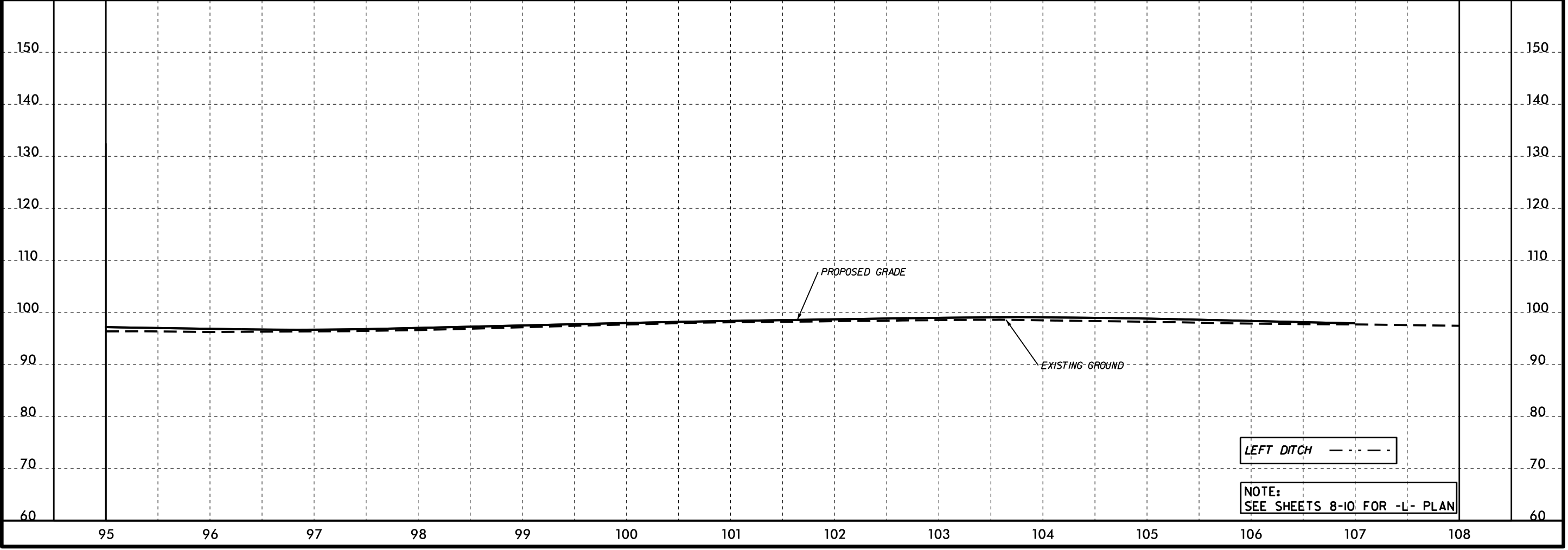
BM \*2  
 -BL- STA. 66+60.00  
 93' LEFT  
 ELEV. = 96.68'  
 -L- STA. 92+23.40  
 103.99' LEFT

PROJECT REFERENCE NO. <b>W-5512</b>	SHEET NO. <b>10</b>
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	



- (A) UNDIVIDED COASTAL PLAIN:  
VERY LOOSE TO MEDIUM DENSE GRAY, WHITE, TAN SILTY FINE TO COARSE SAND WITH TRACE OF GRAVEL (MOIST TO WET)
- (B) UNDIVIDED COASTAL PLAIN:  
LOOSE TO MEDIUM DENSE GRAY AND TAN-BROWN SLIGHTLY SILTY FINE TO COARSE SAND WITH TRACE TO LITTLE GRAVEL (SAT)
- (C) UNDIVIDED COASTAL PLAIN:  
VERY LOOSE TO MEDIUM DENSE WHITE AND GRAY SILTY CLAYEY FINE TO COARSE SAND (SAT)

SOIL TEST RESULTS														CBR VALUES									
SAMPLE NO.	STATION	OFFSET	LINE	DEPTH INTERVAL	AASHTO CLASS.	LL	P.I.	% BY WEIGHT				% PASSING (SIEVES)				% MOISTURE CONTENT	% ORGANIC CONTENT	MAXIMUM DRY DENSITY (PCF)	OPT. MOISTURE %	COMPACTION (PCF)	MOISTURE OF COMPACTION %	0.1"	0.2"
								C. SAND	F. SAND	SILT	CLAY	10	40	60	200								
SS-1	93+05	37' RT	L	8.5' - 10.0'	A-2-7 (L)	48	30	60	12	13	15	100	60	40	29	14.2	ND	ND	ND	ND	ND	ND	ND



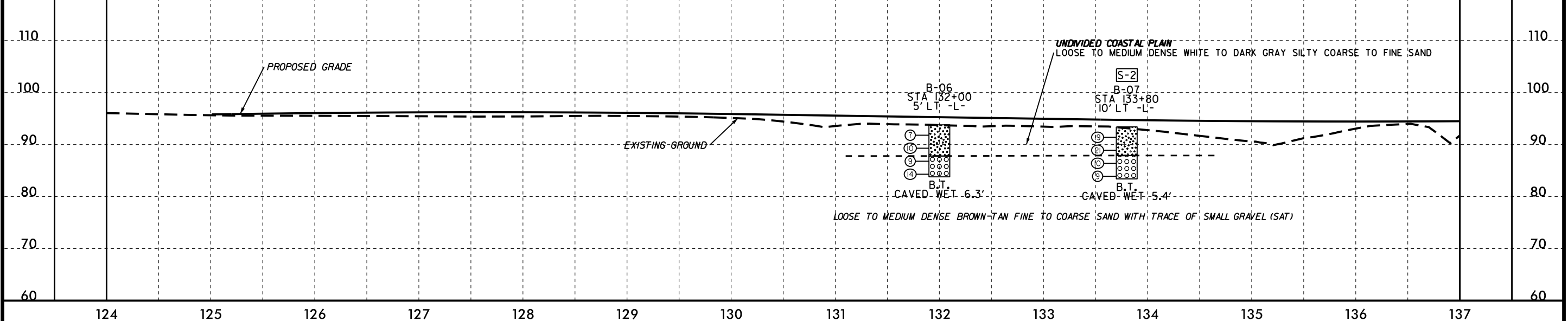
10-JAN-2015 10:23  
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 11:13:00

5/28/99

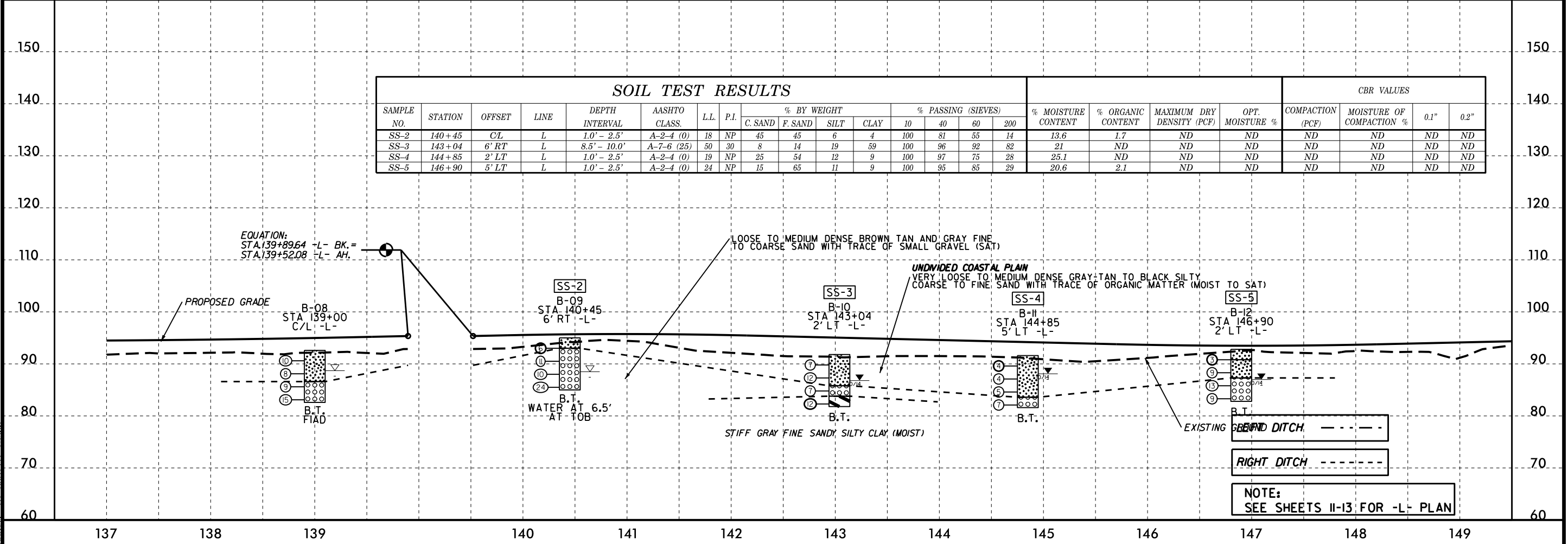
BM #3  
 -BL- STA. 118+79.00  
 80' LEFT  
 ELEV. = 92.75'  
 -L- STA. 144+54.00  
 151.62' LEFT

PROJECT REFERENCE NO. <b>W-5512</b>	SHEET NO. <b>11</b>
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	

SOIL TEST RESULTS																		CBR VALUES					
SAMPLE NO.	STATION	OFFSET	LINE	DEPTH INTERVAL	AASHTO CLASS.	LL	P.I.	% BY WEIGHT				% PASSING (SIEVES)				% MOISTURE CONTENT	% ORGANIC CONTENT	MAXIMUM DRY DENSITY (PCF)	OPT. MOISTURE %	COMPACTION (PCF)	MOISTURE OF COMPACTION %		
								C. SAND	F. SAND	SILT	CLAY	10	40	60	200						0.1"	0.2"	
S-2	133+80	10' LT	L	1.0' - 5.0'	A-2-4 (0)	14	NP	33	50	11	6	100	83	67	24	1.6	ND	116.4	11.1	99.7	13.9	10.7	14.3



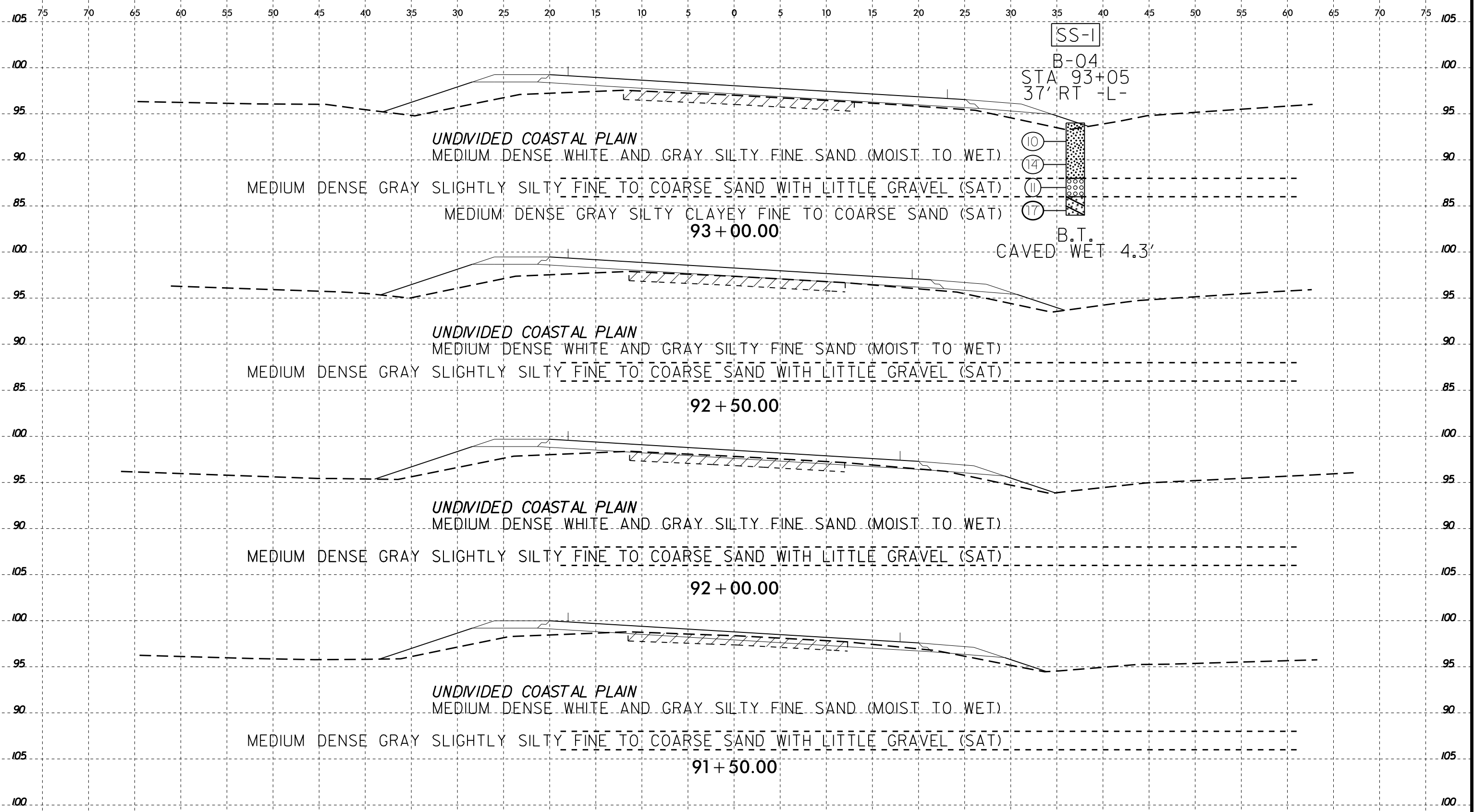
SOIL TEST RESULTS																		CBR VALUES					
SAMPLE NO.	STATION	OFFSET	LINE	DEPTH INTERVAL	AASHTO CLASS.	LL	P.I.	% BY WEIGHT				% PASSING (SIEVES)				% MOISTURE CONTENT	% ORGANIC CONTENT	MAXIMUM DRY DENSITY (PCF)	OPT. MOISTURE %	COMPACTION (PCF)	MOISTURE OF COMPACTION %		
								C. SAND	F. SAND	SILT	CLAY	10	40	60	200						0.1"	0.2"	
SS-2	140+45	CL	L	1.0' - 2.5'	A-2-4 (0)	18	NP	45	45	6	4	100	81	55	14	13.6	1.7	ND	ND	ND	ND	ND	ND
SS-3	143+04	6' RT	L	8.5' - 10.0'	A-7-6 (25)	50	30	8	14	19	59	100	96	92	82	21	ND	ND	ND	ND	ND	ND	ND
SS-4	144+85	2' LT	L	1.0' - 2.5'	A-2-4 (0)	19	NP	25	54	12	9	100	97	75	28	25.1	ND	ND	ND	ND	ND	ND	ND
SS-5	146+90	5' LT	L	1.0' - 2.5'	A-2-4 (0)	24	NP	15	65	11	9	100	95	85	29	20.6	2.1	ND	ND	ND	ND	ND	ND



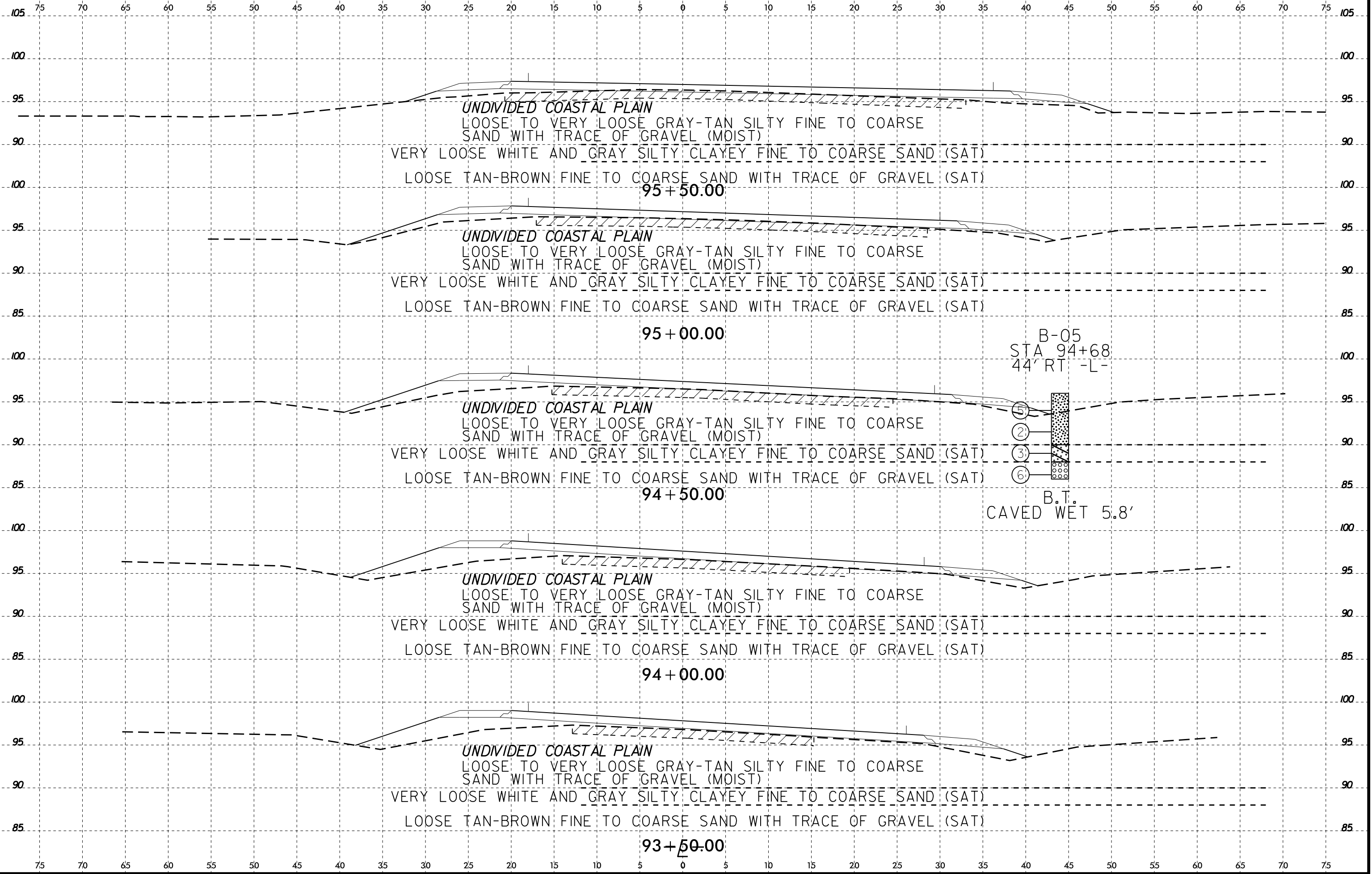
EQUATION:  
 STA. 139+89.64 -L- BK. =  
 STA. 139+52.08 -L- AH.

NOTE:  
 SEE SHEETS 11-13 FOR -L- PLAN

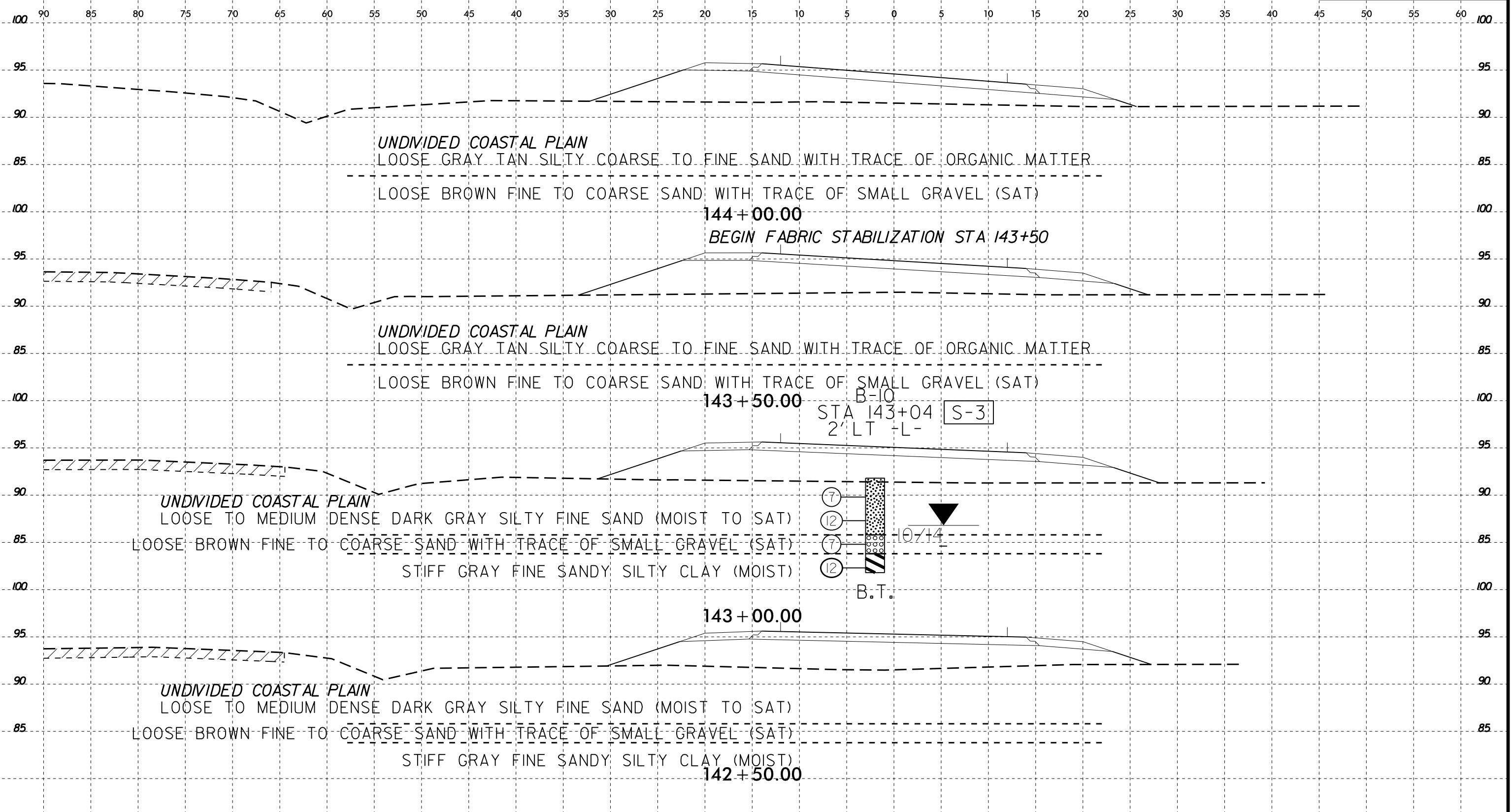
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 1305-14-079\W5512\_GEO\_ROWY\_TOM\_STARLING\CADD\_GEO\TECH\Site&Sub\W-5512\_Rdy\_PFL\_11.DGN



SOIL TEST RESULTS												CBR VALUES											
SAMPLE NO.	STATION	OFFSET	LINE	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)				% MOISTURE CONTENT	% ORGANIC CONTENT	MAXIMUM DRY DENSITY (PCF)	OPT. MOISTURE %	COMPACTION (PCF)	MOISTURE OF COMPACTION %	0.1"	0.2"
								C. SAND	F. SAND	SILT	CLAY	10	40	60	200								
SS-1	93+05	37' RT	L	8.5' - 10.0'	A-2-7 (1)	48	30	60	12	13	15	100	60	40	29	14.2	ND	ND	ND	ND	ND	ND	



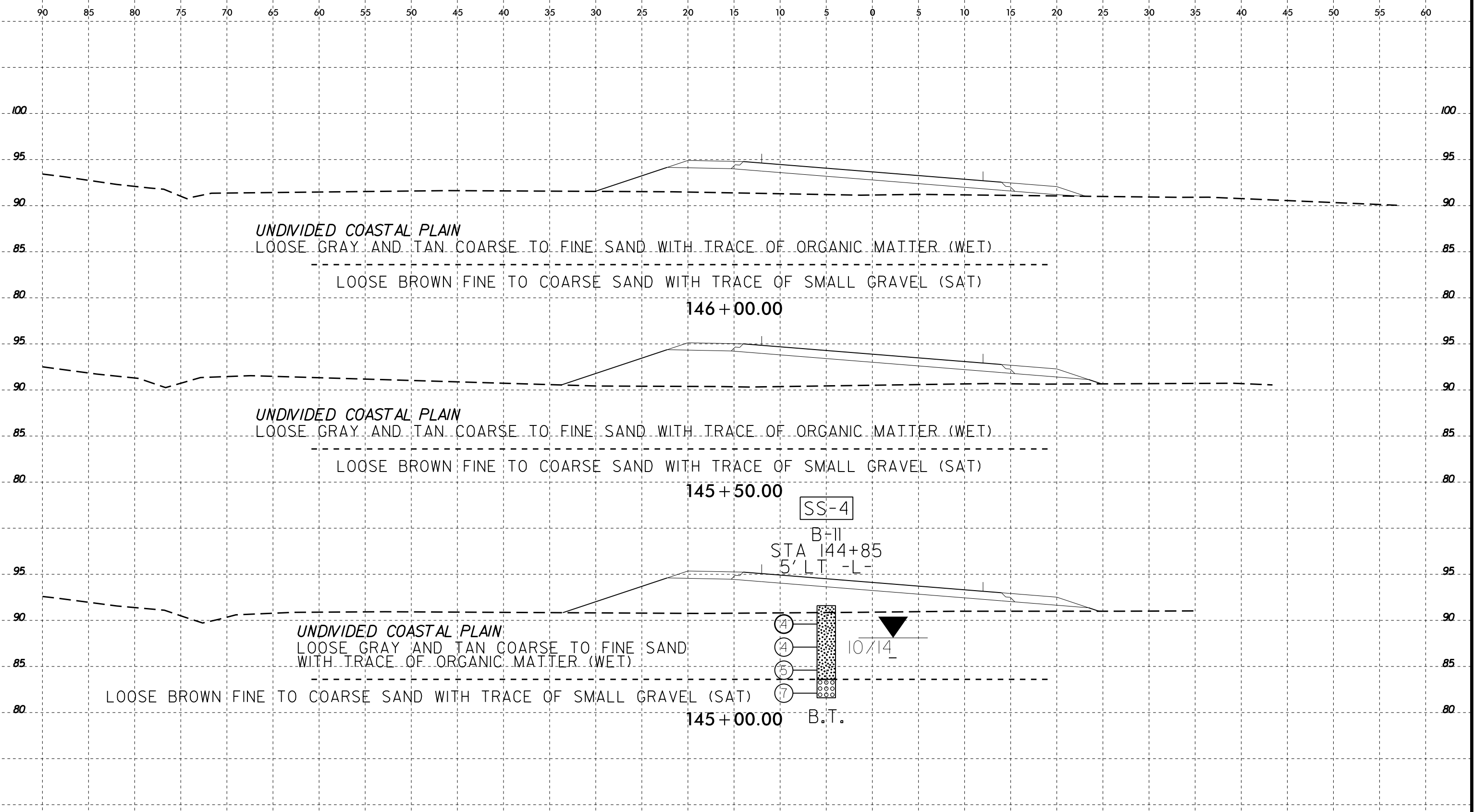
8/23/99  
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 BRATTI - 13000



SOIL TEST RESULTS												CBR VALUES											
SAMPLE NO.	STATION	OFFSET	LINE	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)				% MOISTURE CONTENT	% ORGANIC CONTENT	MAXIMUM DRY DENSITY (PCF)	OPT. MOISTURE %	COMPACTION (PCF)	MOISTURE OF COMPACTION %	0.1"	0.2"
								C. SAND	F. SAND	SILT	CLAY	10	40	60	200								
SS-3	143+04	2' LT	L	8.0' - 10.0'	A-7-6 (25)	50	30	8	14	19	59	100	96	92	82	21.0	ND	ND	ND	ND	ND	ND	ND



8/23/99

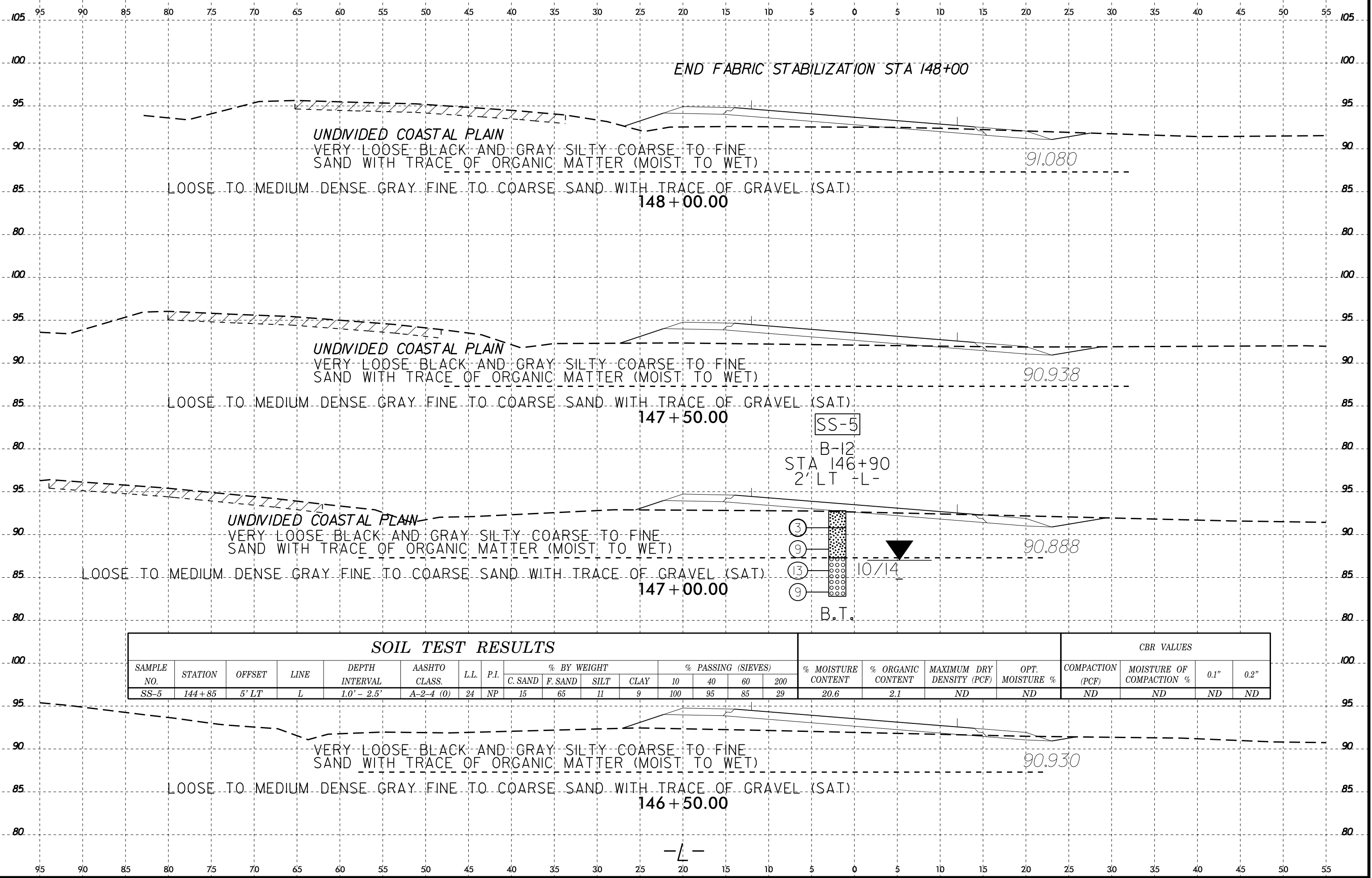


**SOIL TEST RESULTS**

SAMPLE NO.	STATION	OFFSET	LINE	DEPTH INTERVAL	AASHTO CLASS.	LL	P.I.	% BY WEIGHT				% PASSING (SIEVES)				% MOISTURE CONTENT	% ORGANIC CONTENT	MAXIMUM DRY DENSITY (PCF)	OPT. MOISTURE %	CBR VALUES			
								C. SAND	F. SAND	SILT	CLAY	10	40	60	200					COMPACTION (PCF)	MOISTURE OF COMPACTION %	0.1"	0.2"
SS-4	144+85	5' LT	L	1.0' - 2.5'	A-2-4 (0)	19	NP	25	54	12	9	100	97	75	29	25.1	ND	ND	ND	ND	ND	ND	ND

-L-

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 CIVIL\PROJECTS\2014\1305-14-079\W5512\_GEO.ROWY.TOM.STARLING\CADD\_GEO\TECH\Site\W5512.RDY.XPL.L.L.14000.R2.16500.R2.DGN  
 BRATTI-13500



**SOIL TEST RESULTS**

SAMPLE NO.	STATION	OFFSET	LINE	DEPTH INTERVAL	AASHTO CLASS.	LL.	P.I.	% BY WEIGHT				% PASSING (SIEVES)				% MOISTURE CONTENT	% ORGANIC CONTENT	MAXIMUM DRY DENSITY (PCF)	OPT. MOISTURE %	CBR VALUES			
								C. SAND	F. SAND	SILT	CLAY	10	40	60	200					COMPACTION (PCF)	MOISTURE OF COMPACTION %	0.1"	0.2"
SS-5	144+85	5' LT	L	1.0' - 2.5'	A-2-4 (0)	24	NP	15	65	11	9	100	95	85	29	20.6	2.1	ND	ND	ND	ND	ND	ND

I:\JAN-2015 18:02  
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 BRATTI-3500

Moisture - Density Report

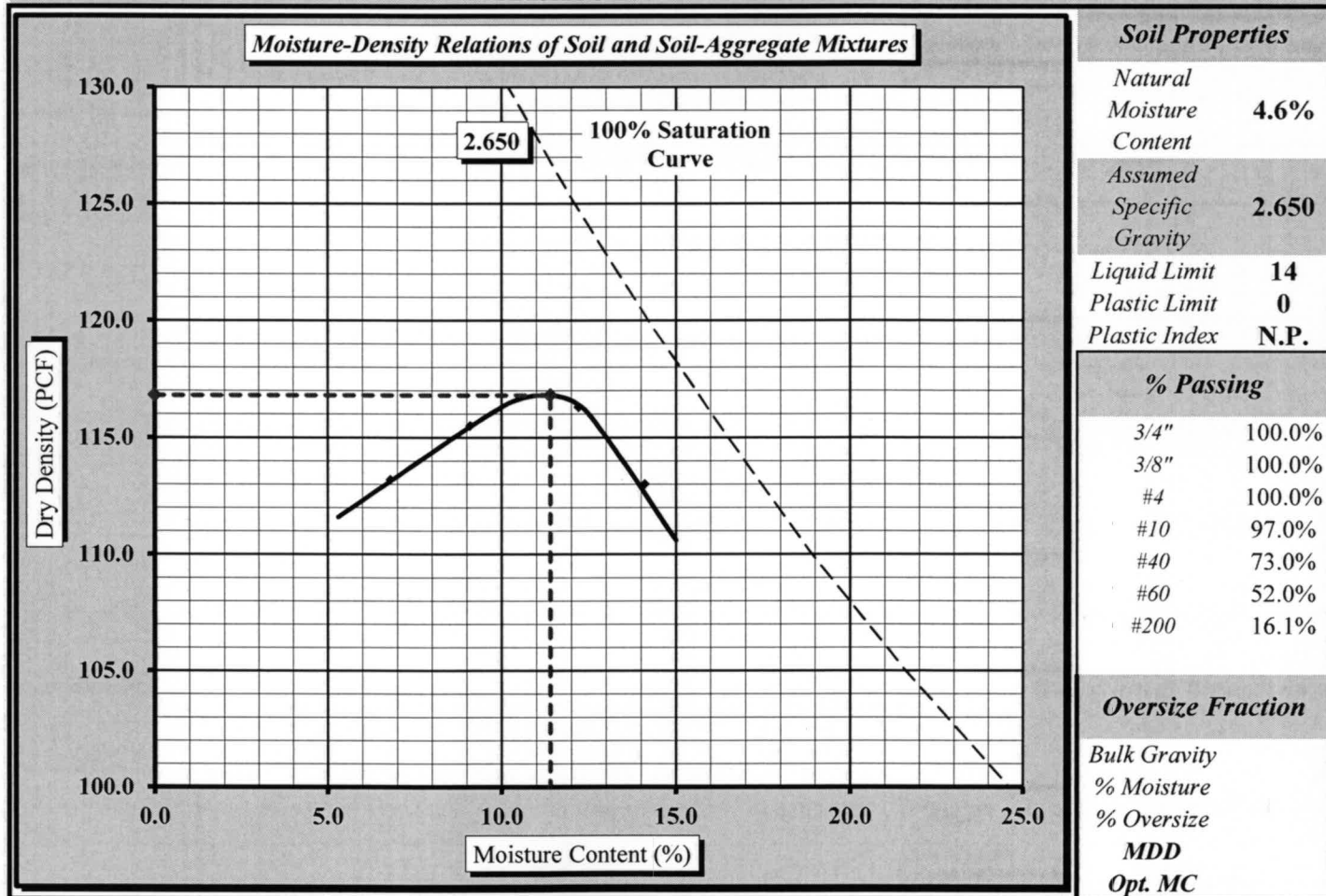


Quality Assurance

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

S&ME Project #:	1305-14-079	W-5512	Report Date:	11/5/14	
Project Name:	Tom Starling Road (SR2220)		Test Date(s):	11/3 - 11/5/14	
Client Name:	Parsons Transportation Group Inc.				
Client Address:	Raleigh, North Carolina				
Boring #:	B-2	Sample #:	S-1	Sample Date:	10/27/2014
Location:	STA 39+30 -L-	Offset:	5' RT	Depth:	1 - 5 ft
Sample Description:	White Silty Fine to Coarse SAND (A-2-4) (0)				

Maximum Dry Density 116.8 PCF. Optimum Moisture Content 11.4%  
 AASHTO T99 -- Method A



Moisture-Density Curve Displayed: Fine Fraction  Corrected for Oversize Fraction (ASTM D 4718)   
 Sieve Size used to separate the Oversize Fraction: #4 Sieve  3/8 inch Sieve  3/4 inch Sieve   
 Mechanical Rammer  Manual Rammer  Moist Preparation  Dry Preparation

References / Comments / Deviations:

AASHTO T88: Particle Size Analysis of Soils  
 AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T 99: Moisture-Density Relations of Soil Using a 5.5 Lb. Rammer and a 12" Drop

Mal Krajan, ET  
 Technical Responsibility

104-01-0703  
 Certification #

Laboratory Manager  
 Position

11/5/14  
 Date

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CBR (California Bearing Ratio) of Laboratory  
 Compacted Soil  
 AASHTO T 193

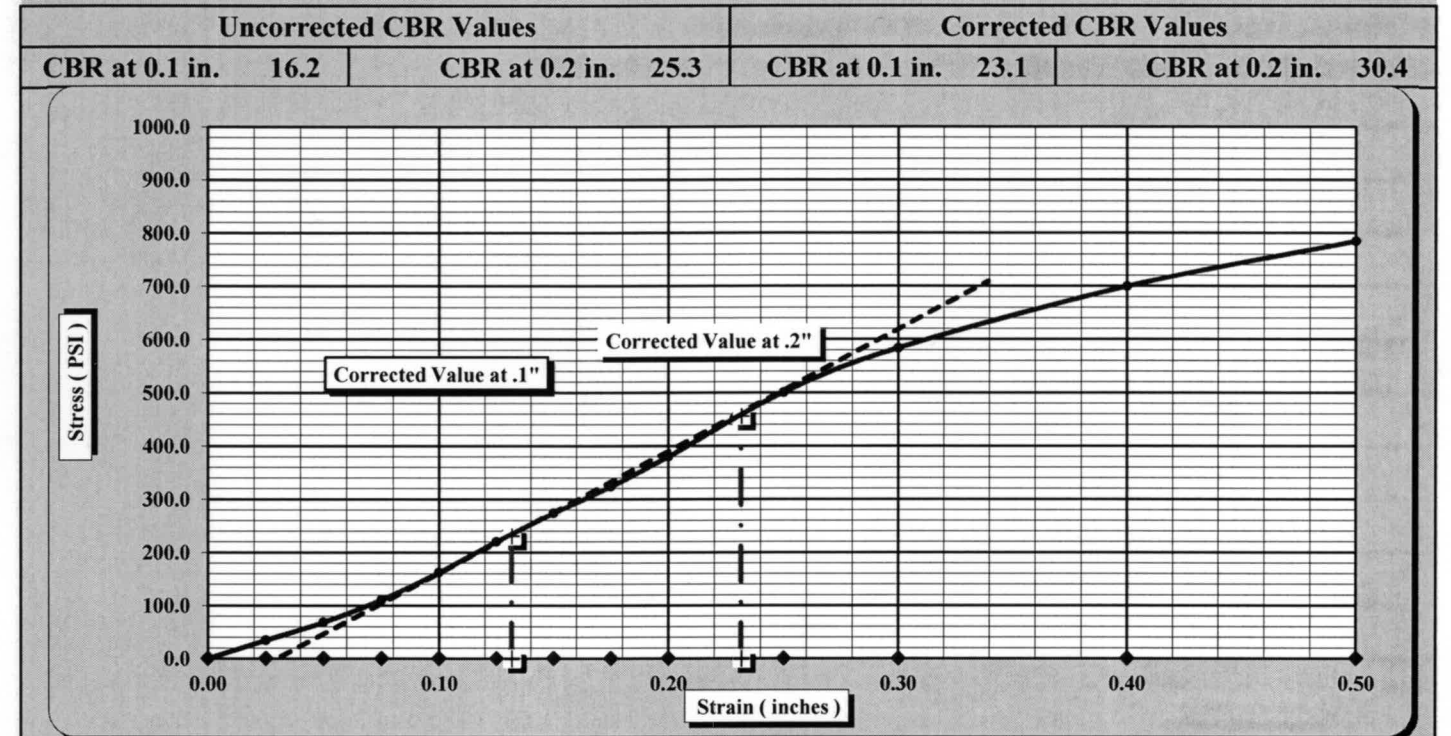


Quality Assurance

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project #:	1305-14-079	W-5512	Report Date:	11/10/14	
Project Name:	Tom Starling Road (SR 2220)		Test Date(s)	11/3 - 10/10/14	
Client Name:	Parsons Transportation Group Inc.				
Client Address:	Raleigh, North Carolina				
Boring #:	B-2	Sample #:	S-1	Sample Date:	10/27/14
Location:	STA 39+30 -L-	Offset:	5' RT	Depth (ft):	1 - 5 ft.
Sample Description:	White Silty Fine to Coarse SAND (A-2-4) (0)				

AASHTO T99 Method A Maximum Dry Density: 116.8 PCF Optimum Moisture Content: 11.4%  
 Compaction Test performed on grading complying with CBR spec. % Retained on the 3/4" sieve: 0.0%



CBR Sample Preparation: Performed on the fine fraction  
 The entire gradation was used and compacted in a 6" CBR mold in accordance with

Before Soaking		After Soaking	
Compactive Effort (Blows per Layer)	65	Final Dry Density (PCF)	115.3
Initial Dry Density (PCF)	116.3	Average Final Moisture Content	15.2%
Moisture Content of the Compacted Specimen	14.3%	Moisture Content (top 1" after soaking)	15.8%
Percent Compaction	99.6%	Percent Swell	0.1%
Soak Time:	96-hr	Surcharge Weight	10.0
Liquid Limit	14	Surcharge Wt. per sq. Ft.	50.9
		Plastic Index	N.P.

Notes/Deviations/References:

Test specimen was compacted to 100% at 3% wet of optimum moisture content.

Mal Krajan, ET  
 Technical Responsibility

*[Signature]*  
 Signature

Laboratory Manager  
 Position

11/10/14  
 Date

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Moisture - Density Report

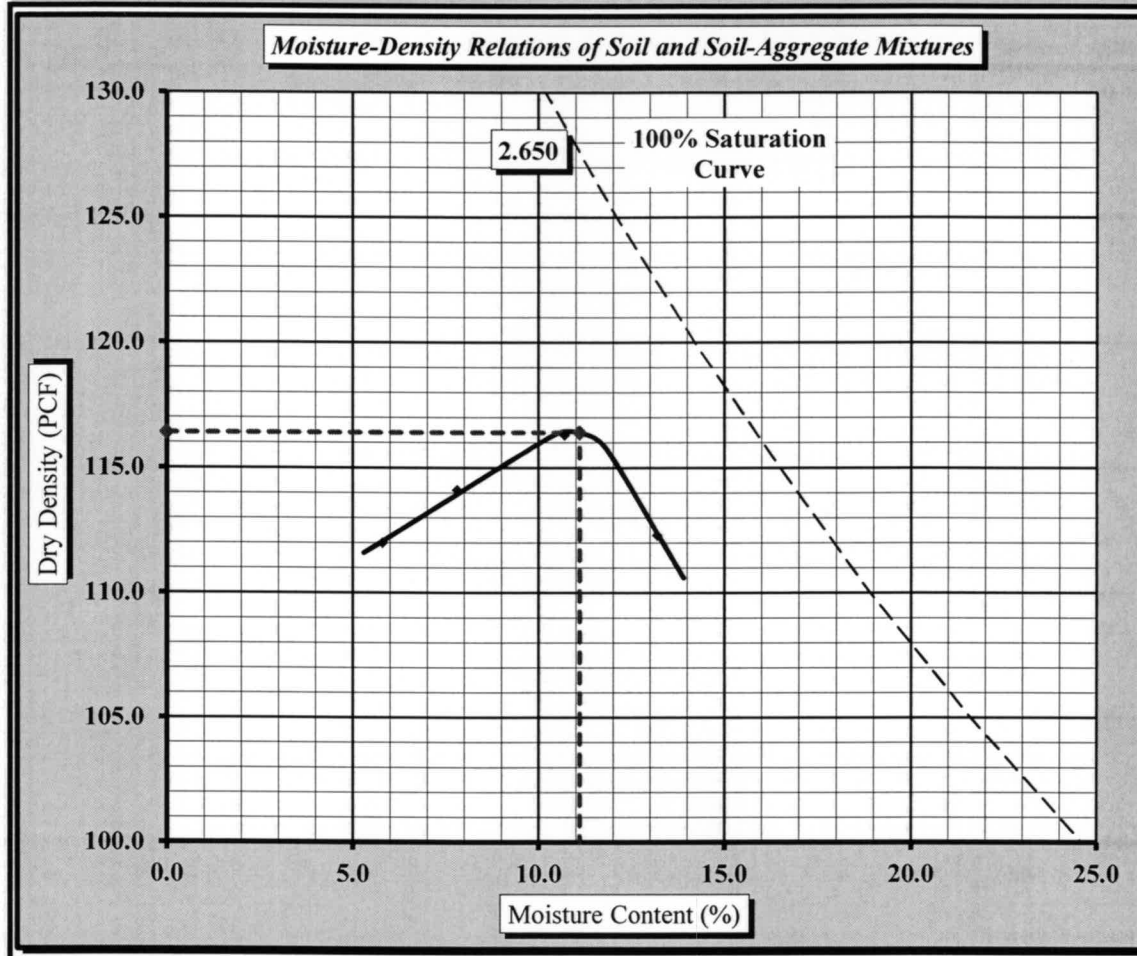


Quality Assurance

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

S&ME Project #:	1305-14-079	W-5512	Report Date:	11/5/14	
Project Name:	Tom Starling Road (SR 2220)		Test Date(s):	11/3 - 11/5/14	
Client Name:	Parsons Transportation Group, Inc.				
Client Address:	Raleigh, North Carolina				
Boring #:	B-7	Sample #:	S-2	Sample Date:	5/6/14 - 5/7/14
Location:	STA 133+80 -L-	Offset:	10' LT	Depth:	1 - 5 ft
Sample Description:	White and Gray Silty Coarse to Fine SAND (A-2-4) (0)				

Maximum Dry Density 116.4 PCF. Optimum Moisture Content 11.1%  
 AASHTO T99 -- Method A



Soil Properties	
Natural Moisture Content	1.6%
Assumed Specific Gravity	2.650
Liquid Limit	14
Plastic Limit	0
Plastic Index	N.P.
% Passing	
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#40	83.0%
#60	67.0%
#200	23.5%
Oversize Fraction	
Bulk Gravity	
% Moisture	
% Oversize	
MDD	
Opt. MC	

Moisture-Density Curve Displayed: Fine Fraction  Corrected for Oversize Fraction (ASTM D 4718)   
 Sieve Size used to separate the Oversize Fraction: #4 Sieve  3/8 inch Sieve  3/4 inch Sieve   
 Mechanical Rammer  Manual Rammer  Moist Preparation  Dry Preparation

References / Comments / Deviations:  
 AASHTO T88: Particle Size Analysis of Soils  
 AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T 99: Moisture-Density Relations of Soil Using a 5.5 Lb. Rammer and a 12" Drop

Mal Krajan, ET 104-01-0703 Laboratory Manager 11/5/14  
 Technical Responsibility Certification # Position Date

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CBR (California Bearing Ratio) of Laboratory

Compacted Soil

AASHTO T 193

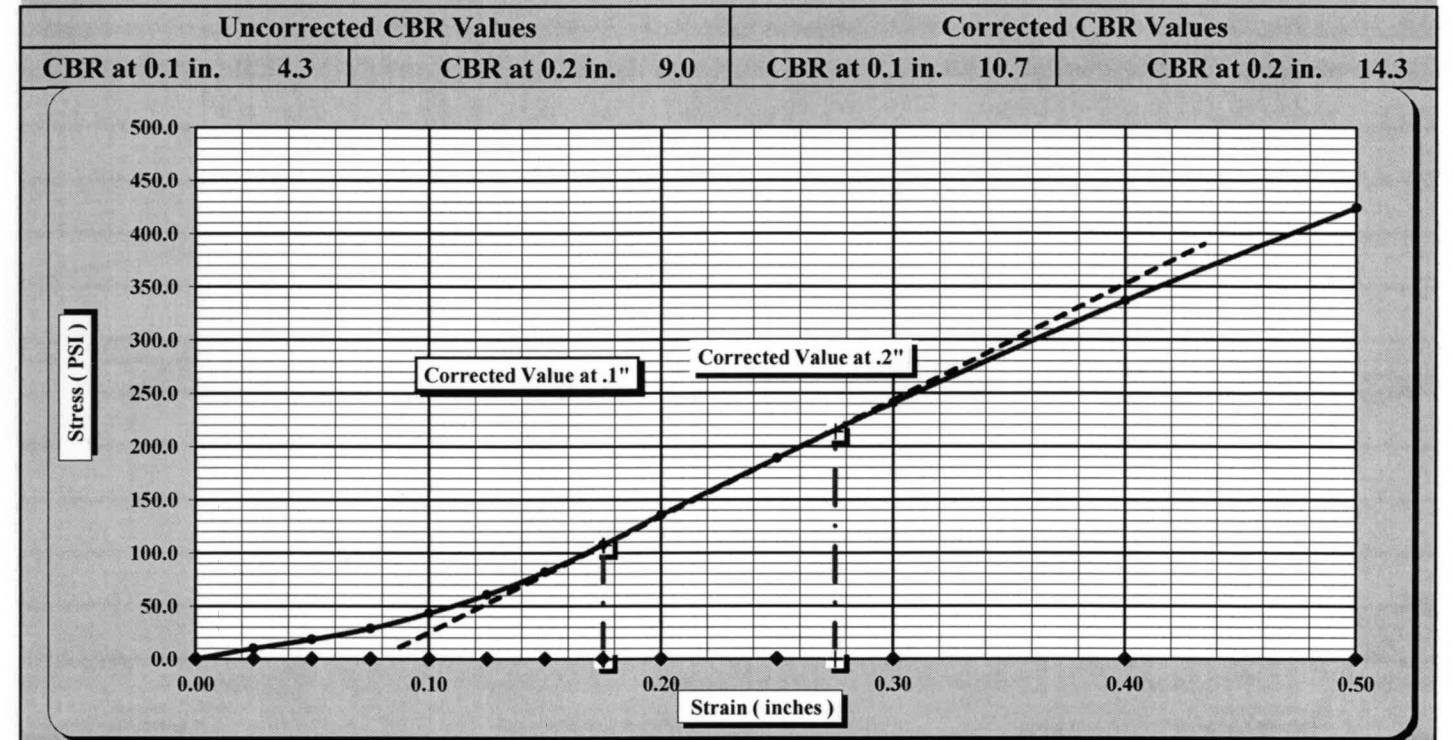


Quality Assurance

S&ME, Inc. Raleigh, 3201 Spring Forest Road, Raleigh, North Carolina 27616

Project #:	1305-14-079	W-5512	Report Date:	11/10/14	
Project Name:	Tom Starling Road (SR 2220)		Test Date(s):	11/3 - 10/10/14	
Client Name:	Parsons Transportation Group, Inc.				
Client Address:	Raleigh, North Carolina				
Boring #:	B-7	Sample #:	S-2	Sample Date:	10/27/14
Location:	STA 133+80 -L-	Offset:	10' LT	Depth (ft):	1 - 5 ft.
Sample Description:	White and Gray Silty Coarse to Fine SAND (A-2-4) (0)				

AASHTO T99 Method A Maximum Dry Density: 116.4 PCF Optimum Moisture Content: 11.1%  
 Compaction Test performed on grading complying with CBR spec. % Retained on the 3/4" sieve: 0.0%



CBR Sample Preparation:		Performed on the fine fraction	
The entire gradation was used and compacted in a 6" CBR mold in accordance with			
Before Soaking		After Soaking	
Compactive Effort (Blows per Layer)	65	Final Dry Density (PCF)	115.0
Initial Dry Density (PCF)	116.0	Average Final Moisture Content	15.1%
Moisture Content of the Compacted Specimen	13.9%	Moisture Content (top 1" after soaking)	15.8%
Percent Compaction	99.7%	Percent Swell	-0.2%
Soak Time:	96-hr	Surcharge Weight	10.0
Liquid Limit	14	Surcharge Wt. per sq. Ft.	50.9
		Plastic Index	N.P.

Notes/Deviations/References:  
 Test specimen was compacted to 100% at 3% wet of optimum moisture content.

Mal Krajan, ET 11/10/14 Laboratory Manager  
 Technical Responsibility Signature Position Date

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