

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

STRUCTURE
SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. B-4991 F.A. PROJ. N/A
 COUNTY WAKE
 PROJECT DESCRIPTION BRIDGE No. 359 OVER BEAVER CREEK ON
KELLY ROAD

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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) 250-4086. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE 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 THIS 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.

PROJECT: B-4991 ID: N/A

PERSONNEL

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INVESTIGATED BY MACTEC

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SUBMITTED BY B. Deobald

DATE 08/12/11

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NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IT IS CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

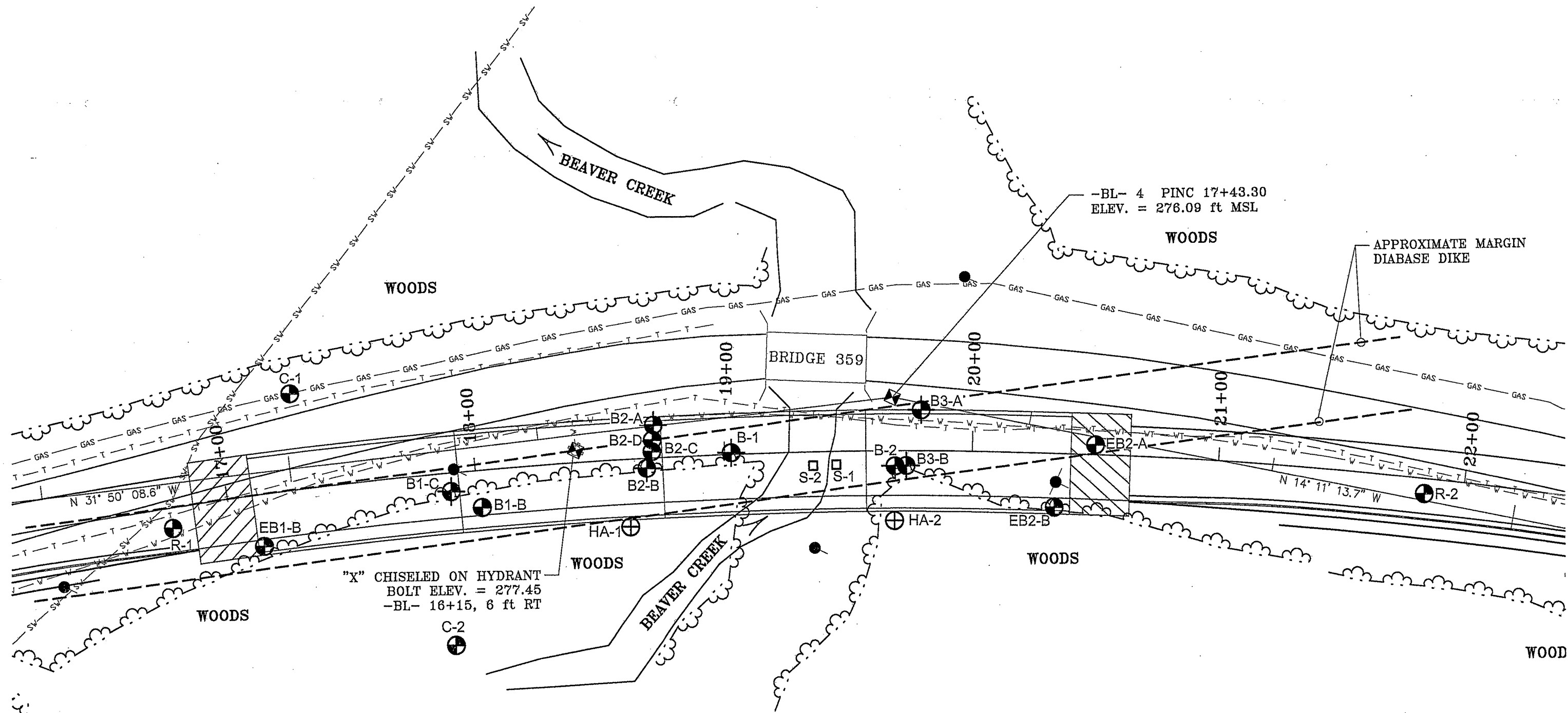
NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

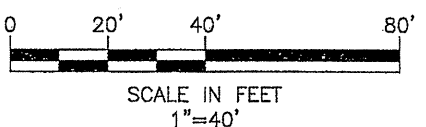
SOIL DESCRIPTION	GRADATION	ROCK DESCRIPTION	TERMS AND DEFINITIONS
SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (ASTM T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE: <i>VERY STIFF, GRAY, SILTY CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i>	WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED) GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES. ANGULARITY OF GRAINS THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: <u>ANGULAR</u> , <u>SUBANGULAR</u> , <u>SUBROUNDED</u> , OR <u>ROUNDED</u> .	HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. 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 (CPS) - COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.	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, 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 DISLOGGED 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.
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-7 SYMBOL	MINERALOGICAL COMPOSITION MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE. COMPRESSIBILITY SLIGHTLY COMPRESSIBLE LIQUID LIMIT LESS THAN 31 MODERATELY COMPRESSIBLE LIQUID LIMIT EQUAL TO 31-50 HIGHLY COMPRESSIBLE LIQUID LIMIT GREATER THAN 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	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, YIELDS SPT N VALUES > 100 BPF</i> VERY SEVERE (V SEV.) ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, YIELDS SPT N VALUES < 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.	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 DISLOGGED 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. 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TEXTURE OR GRAIN SIZE U.S. STD. SIEVE SIZE OPENING (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 75 2.0 0.25 0.05 0.005 IN. 12 3	MISCELLANEOUS SYMBOLS 	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 0.25 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 FINGER NAIL.	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.
CONSISTENCY OR DENSITY PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY PENETRATION RESISTANCE (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 0.50 0.5 TO 1.0 1 TO 2 2 TO 4 >4	ABBREVIATIONS AR - AUGER REFUSAL MED. - MEDIUM VST - VANE SHEAR TEST BT - BORING TERMINATED MICA - MICACEOUS WEA - WEATHERED CL - CLAY MOD. - MODERATELY UNIT WEIGHT CPT - CONE PENETRATION TEST NP - NON PLASTIC ORG. - ORGANIC DRY UNIT WEIGHT CSE. - COARSE PMT - PRESSUREMETER TEST DMT - DILATOMETER TEST SAP. - SAPROLITIC SAMPLE ABBREVIATIONS DPT - DYNAMIC PENETRATION TEST SD. - SAND, SANDY S - BULK F - FINE SL. - SILT, SILTY SS - SPLIT SPOON FOSS. - FOSSILIFEROUS SLI. - SLIGHTLY ST - SHELFY TUBE FRAC. - FRACTURED, FRACTURES TCR - TRICONE REFUSAL RT - RECOMPACTED TRIAXIAL FRAGS. - FRAGMENTS # - MOISTURE CONTENT CBR - CALIFORNIA BEARING RATIO HL - HIGHLY V - VERY	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 0.25 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 FINGER NAIL.	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.
SOIL MOISTURE - CORRELATION OF TERMS SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION LL - LIQUID LIMIT - SATURATED - (SAT.) USUALLY LIQUID; VERY WET, USUALLY PLASTIC RANGE (PI) PL - PLASTIC LIMIT - WET - (W) SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE OM - OPTIMUM MOISTURE - MOIST - (M) SOLID; AT OR NEAR OPTIMUM MOISTURE SL - SHRINKAGE LIMIT - DRY - (D) REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE	EQUIPMENT USED ON SUBJECT PROJECT DRILL UNITS: <input type="checkbox"/> MOBILE B- <input type="checkbox"/> BK-51 <input checked="" type="checkbox"/> CME-55B <input checked="" type="checkbox"/> CME-55 LC <input type="checkbox"/> PORTABLE HOIST <input checked="" type="checkbox"/> D-50 ATV ADVANCING TOOLS: <input type="checkbox"/> CLAY BITS <input type="checkbox"/> 6" CONTINUOUS FLIGHT AUGER <input type="checkbox"/> 6" HOLLOW AUGERS <input type="checkbox"/> HARD FACED FINGER BITS <input type="checkbox"/> TUNG-CARBIDE INSERTS <input checked="" type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER <input checked="" type="checkbox"/> TRICONE 3", 4" STEEL TEETH <input type="checkbox"/> TRICONE _____ STEEL TEETH <input checked="" type="checkbox"/> CORE BIT <input type="checkbox"/> _____ HAMMER TYPE: <input checked="" type="checkbox"/> AUTOMATIC <input checked="" type="checkbox"/> MANUAL CORE SIZE: <input type="checkbox"/> B- <input checked="" type="checkbox"/> N-Q <input checked="" type="checkbox"/> H-Q HAND TOOLS: <input type="checkbox"/> POST HOLE DIGGER <input checked="" type="checkbox"/> HAND AUGER <input type="checkbox"/> SOUNDING ROD <input type="checkbox"/> VANE SHEAR TEST	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 0.25 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 FINGER NAIL.	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.
PLASTICITY PLASTICITY INDEX (PI) DRY STRENGTH NONPLASTIC 0-5 VERY LOW LOW PLASTICITY 6-15 SLIGHT MED. PLASTICITY 16-25 MEDIUM HIGH PLASTICITY 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.	FRACATURE SPACING TERM SPACING TERM THICKNESS VERY WIDE MORE THAN 10 FEET VERY THICKLY BEDDED > 4 FEET WIDE 3 TO 10 FEET THICKLY BEDDED 1.5 - 4 FEET MODERATELY CLOSE 1 TO 3 FEET THINLY BEDDED 0.16 - 1.5 FEET CLOSE 0.16 TO 1 FEET 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	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 0.25 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 FINGER NAIL.	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.
		INDURATION FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE 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.	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.
			NOTES: GEOTECHNICAL EXPLORATION PERFORMED BY: MACTEC ENGINEERING & CONSULTING, INC. 4021 STIRRUP CREEK DRIVE, SUITE 100 DURHAM, NORTH CAROLINA 27703 (919) 381-9900



"X" CHISELED ON HYDRANT
 BOLT ELEV. = 277.45
 -BL- 16+15, 6 ft RT

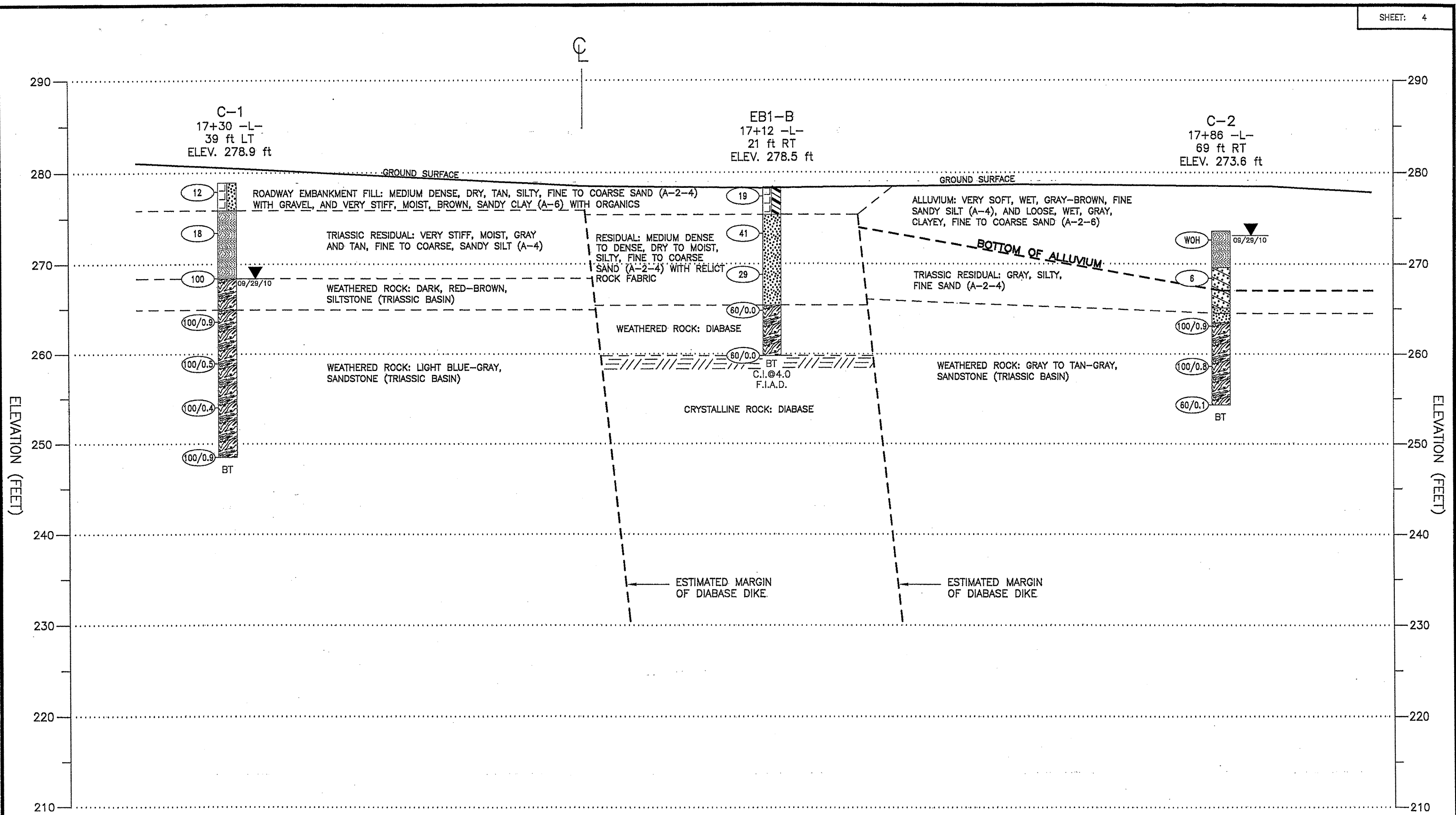
-BL- 4 PINC 17+43.30
 ELEV. = 276.09 ft MSL

APPROXIMATE MARGIN
 DIABASE DIKE



BORING LOCATION PLAN
 BRIDGE No. 359 OVER BEAVER CREEK ON KELLY ROAD
 PROJECT REFERENCE NO. B-4991
 WAKE COUNTY, NORTH CAROLINA

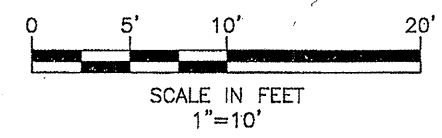
MACTEC ENGINEERING AND CONSULTING, INC. DURHAM, NORTH CAROLINA			
REVISIONS	DRAWN: R.R.	DATE: 08/12/11	
	DFT CHECK: W.B.D.	JOB: 646B-10-0203	
	ENG CHECK: J.E.V.	DWG: 1	



ELEVATION (FEET)

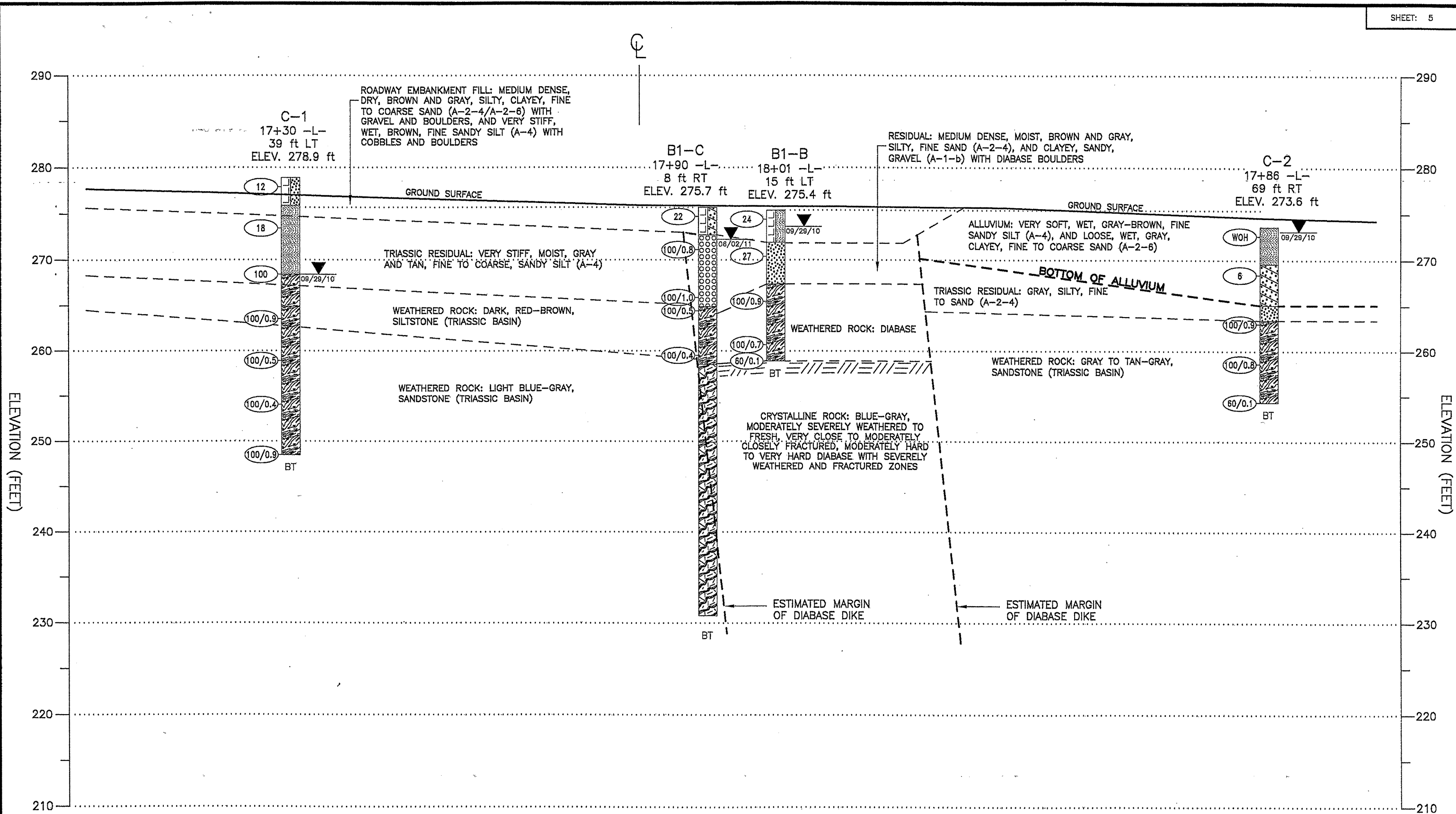
ELEVATION (FEET)

-GROUNDLINE SURVEYED BY MACTEC ALONG CROSS SECTION ON 6/2/11.
-INFERRED STRATIGRAPHY IS DRAWN ALONG CROSS SECTION WITH BORINGS PROJECTED ONTO THE CROSS SECTION.

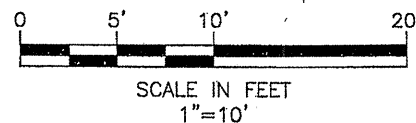


CROSS SECTION ALONG END BENT 1
BRIDGE No. 359 OVER BEAVER CREEK ON KELLY ROAD
PROJECT REFERENCE NO. B-4991
WAKE COUNTY, NORTH CAROLINA

MACTEC ENGINEERING AND CONSULTING, INC. DURHAM, NORTH CAROLINA			
REVISIONS	DRAWN: R.R.	DATE: 08/12/11	
	DFT CHECK: W.B.D.	JOB: 6468-10-0203	
	ENG CHECK: J.E.V.	DWG: 2	



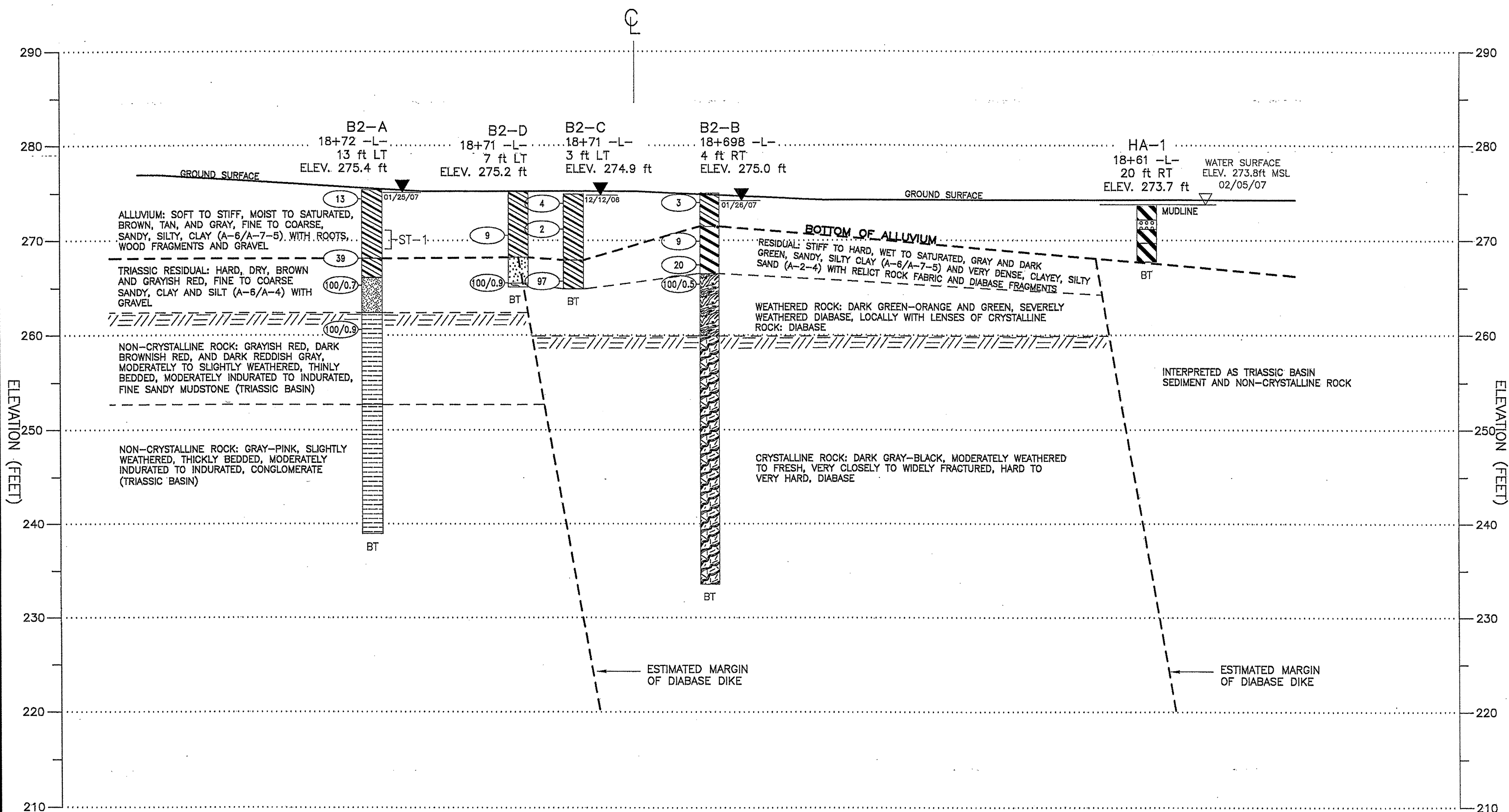
-GROUNDLINE SURVEYED BY MACTEC ALONG CROSS SECTION ON 6/2/11.
 -INFERRED STRATIGRAPHY IS DRAWN ALONG CROSS SECTION WITH BORINGS PROJECTED ONTO THE CROSS SECTION.



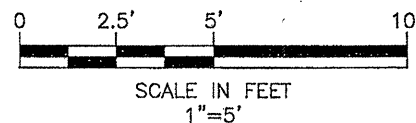
CROSS SECTION ALONG BENT 1
 BRIDGE No. 359 OVER BEAVER CREEK ON KELLY ROAD
 PROJECT REFERENCE NO. B-4991
 WAKE COUNTY, NORTH CAROLINA

MACTEC ENGINEERING AND CONSULTING, INC.
 DURHAM, NORTH CAROLINA

REVISIONS	DRAWN:	R.R.	DATE:
	DFT CHECK:	W.B.D.	08/12/11
	ENG CHECK:	J.E.V.	JOB: 6468-10-0203
			DWG: 3



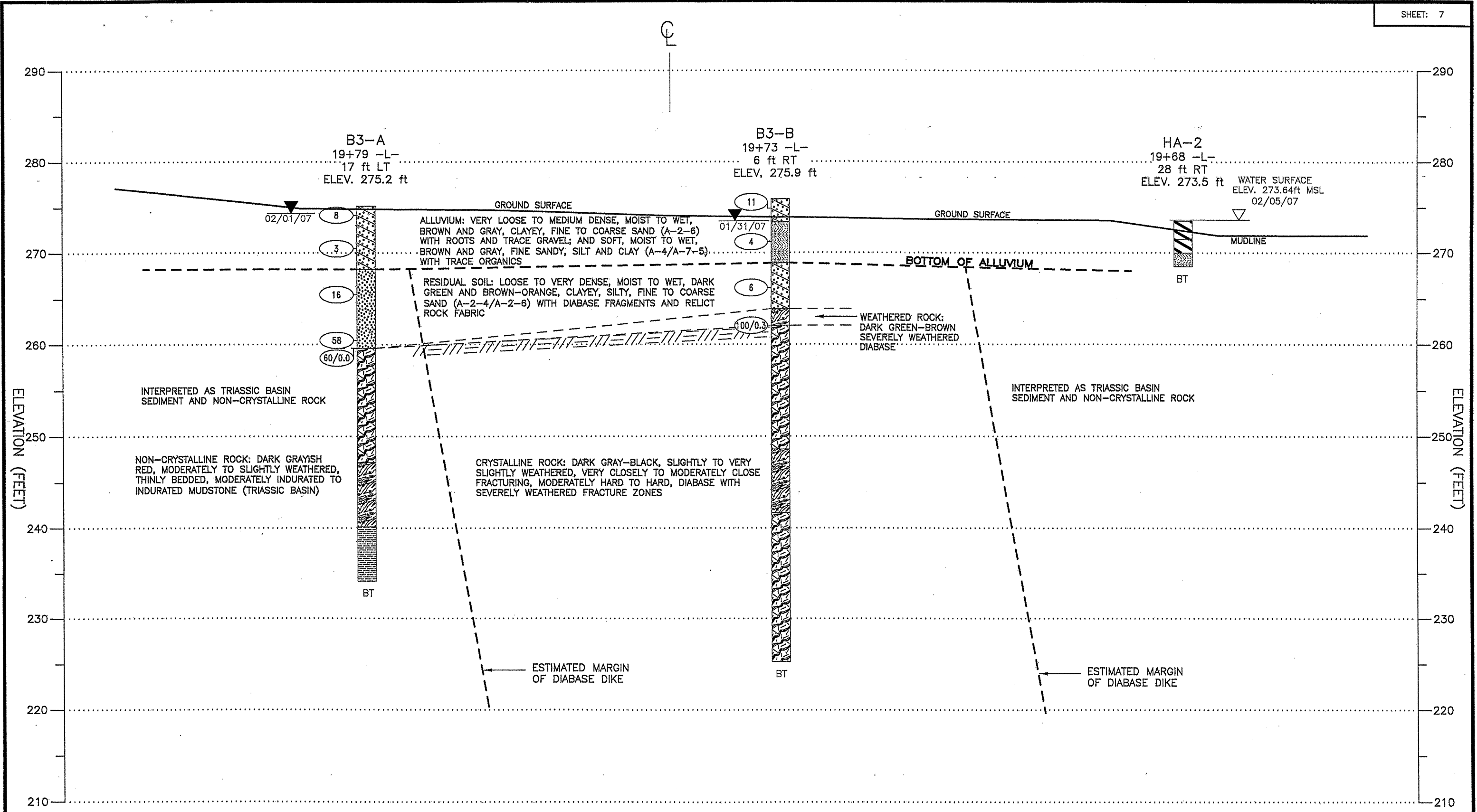
-GROUNDLINE SURVEYED BY MACTEC ALONG CROSS SECTION ON 6/2/11.
 -INFERRED STRATIGRAPHY IS DRAWN ALONG CROSS SECTION WITH BORINGS PROJECTED ONTO THE CROSS SECTION.



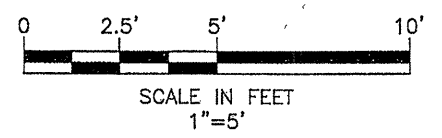
CROSS SECTION ALONG BENT 2
 BRIDGE No. 359 OVER BEAVER CREEK ON KELLY ROAD
 PROJECT REFERENCE NO. B-4991
 WAKE COUNTY, NORTH CAROLINA

MACTEC ENGINEERING AND CONSULTING, INC.
 DURHAM, NORTH CAROLINA

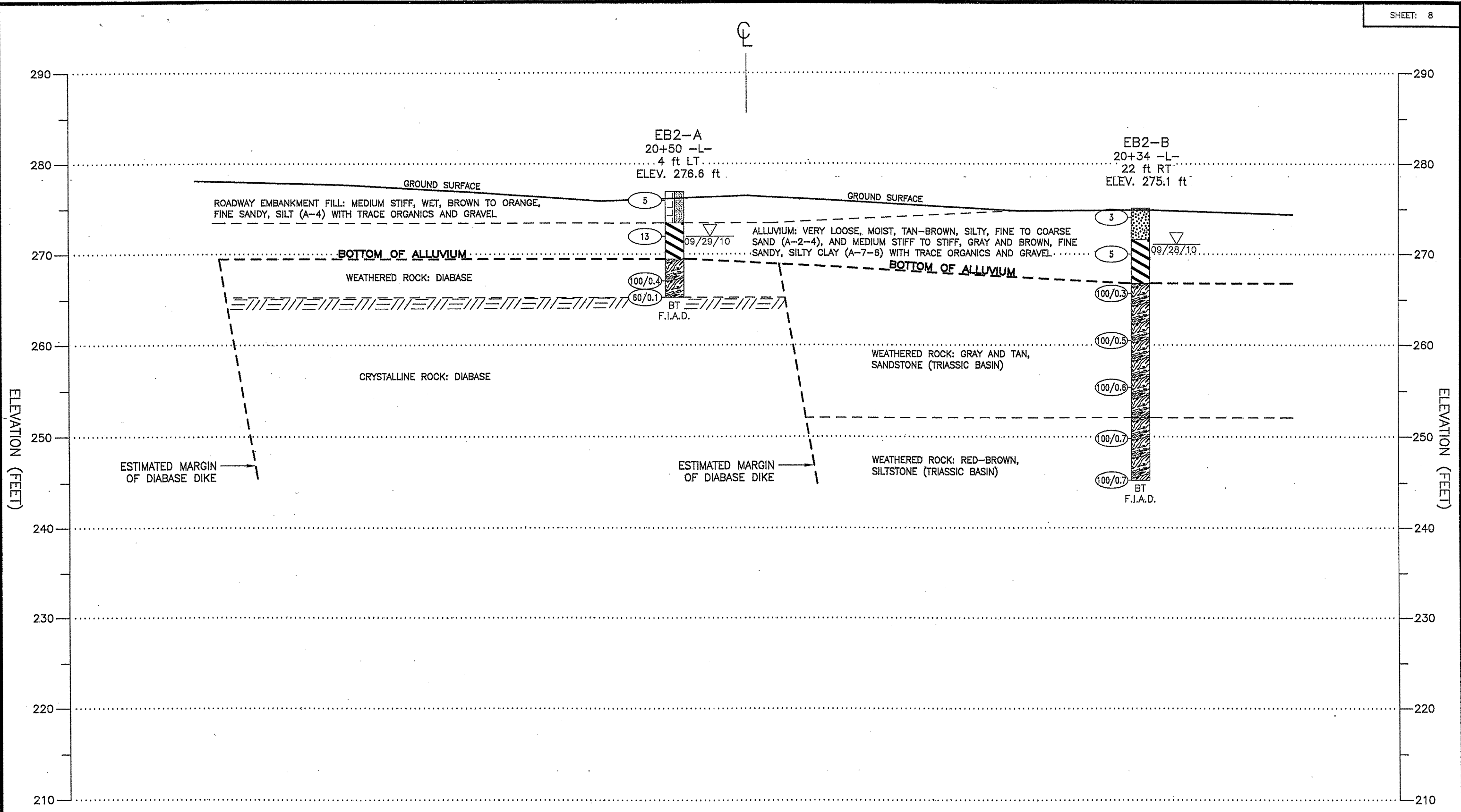
REVISIONS	DRAWN:	R.R.	DATE:
	DFT CHECK:	W.B.D.	08/12/11
	ENG CHECK:	J.E.V.	JOB: 6468-10-0203
			DWG: 4



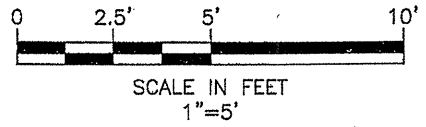
-GROUNDLINE SURVEYED BY MACTEC ALONG CROSS SECTION ON 6/2/11.
-INFERRED STRATIGRAPHY IS DRAWN ALONG CROSS SECTION WITH BORINGS PROJECTED ONTO THE CROSS SECTION.



CROSS SECTION ALONG BENT 3 BRIDGE No. 359 OVER BEAVER CREEK ON KELLY ROAD PROJECT REFERENCE NO. B-4991 WAKE COUNTY, NORTH CAROLINA				MACTEC ENGINEERING AND CONSULTING, INC. DURHAM, NORTH CAROLINA			
REVISIONS	DRAWN:	R.R.	DATE:	08/12/11			
	DFT CHECK:	W.B.D.	JOB:	6468-10-0203			
	ENG CHECK:	J.E.V.	DWG:	5			



-GROUNDLINE SURVEYED BY MACTEC ALONG CROSS SECTION ON 6/2/11.
 -INFERRED STRATIGRAPHY IS DRAWN ALONG CROSS SECTION WITH BORINGS PROJECTED ONTO THE CROSS SECTION.



CROSS SECTION ALONG END BENT 2 BRIDGE No. 359 OVER BEAVER CREEK ON KELLY ROAD PROJECT REFERENCE NO. B-4991 WAKE COUNTY, NORTH CAROLINA			MACTEC ENGINEERING AND CONSULTING, INC. DURHAM, NORTH CAROLINA		
			REVISIONS	DRAWN: R.R.	DATE: 08/12/11
	DFT CHECK: W.B.D.	JOB: 6468-10-0203			
	ENG CHECK: J.E.V.	DWG: 6			

PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST B. Deobald									
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)								
BORING NO. R-1		STATION 16+76		OFFSET 8 ft RT		ALIGNMENT -L-									
COLLAR ELEV. 279.3 ft		TOTAL DEPTH 13.5 ft		NORTHING 720,412		EASTING 2,031,392									
DRILL MACHINE D-50		DRILL METHOD Mud Rotary		HAMMER TYPE Manual											
DRILLER T. Hahn		START DATE 12/11/06		COMP. DATE 12/11/06		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280	279.3	0.0												279.3	0.0
			2	2	5									276.8	2.5
275	275.4	3.9	10	11	15									276.8	2.5
270	270.4	8.9	5	8	8										
265	265.8	13.5	60/0.0											265.8	13.5
260															
255															
250															
245															
240															
235															
230															
225															
220															
215															
210															
205															
200															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST J.Howard									
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)								
BORING NO. EB1-B		STATION 17+12		OFFSET 21 ft RT		ALIGNMENT -L-									
COLLAR ELEV. 278.5 ft		TOTAL DEPTH 18.6 ft		NORTHING 720,449		EASTING 2,031,383									
DRILL MACHINE CME-55LC		DRILL METHOD H.S. Augers/Mud Rotary		HAMMER TYPE Automatic											
DRILLER D.White		START DATE 05/26/11		COMP. DATE 06/02/11		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280	278.5	0.0												278.5	0.0
			5	7	12									275.5	3.0
275	274.4	4.1	5	13	28									275.5	3.0
270	269.9	8.6	13	7	22										
265	264.9	13.6	60/0.0											265.5	13.0
260	259.9	18.6	60/0.0											259.9	18.6
255															
250															
245															
240															
235															
230															
225															
220															
215															
210															
205															
200															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11



NCDOT GEOTECHNICAL ENGINEERING UNIT

BORELOG REPORT

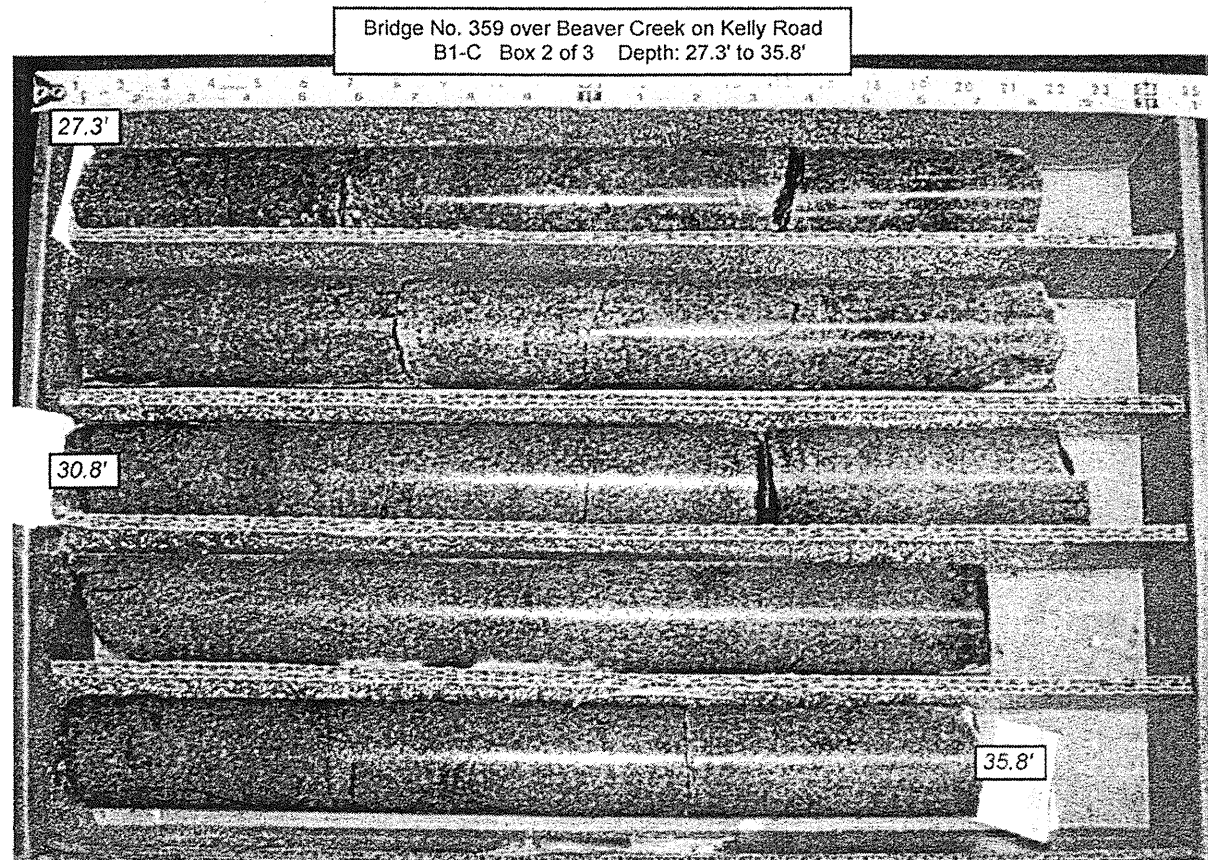
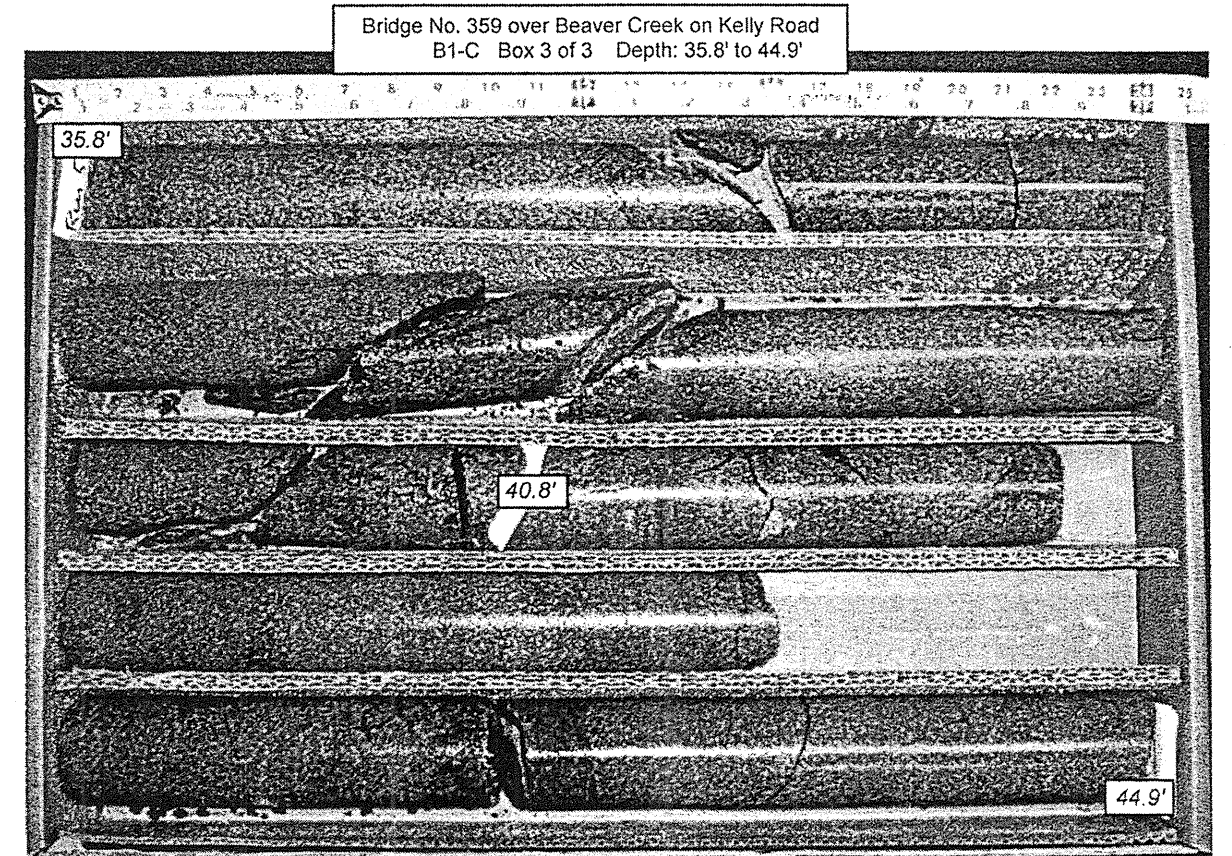
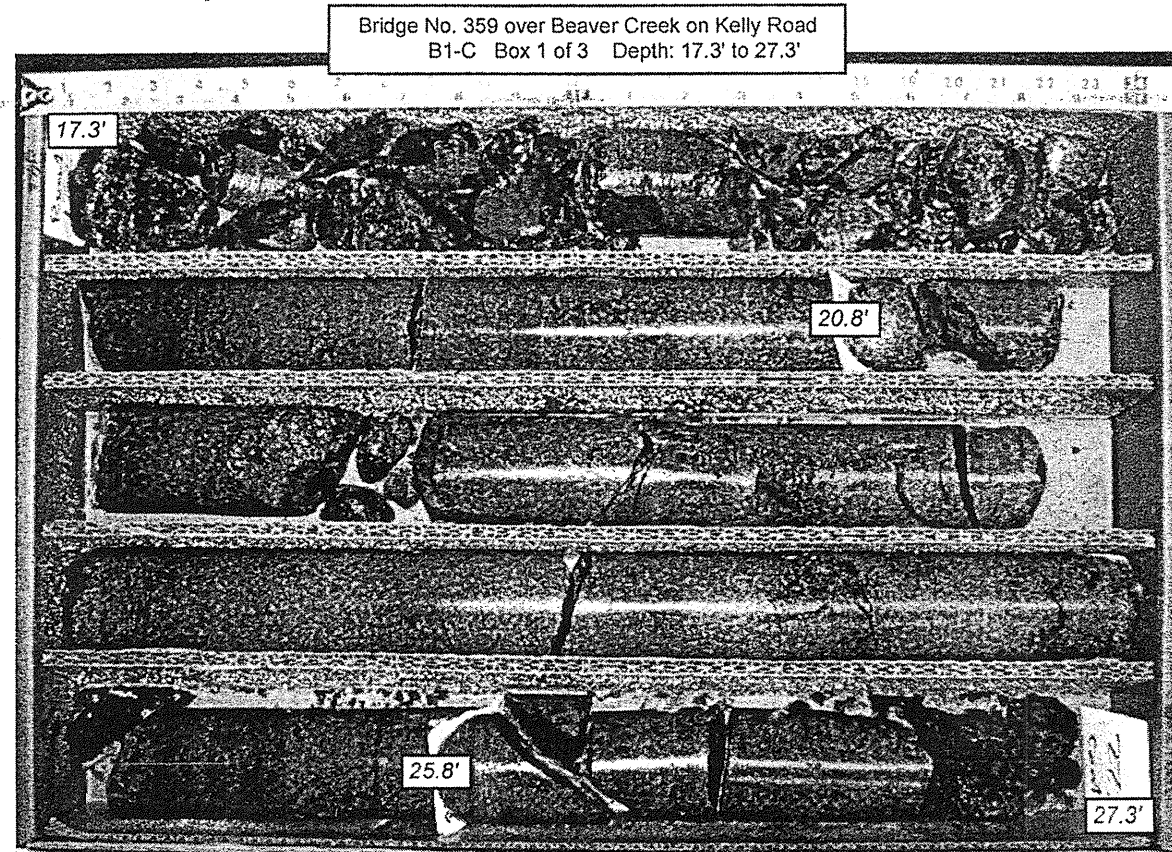
PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST J. Howard
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. C-1	STATION 17+30	OFFSET 39 ft LT	ALIGNMENT -L-
COLLAR ELEV. 278.9 ft	TOTAL DEPTH 30.4 ft	NORTHING 720,432	EASTING 2,031,323
DRILL MACHINE CME-55	DRILL METHOD H.S. Augers	HAMMER TYPE Automatic	
DRILLER P. Pitts	START DATE 09/28/10	COMP. DATE 09/28/10	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280	278.9	0.0												GROUND SURFACE	0.0
275	274.4	4.5	5	8	4	12							D	ROADWAY EMBANKMENT Tan, silty, fine to coarse SAND (A-2-4), with trace gravel sized rock fragments	3.0
270	269.4	9.5	5	10	8	18							M	TRIASSIC RESIDUAL Gray and tan, fine to coarse sandy, SILT (A-4)	
265	264.4	14.5	8	29	71					100			M	WEATHERED ROCK Dark red-brown, SILTSTONE (Triassic Basin)	10.5
260	259.4	19.5	35	65/0.4						100/0.9				WEATHERED ROCK Light blue-gray, SANDSTONE (Triassic Basin)	14.0
255	254.4	24.5	100/0.6							100/0.5					
250	249.4	29.5	100/0.4							100/0.4					
245	248.4	29.5	19	81/0.4						100/0.9					
240															
235															
230															
225															
220															
215															
210															
205															
200															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

Core Photos
MACTEC Proj. No. 6468-04-0743/6468-10-0203

Bridge No. 359 over Beaver Creek on Kelly Road
NCDOT TIP B-4991



PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST J. Howard										
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)									
BORING NO. B1-B		STATION 18+01		OFFSET 15 ft RT		ALIGNMENT -L-										
COLLAR ELEV. 275.4 ft		TOTAL DEPTH 16.5 ft		NORTHING 720,521		EASTING 2,031,332										
DRILL MACHINE CME-55		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic												
DRILLER P. Pitts		START DATE 09/28/10		COMP. DATE 09/28/10		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
280																
275	275.4	0.0													275.4	0.0
			24	18	6											
270	271.4	4.0	7	14	13										271.9	3.5
265	266.4	9.0	45	55/0.4											267.4	8.0
260	261.4	14.0	55	45/0.2											267.4	8.0
255	259.0	16.4	60/0.1												258.9	16.5
250																
245																
240																
235																
230																
225																
220																
215																
210																
205																
200																

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST J. Howard										
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)									
BORING NO. C-2		STATION 17+86		OFFSET 69 ft RT		ALIGNMENT -L-										
COLLAR ELEV. 273.6 ft		TOTAL DEPTH 19.3 ft		NORTHING 720,535		EASTING 2,031,387										
DRILL MACHINE CME-55		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic												
DRILLER P. Pitts		START DATE 09/28/10		COMP. DATE 09/28/10		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
275																
															273.6	0.0
270	269.4	4.2													269.6	4.0
265	264.4	9.2													265.1	8.5
															263.4	10.2
260	259.4	14.2														
255	254.4	19.2													254.3	19.3
250																
245																
240																
235																
230																
225																
220																
215																
210																
205																
200																
195																

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B2-A	STATION 18+72	OFFSET 13 ft LT	ALIGNMENT -L- 0 HR. 3.3
COLLAR ELEV. 275.4 ft	TOTAL DEPTH 36.5 ft	NORTHING 720,569	EASTING 2,031,273 24 HR. 0.3
DRILL MACHINE CME-550	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 01/23/07	COMP. DATE 01/24/07	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280															
275	275.4	0.0	3	8	5									275.4	GROUND SURFACE
270	269.1	6.3	4	9	30									268.1	ALLUVIAL Brown and gray, fine to coarse sandy, CLAY (A-6) with roots Pushed Shelby tube ST-1 from 4.3' to 6.3', recovery=1.7' (85%)
265	266.5	8.9	9	17	83/0.2									268.1	TRIASSIC RESIDUAL Brown, silty, fine to coarse sandy, CLAY (A-6) with gravel
260	261.5	13.9	70	30/0.4	100/0.9									262.4	TRIASSIC RESIDUAL Grayish red, fine sandy, SILT (A-4) NON-CRYSTALLINE ROCK Grayish red, dark brownish red, and dark reddish gray, moderately to slightly weathered, thinly bedded, moderately indurated to indurated, fine sandy MUDSTONE (Triassic Basin)
255														252.7	NON-CRYSTALLINE ROCK Gray-pink, slightly weathered, thickly bedded, moderately indurated to indurated, CONGLOMERATE (Triassic Basin)
250															
245															
240															
235														238.9	Boring Terminated at Elevation 238.9 ft in Non-Crystalline Rock: Indurated, CONGLOMERATE (Triassic Basin) Other Samples: ST-1 (4.3 - 6.3)
230															
225															
220															
215															
210															
205															
200															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

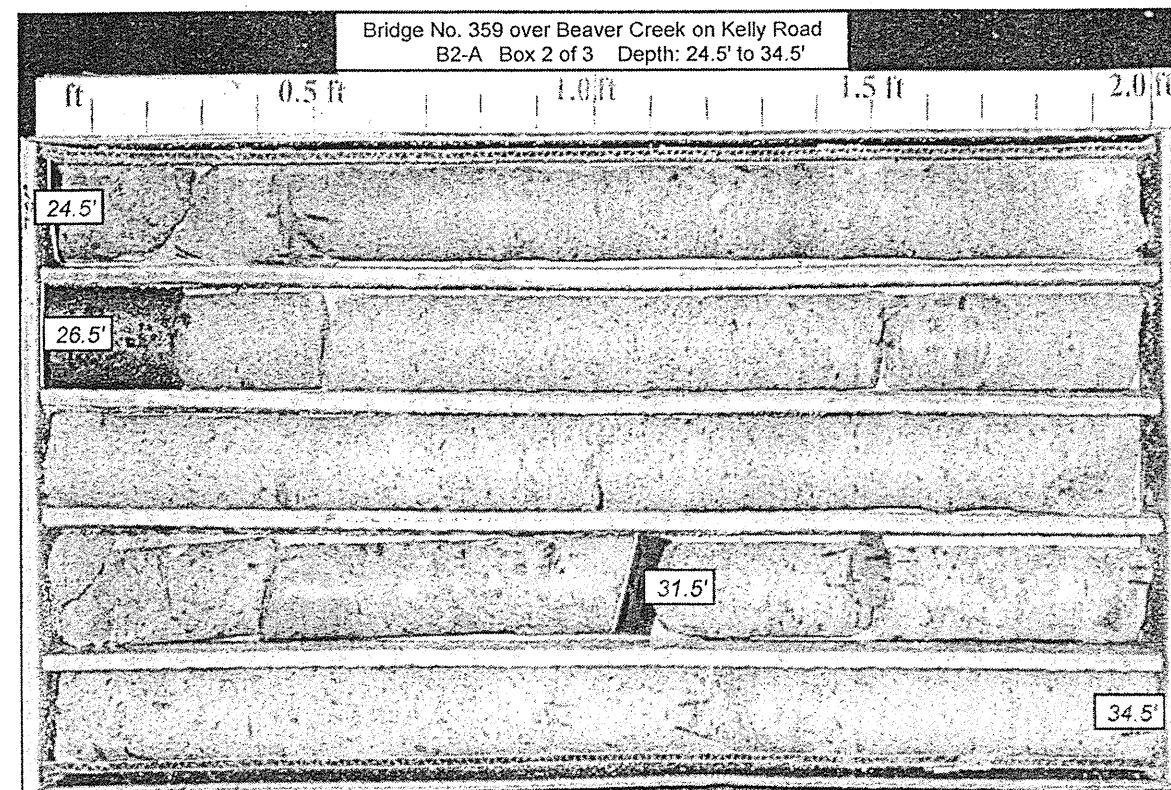
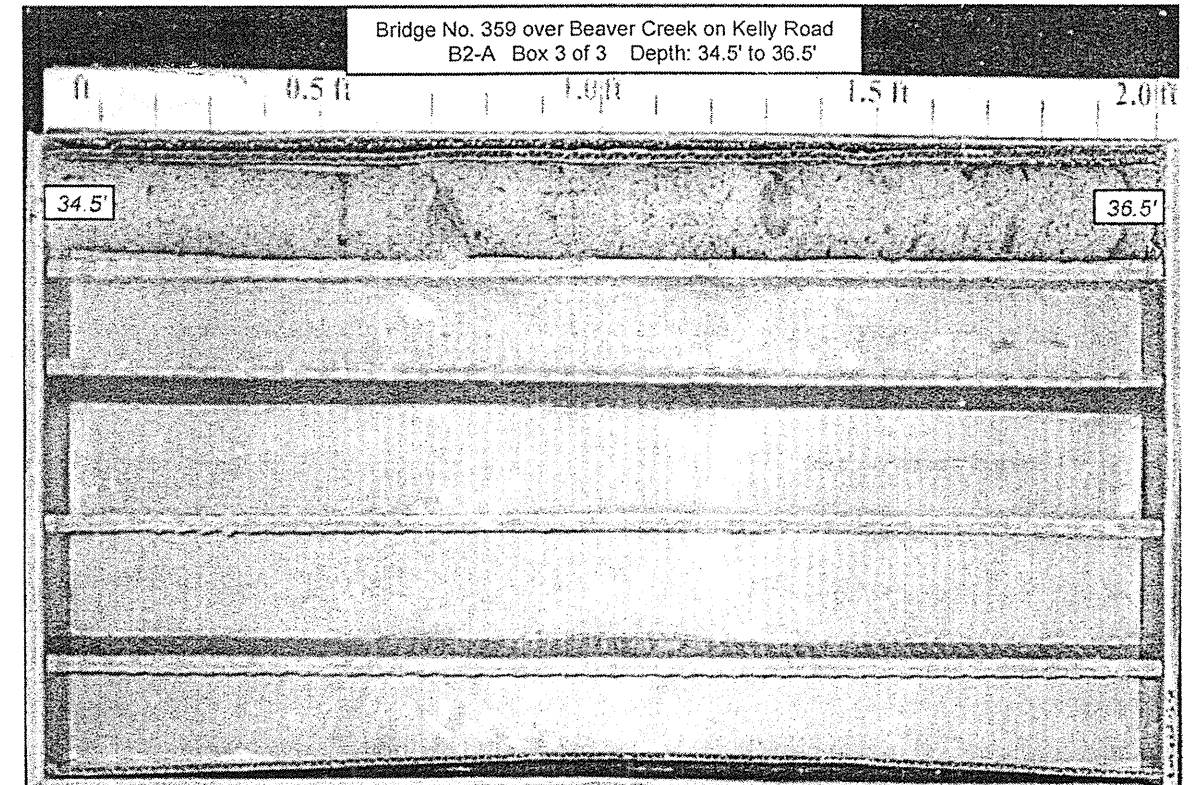
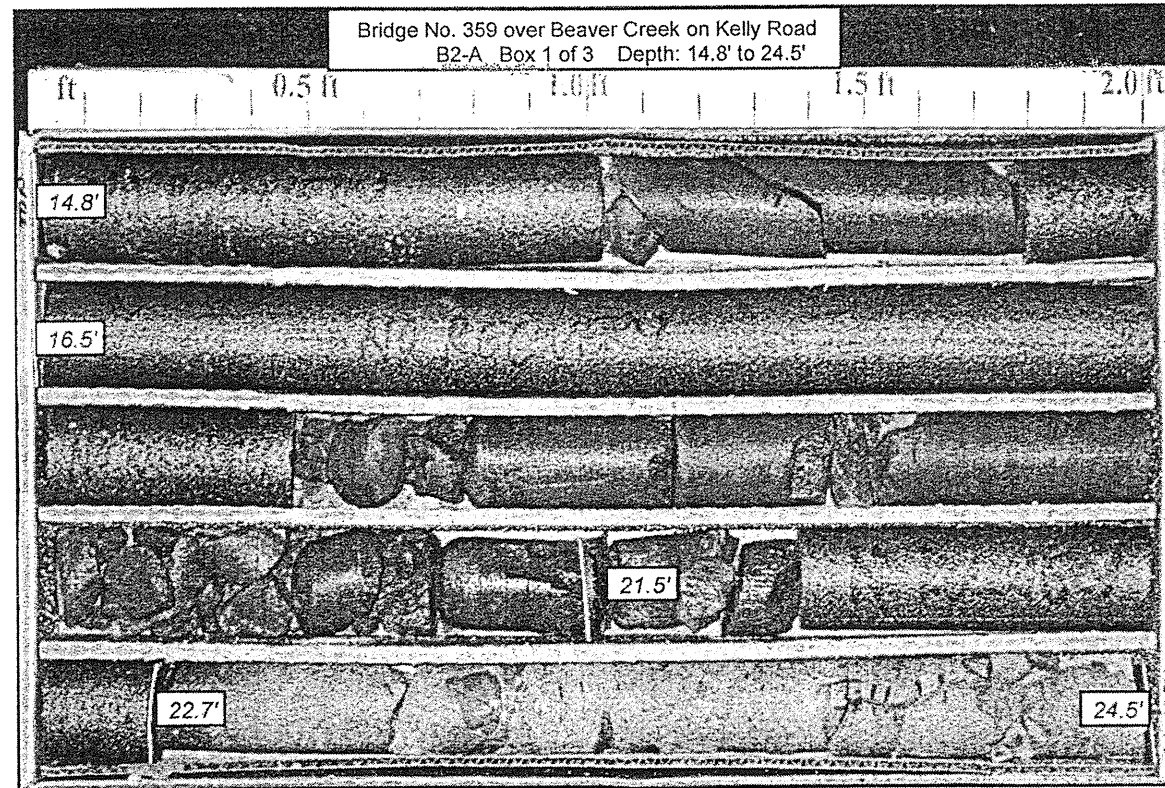
PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B2-A	STATION 18+72	OFFSET 13 ft LT	ALIGNMENT -L- 0 HR. 3.3
COLLAR ELEV. 275.4 ft	TOTAL DEPTH 36.5 ft	NORTHING 720,569	EASTING 2,031,273 24 HR. 0.3
DRILL MACHINE CME-550	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 01/23/07	COMP. DATE 01/24/07	SURFACE WATER DEPTH N/A

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (%)	RQD (%)		REC. (%)	RQD (%)			
260.61												
	260.6	14.8	1.7	4:33/0.7	(0.7)	(0.7)		(3.6)	(0.7)		Begin Coring @ 14.8 ft	
	258.9	16.5	5.0	7:01	41%	41%		46%	9%		NON-CRYSTALLINE ROCK Grayish red, dark brownish red, and dark reddish gray, moderately to slightly weathered, thinly bedded, moderately indurated to indurated, fine sandy MUDSTONE (Triassic Basin) (continued)	
255												
	253.9	21.5	5.0	3:57 5:41 4:16 11:10 10:45	(2.5)	(0.0)						
250												
	248.9	26.5	5.0	11:21 2:58 2:28 2:18 3:29	(4.2)	(3.8)		(13.5)	(13.5)		NON-CRYSTALLINE ROCK Gray-pink, slightly weathered, thickly bedded, moderately indurated to indurated, CONGLOMERATE (Triassic Basin) (1 joint at 60°)	22.7
245												
	243.9	31.5	5.0	1:38 1:34 1:42 1:36 1:48	(4.8)	(4.8)					(1 joint at 60°)	
240												
	238.9	36.5	5.0	1:32 1:37 1:36 1:32 1:35	(4.9)	(4.9)						
235												
230												
225												
220												
215												
210												
205												
200												

NCDOT CORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

Core Photos
MACTEC Proj. No. 6468-04-0743/6468-10-0203

Bridge No. 359 over Beaver Creek on Kelly Road
NCDOT TIP B-4991



PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST M. Lear										
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)									
BORING NO. B2-D		STATION 18+71		OFFSET 7 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 275.2 ft		TOTAL DEPTH 10.1 ft		NORTHING 720,571		EASTING 2,031,279										
DRILL MACHINE CME-550		DRILL METHOD Mud Rotary		HAMMER TYPE Manual												
DRILLER T. Hahn		START DATE 02/02/07		COMP. DATE 02/02/07		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
280																
275															275.2	GROUND SURFACE 0.0
270	271.5	3.7	2	3	6								W			ALLUVIAL Brown and Gray, fine to coarse sandy, CLAY (A-6) with DIABASE gravel and wood fragments
265	266.5	8.7	12	30	70/0.4								W			RESIDUAL Dark green, clayey, silty, SAND (A-2-4) with relict rock fabric
260																WEATHERED ROCK Dark green-orange, severely weathered, DIABASE (Interpreted as being along the margin of the DIABASE/Triassic Basin rock) Boring Terminated at Elevation 265.1 ft in Weathered Rock: DIABASE
255																
250																
245																
240																
235																
230																
225																
220																
215																
210																
205																
200																

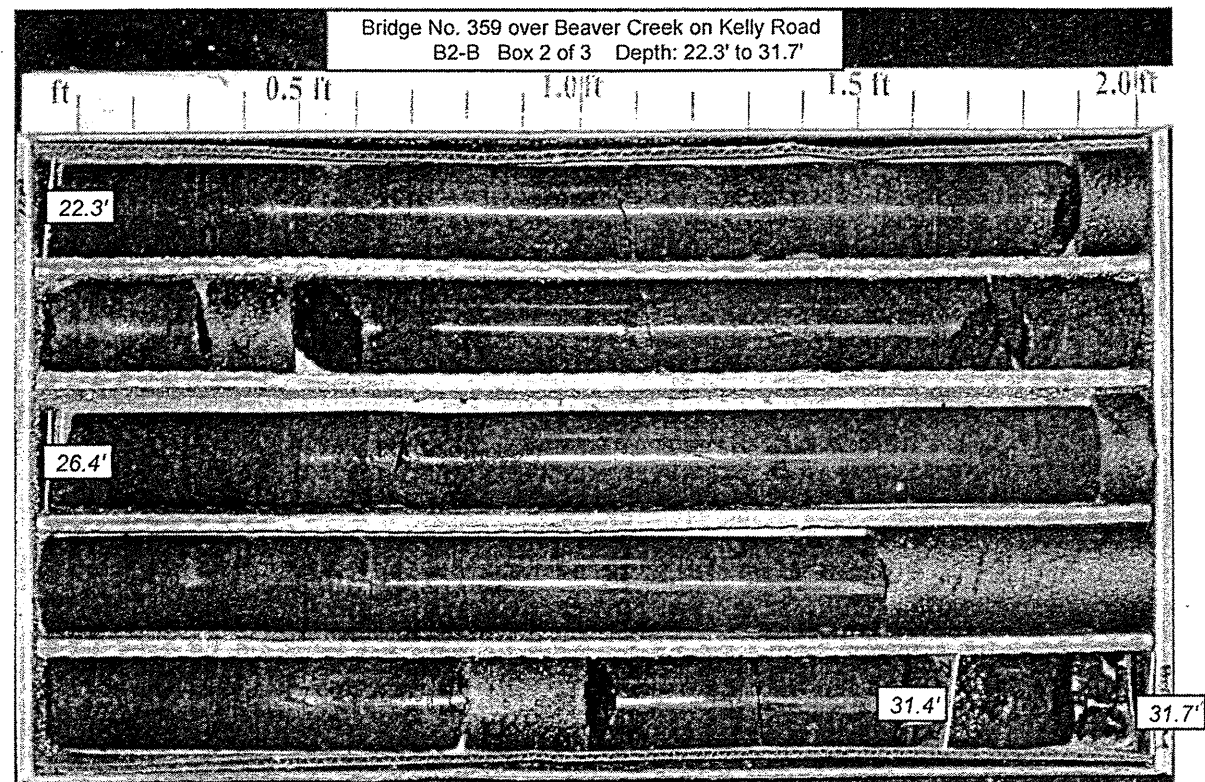
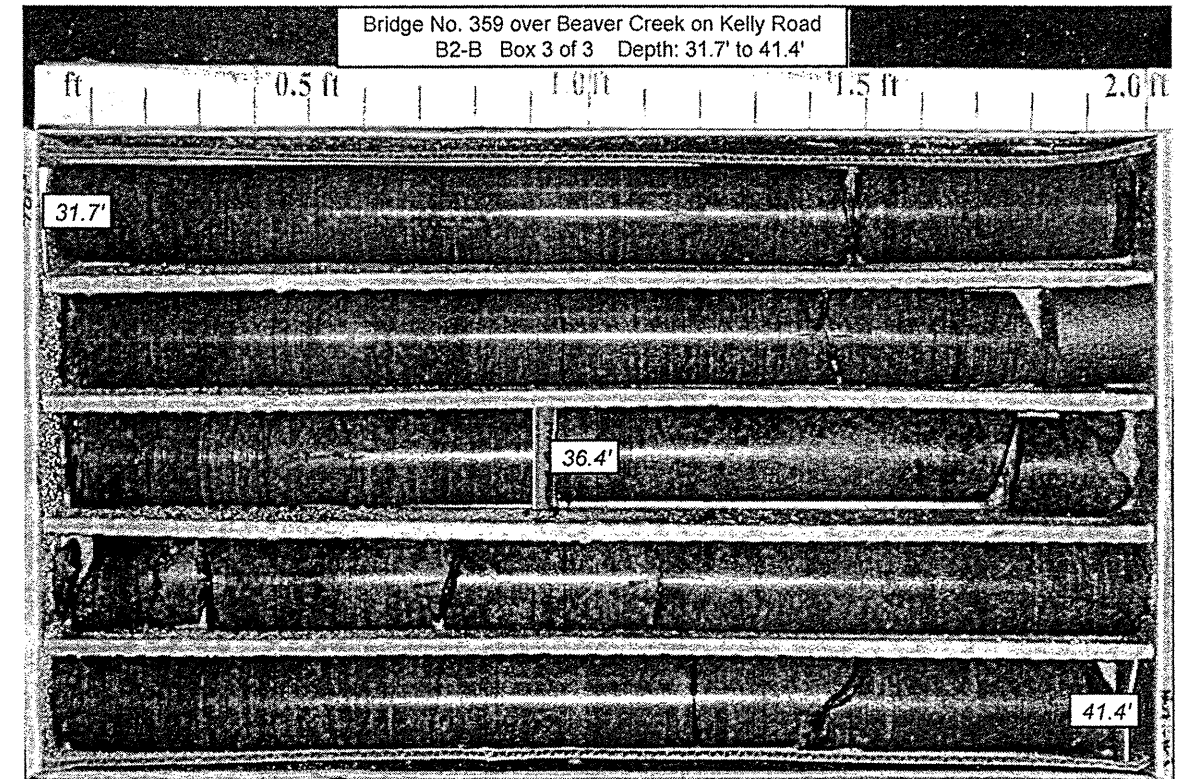
NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST B. Deobald										
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)									
BORING NO. B2-C		STATION 18+71		OFFSET 3 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 274.9 ft		TOTAL DEPTH 10.0 ft		NORTHING 720,573		EASTING 2,031,283										
DRILL MACHINE D-50		DRILL METHOD H.S. Augers		HAMMER TYPE Manual												
DRILLER T. Hahn		START DATE 12/11/06		COMP. DATE 12/11/06		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
275	274.9	0.0	2	2	2										274.9	GROUND SURFACE 0.0
270	272.2	2.7	1	1	1											ALLUVIAL Tan and gray, fine to coarse sandy, silty, CLAY (A-6) with trace roots
265	266.7	8.2	25	65	32											RESIDUAL Gray, fine to coarse sandy, silty, CLAY (A-6) with DIABASE rock fragments
260																Boring Terminated by Auger Refusal at Elevation 264.9 ft on Weathered Rock: DIABASE
255																
250																
245																
240																
235																
230																
225																
220																
215																
210																
205																
200																
195																

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

Core Photos
MACTEC Proj. No. 6468-04-0743/6468-10-0203

Bridge No. 359 over Beaver Creek on Kelly Road
NCDOT TIP B-4991





PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. HA-1	STATION 18+61	OFFSET 20 ft RT	ALIGNMENT -L- 0 HR. Water
COLLAR ELEV. 273.7 ft	TOTAL DEPTH 6.0 ft	NORTHING 720,578	EASTING 2,031,314 24 HR. Boring
DRILL MACHINE NA	DRILL METHOD Hand Auger	HAMMER TYPE N/A	
DRILLER NA	START DATE 02/05/07	COMP. DATE 02/05/07	SURFACE WATER DEPTH 0.1ft

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT				SAMP. NO.	L O G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0-0.5ft	0.5ft-1.0ft	1.0ft-1.5ft	0	25	50	75				
275													
												WATER SURFACE (02/05/07)	0.0
												ALLUVIAL Brown-gray, CLAY (A-7-5) with organics, wet	
												ALLUVIAL Brown-gray, fine to coarse SAND (A-1-b), wet	1.5
												ALLUVIAL Brownish-gray, silty, CLAY (A-7-5) with organics, saturated	2.5
270												ALLUVIAL Greenish-dark gray, silty, CLAY (A-7-5) with trace organics, saturated	4.0
												Boring Terminated at Elevation 267.7 ft in Alluvium: Silty CLAY (A-7-5) with trace organics	6.0
265													
260													
255													

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.CPJ NC_DOT_GDT_8/9/11

PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST B. Deobald
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B-1	STATION 19+03	OFFSET 1 ft LT	ALIGNMENT -L- 0 HR. 1.3
COLLAR ELEV. 274.9 ft	TOTAL DEPTH 27.0 ft	NORTHING 720,602	EASTING 2,031,270 24 HR. 1.0
DRILL MACHINE D-50	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 12/12/06	COMP. DATE 12/12/06	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
275	274.9	0.0	3	2	2						SS-3	W	GROUND SURFACE	0.0	
270	270.6	4.3	WOH		1	2								ALLUVIAL Tan and gray, clayey, silty, fine to coarse SAND (A-2-4) with trace roots	
265	265.2	9.7	22	35	65								WEATHERED ROCK DIABASE	8.2	
260													CRYSTALLINE ROCK Dark gray, very slightly weathered to fresh, close to moderately close fracturing, very hard, DIABASE	11.7	
255															
250															
245													Boring Terminated at Elevation 247.9 ft in Crystalline Rock: Very hard, DIABASE	27.0	

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

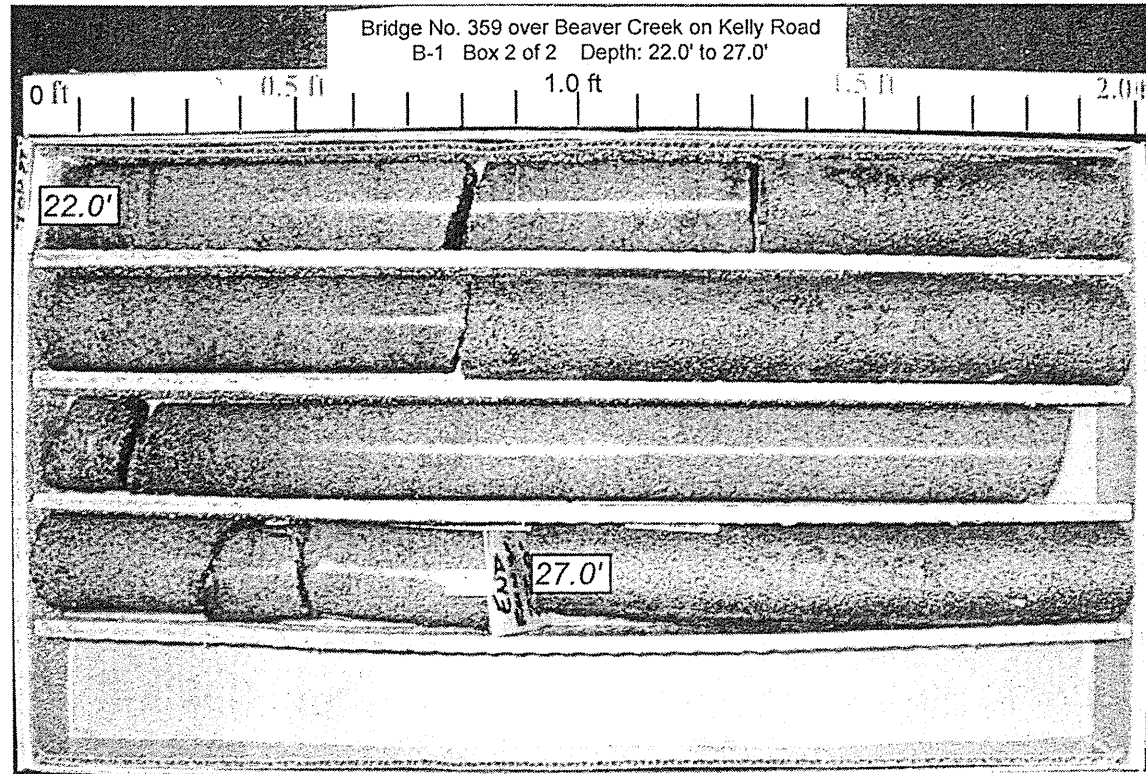
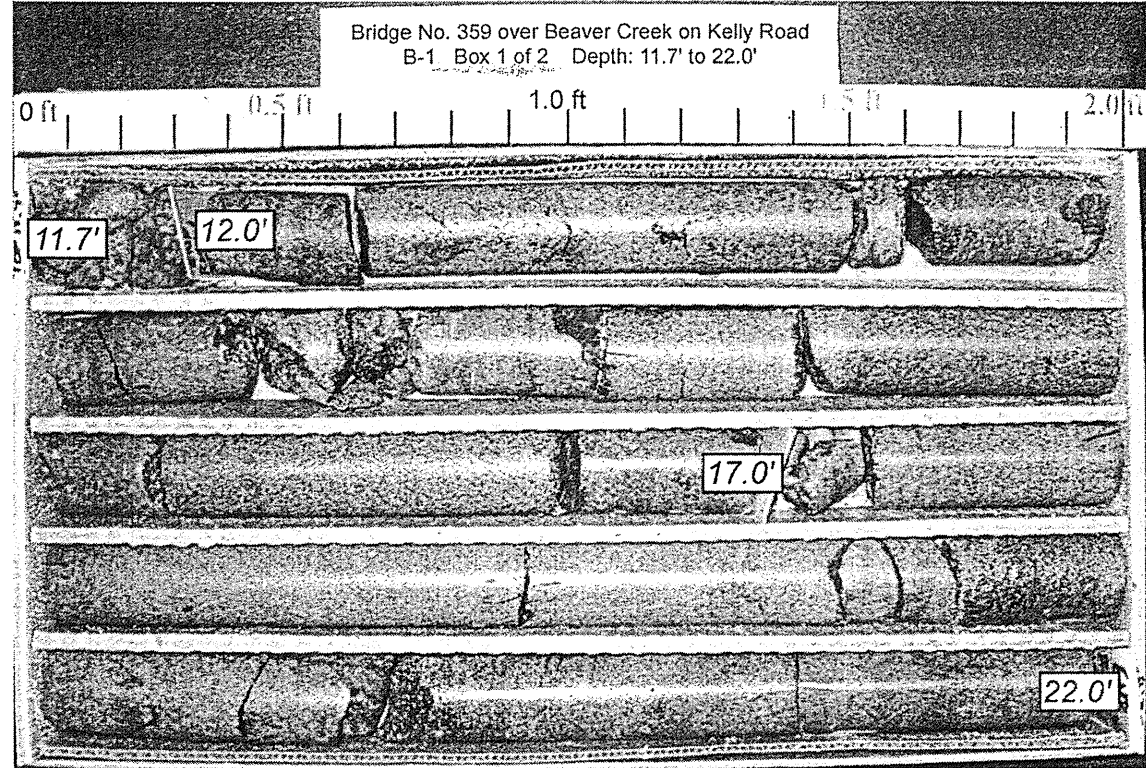
PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST B. Deobald
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B-1	STATION 19+03	OFFSET 1 ft LT	ALIGNMENT -L- 0 HR. 1.3
COLLAR ELEV. 274.9 ft	TOTAL DEPTH 27.0 ft	NORTHING 720,602	EASTING 2,031,270 24 HR. 1.0
DRILL MACHINE D-50	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 12/12/06	COMP. DATE 12/12/06	SURFACE WATER DEPTH N/A

CORE SIZE NQ										TOTAL RUN 15.8 ft				LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	REC. (%)	RQD (%)	SAMP. NO.	REC. (%)	RQD (%)	STRATA	ELEV. (ft)					
263.71	263.71	11.2	0.8	0:55/0.8	(0.3)	(0.0)		(14.3)	(12.6)		263.2		Begin Coring @ 11.2 ft	11.7		
260	257.9	17.0	5.0	3:30 3:00 6:00 3:10 3:00	38%	0%		93%	82%		263.2		WEATHERED ROCK (continued)	11.7		
255	252.9	22.0	5.0	2:00 3:05 3:15 3:10 4:10	(4.2)	(3.6)		84%	72%				CRYSTALLINE ROCK Dark gray, very slightly weathered to fresh, close to moderately close fracturing, very hard, DIABASE (7 Joints at 20°, 1 joint at 45°, all with iron staining)			
250	247.9	27.0	5.0	2:35 3:18 3:00 3:20	(4.8)	(4.5)		96%	90%				(4 joints at 30°, 1 joint at 45°)			
245													Boring Terminated at Elevation 247.9 ft in Crystalline Rock: Very hard, DIABASE	27.0		
240																
235																
230																
225																
220																
215																
210																
205																
200																
195																
190																
185																

NCDOT CORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

Core Photos
MACTEC Proj. No. 6468-04-0743/6468-10-0203

Bridge No. 359 over Beaver Creek on Kelly Road
NCDOT TIP B-4991



PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B3-A	STATION 19+79	OFFSET 19 ft LT	ALIGNMENT -L- 0 HR. 0.6
COLLAR ELEV. 275.2 ft	TOTAL DEPTH 41.0 ft	NORTHING 720,664	EASTING 2,031,222 24 HR. 0.8
DRILL MACHINE CME-550	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 01/31/07	COMP. DATE 01/31/07	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280															
275	275.2	0.0												275.2	0.0
			3	3	5										
270	271.5	3.7	1	1	2										
265	266.5	8.7	6	9	7										
260	261.5	13.7	26	28	30										
	259.6	15.6	60/0.0											259.6	15.6
255															
250															
245															
240															
235															
230															
225															
220															
215															
210															
205															
200															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

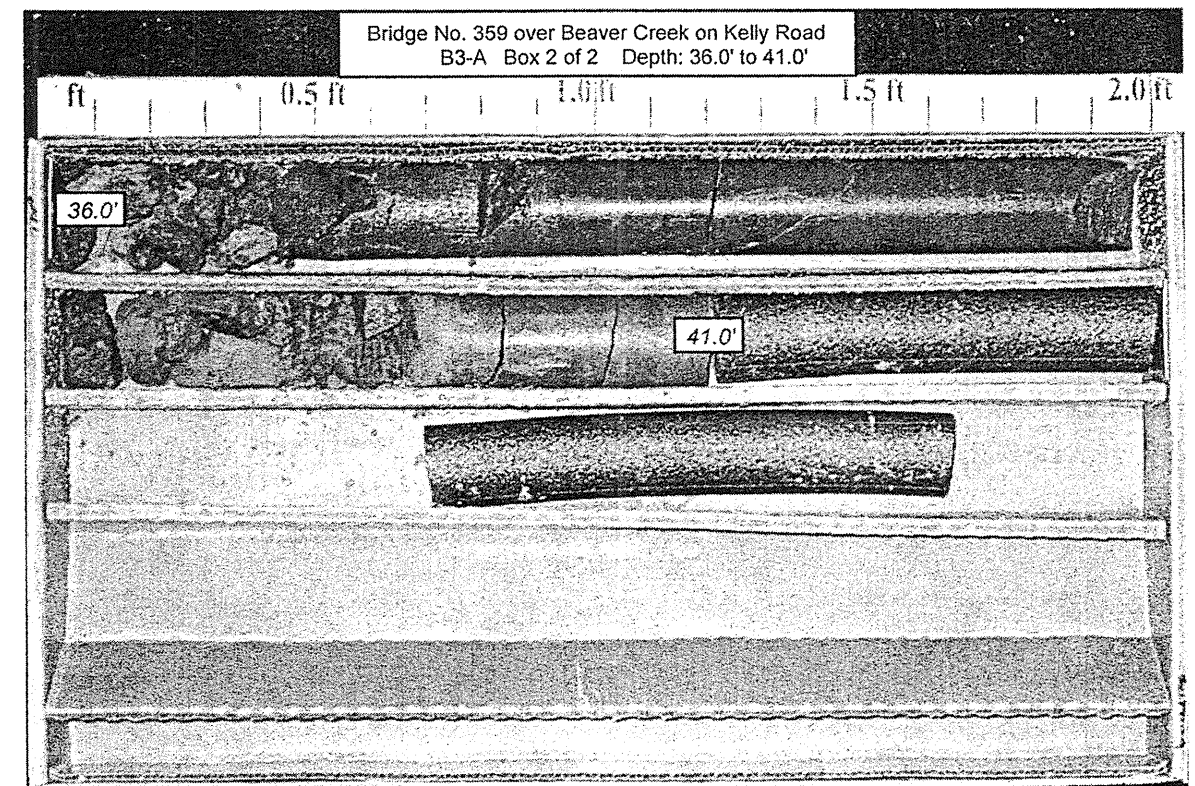
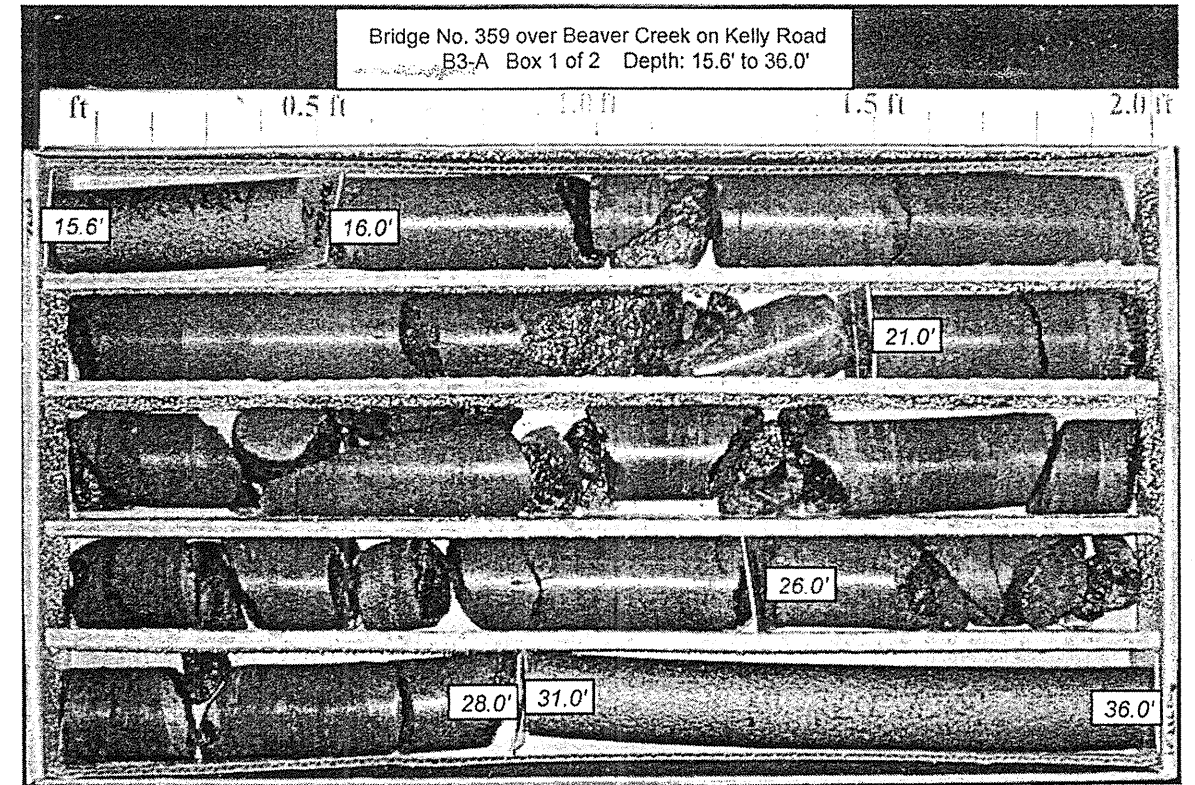
PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B3-A	STATION 19+79	OFFSET 19 ft LT	ALIGNMENT -L- 0 HR. 0.6
COLLAR ELEV. 275.2 ft	TOTAL DEPTH 41.0 ft	NORTHING 720,664	EASTING 2,031,222 24 HR. 0.8
DRILL MACHINE CME-550	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 01/31/07	COMP. DATE 01/31/07	SURFACE WATER DEPTH N/A

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (%)	RQD (%)		REC. (%)	RQD (%)			
259.62											Begin Coring @ 15.6 ft	
	258.8	18.8	0.4	N=60/0.0	(0.0)	(0.0)		(8.2)	(3.8)		CRYSTALLINE ROCK	15.6
	259.2	16.0	5.0	2:07/0.4	0%	0%		66%	31%		Dark gray-black, slightly weathered, closely fractured, hard DIABASE with severely weathered fracture zones with no recovery (4 joints at 40-50°, orange-brown iron staining)	
255	254.2	21.0	5.0	1:20 4:50 2:51 3:39 2:06	(2.9)	(2.4)					(3 joints at 40-50°, 4 joints at 20-30°, 1 joint at 75°; orange-brown Iron staining)	
250	249.2	26.0	5.0	1:00 2:21 3:40 2:50 3:36	(3.8)	(1.4)						
245	244.2	31.0	5.0	1:32 2:46 1:16 1:43 1:19	(1.5)	(0.0)		(0.0)	N/A		WEATHERED ROCK	28.0
											Severely weathered, DIABASE-No Recovery	
240	239.2	36.0	5.0	1:23 1:28 2:25 1:09 2:00	(0.0)	(0.0)					35.0 ft: Drill fluid color change from gray to brown-tan	35.0
											NON-CRYSTALLINE ROCK	
235	234.2	41.0	5.0	1:28 5:44 7:20 2:44 5:39	(3.0)	(2.0)		(3.0)	(2.0)		Dark grayish red, moderately to slightly weathered, thinly bedded, moderately indurated to indurated, MUDSTONE (Triassic Basin) Unable to retrieve bottom 2.0 feet of core run 6 (left in hole)	41.0
											Boring Terminated at Elevation 234.2 ft in Non-Crystalline Rock: Moderately Indurated to indurated, MUDSTONE (Triassic Basin)	
230												
225												
220												
215												
210												
205												
200												

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

Core Photos
MACTEC Proj. No. 6468-04-0743/6468-10-0203

Bridge No. 359 over Beaver Creek on Kelly Road
NCDOT TIP B-4991



PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST B. Deobald
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B-2	STATION 19+69	OFFSET 6 ft RT	ALIGNMENT -L-
COLLAR ELEV. 275.6 ft	TOTAL DEPTH 41.2 ft	NORTHING 720,664	EASTING 2,031,247
DRILL MACHINE D-50	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 12/12/06	COMP. DATE 12/13/06	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280															
275	275.6	0.0	4	6	4									275.6	GROUND SURFACE
270	271.4	4.2	WOH	2	4									272.6	ALLUVIAL Brown and tan, silty, fine to coarse SAND (A-2-4) with little gravel
265	266.0	9.6												267.6	ALLUVIAL Gray, fine sandy, SILT (A-4) with trace subrounded gravel
260	261.0	14.6	10	6	13									262.8	RESIDUAL Tan and green, fine to coarse, clayey, SAND (A-2-7) with relict rock fabric
255														259.3	RESIDUAL White and gray, fine to coarse SAND and DIABASE rock fragments (A-2-4)
250															CRYSTALLINE ROCK Dark gray, very slightly weathered to fresh, close fracturing, very hard, DIABASE
245														246.6	WEATHERED ROCK DIABASE (No recovery)
240														240.6	CRYSTALLINE ROCK Orange and dark gray, slightly to very slightly weathered, very closely fractured, very hard, DIABASE with severely weathered fracture zones with no recovery
235														234.4	Boring Terminated at Elevation 234.4 ft in Crystalline Rock: Very hard, DIABASE

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

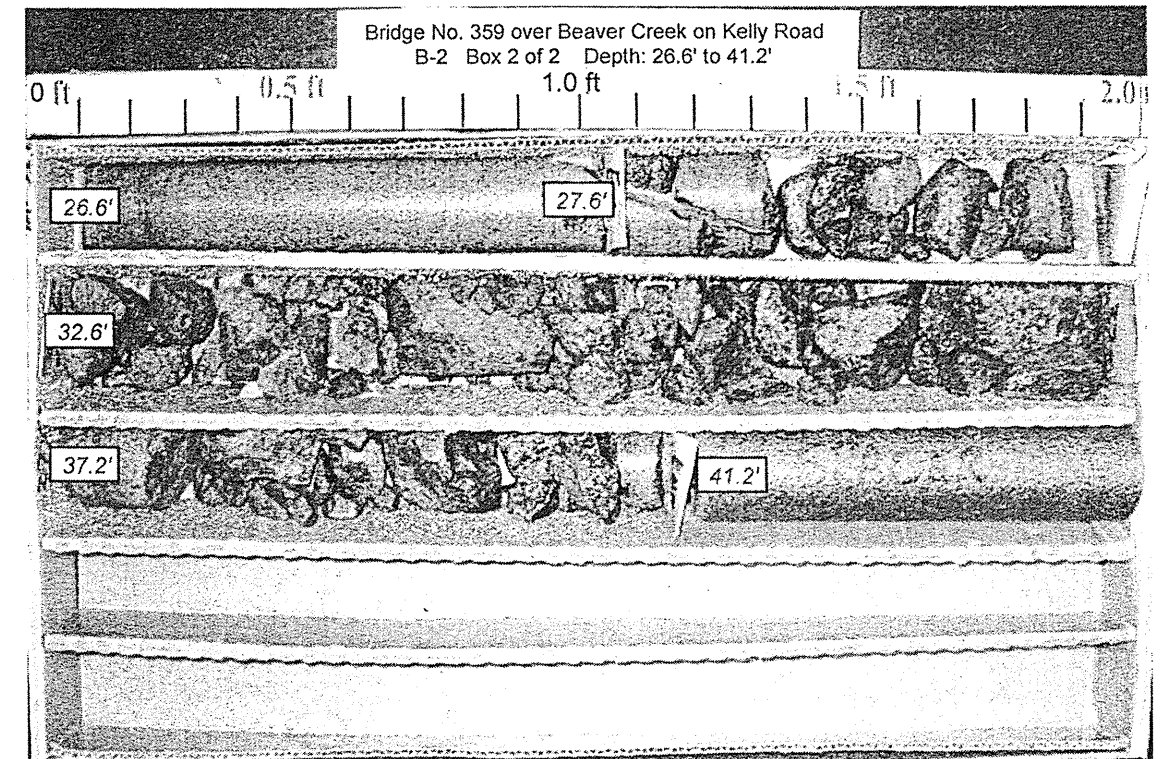
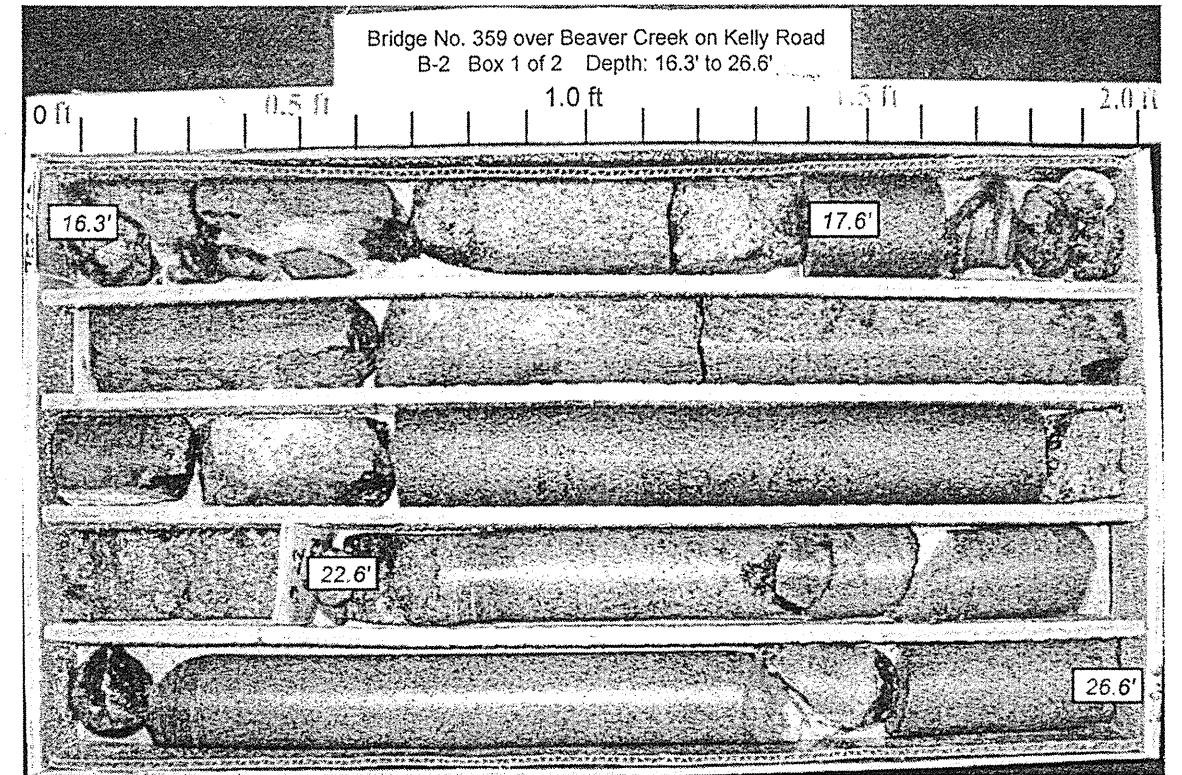
PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST B. Deobald
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B-2	STATION 19+69	OFFSET 6 ft RT	ALIGNMENT -L-
COLLAR ELEV. 275.6 ft	TOTAL DEPTH 41.2 ft	NORTHING 720,664	EASTING 2,031,247
DRILL MACHINE D-50	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 12/12/06	COMP. DATE 12/13/06	SURFACE WATER DEPTH N/A

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (%)	RQD (%)		REC. (%)	RQD (%)			
259.29											Begin Coring @ 16.3 ft	
255	259.3	16.3	1.3	2:00	(1.3)	(0.5)		(10.2)	(7.0)		CRYSTALLINE ROCK Dark gray, very slightly weathered to fresh, close fracturing, very hard, DIABASE	16.3
250	253.0	22.6	5.0	3:00	(3.6)	(3.1)					(2 joints at 20°, 1 joint at 90°, iron stained) (2 joints at 10°, 1 joint at 90°, iron stained) 19.0-20.2 ft: Severely weathered fracture zone, no recovery (2 joints at 10°, 3 joints at 45°, iron stained)	
245	243.0	32.6	4.6	0:10	(2.0)	(0.0)		(0.0)	N/A		WEATHERED ROCK DIABASE (No recovery)	29.0
240	238.4	37.2	4.0	2:00	(1.1)	(0.0)		(3.1)	(0.0)		CRYSTALLINE ROCK Orange and dark gray, slightly to very slightly weathered, very closely fractured, very hard, DIABASE with severely weathered fracture zones with no recovery (No discernible joints-completely fractured)	35.0
235	234.4	41.2									Boring Terminated at Elevation 234.4 ft in Crystalline Rock: Very hard, DIABASE	41.2

NCDOT CORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

Core Photos
MACTEC Proj. No. 6468-04-0743/6468-10-0203

Bridge No. 359 over Beaver Creek on Kelly Road
NCDOT TIP B-4991



PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B3-B	STATION 19+73	OFFSET 6 ft RT	ALIGNMENT -L-
COLLAR ELEV. 275.9 ft	TOTAL DEPTH 50.6 ft	NORTHING 720,668	EASTING 2,031,245
DRILL MACHINE CME-550	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 01/30/07	COMP. DATE 01/30/07	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280															
275	275.9	0.0	4	6	5								GROUND SURFACE	0.0	
270	272.2	3.7	3	2	2								ALLUVIAL Brown, clayey, fine to coarse SAND (A-2-6) with roots	2.5	
265	267.2	8.7	3	3	3								ALLUVIAL Gray, clayey, fine sandy, SILT (A-4) with trace organics	7.0	
260	262.4	13.5	100/0.3										RESIDUAL Green, clayey, SAND (A-2-6) with DIABASE fragments and relict rock fabric	12.0	
255													WEATHERED ROCK Dark green-brown, severely weathered, DIABASE	13.8	
250													CRYSTALLINE ROCK Dark gray-black, slightly to very slightly weathered, close to moderately close fracturing, moderately hard to hard, DIABASE with severely weathered fracture zones with no recovery from 16.0'-17.2', 18.5'-18.8', 19.6'-21.6', and 22.6'-23.9'	27.3	
245													WEATHERED ROCK DIABASE (No recovery)	34.2	
240													CRYSTALLINE ROCK Dark gray-black, slightly weathered, very close to close fracturing, hard, DIABASE with severely weathered fracture zones with no recovery	50.6	
235															
230															
225															
220															
215															
210															
205															
200															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

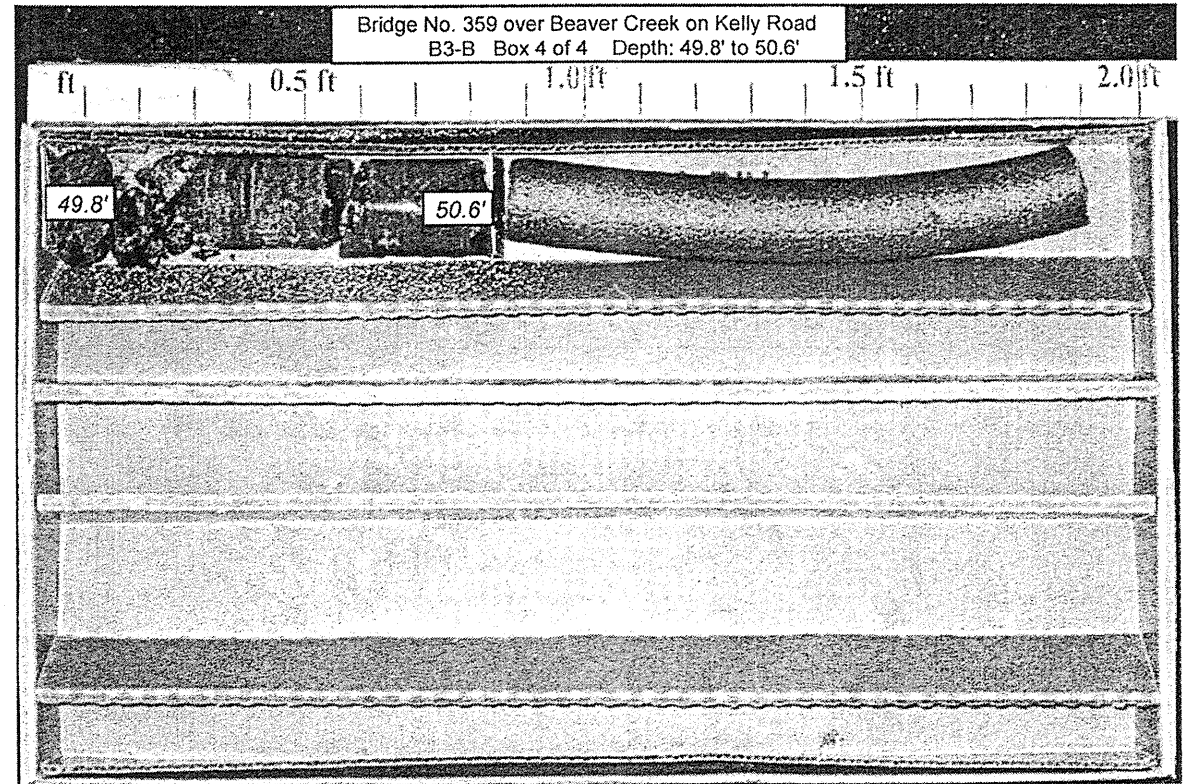
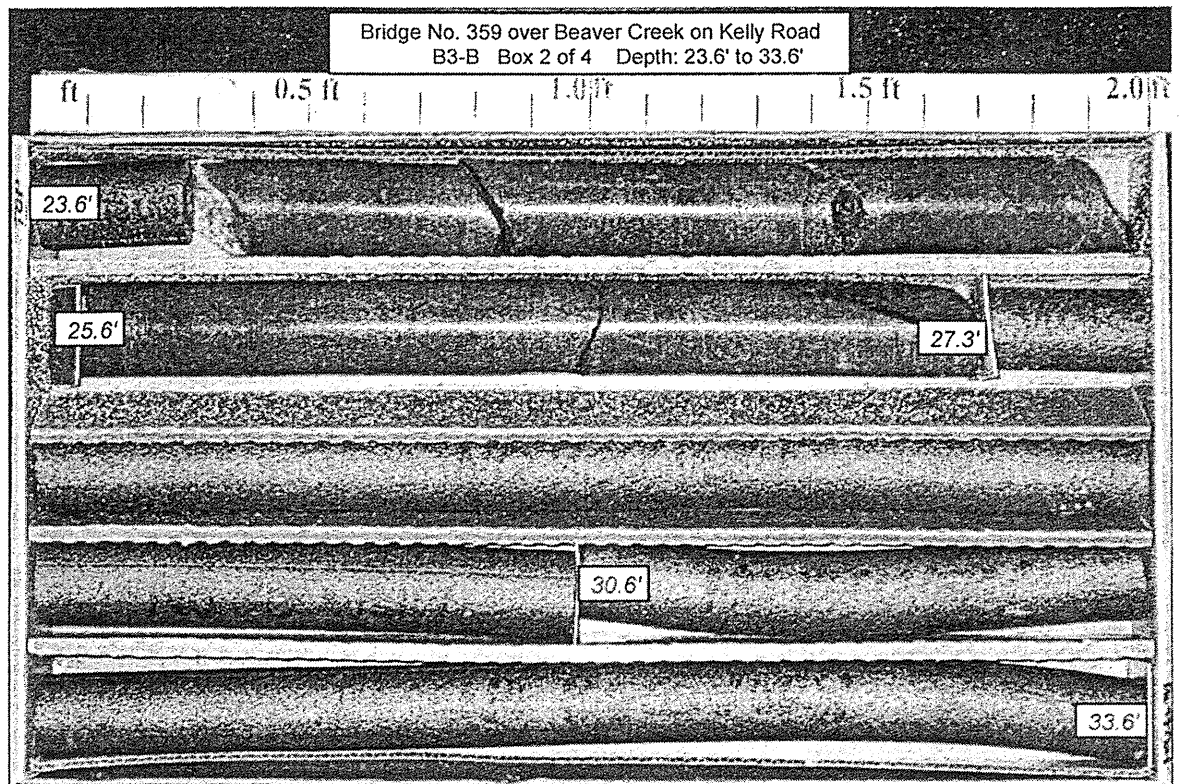
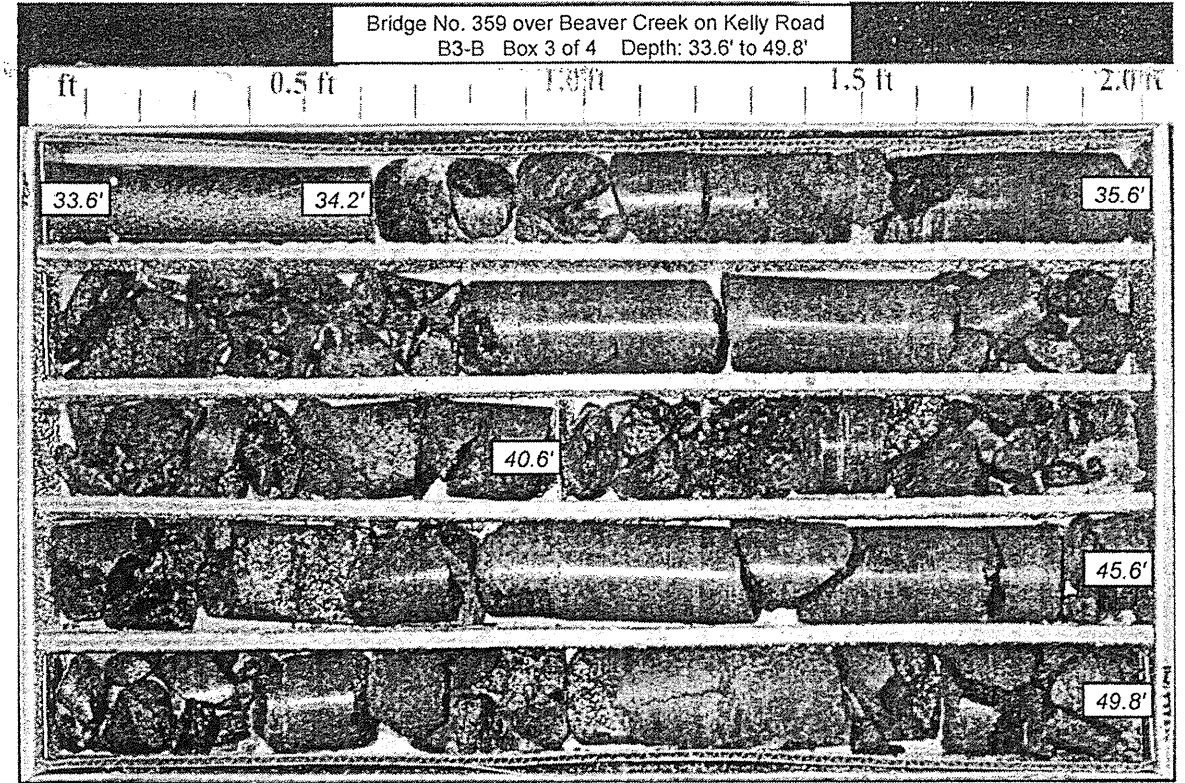
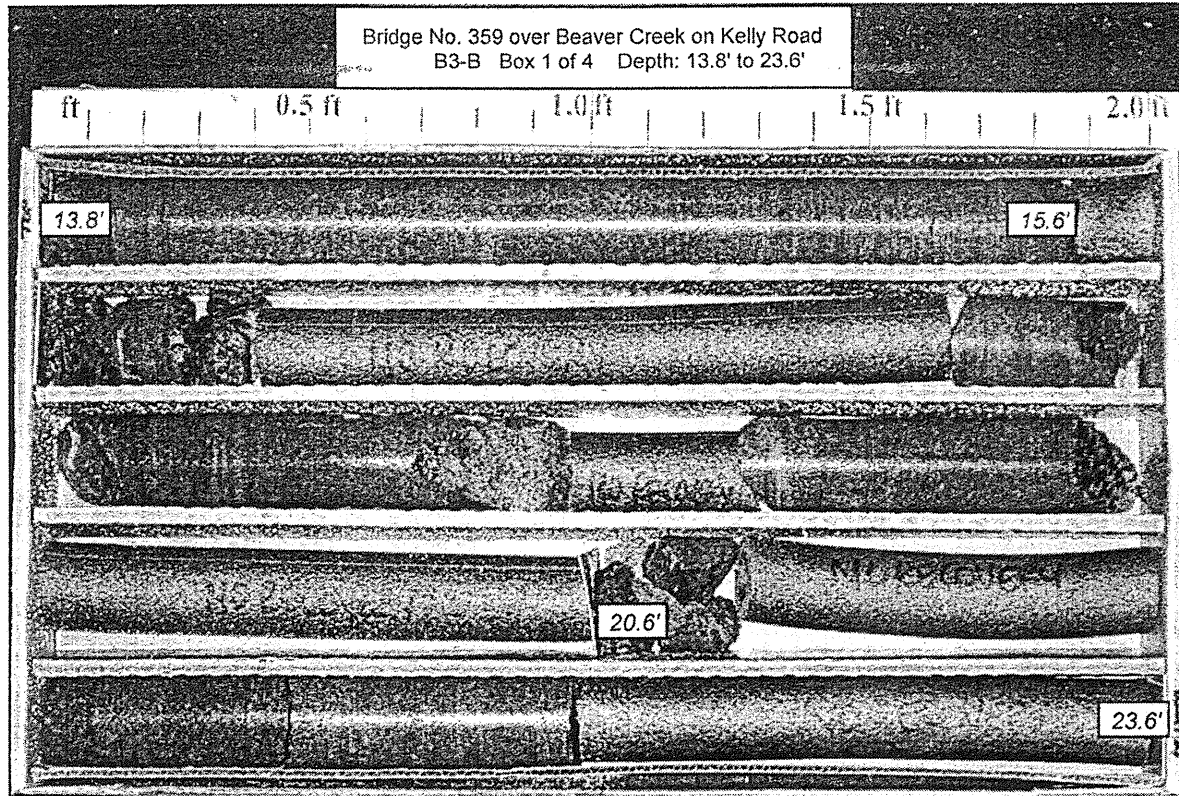
PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. B3-B	STATION 19+73	OFFSET 6 ft RT	ALIGNMENT -L-
COLLAR ELEV. 275.9 ft	TOTAL DEPTH 50.6 ft	NORTHING 720,668	EASTING 2,031,245
DRILL MACHINE CME-550	DRILL METHOD SPT Core Boring	HAMMER TYPE Manual	
DRILLER T. Hahn	START DATE 01/30/07	COMP. DATE 01/30/07	SURFACE WATER DEPTH N/A

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	-RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (%)	RQD (%)		REC. (%)	RQD (%)			
262.14											Begin Coring @ 13.8 ft	
260	262.1	13.8	1.8	1:32	(1.8)	(1.8)		(8.5)	(7.6)		CRYSTALLINE ROCK	13.8
	260.3	15.6	5.0	1:47/0.8	100%	100%		63%	56%		Dark gray-black, slightly to very slightly weathered, close to moderately close fracturing, moderately hard to hard, DIABASE with severely weathered fracture zones with no recovery from 16.0'-17.2', 18.5'-18.8', 19.6'-21.6', and 22.6'-23.9'	
255	255.3	20.6	5.0	0:55 1:21 1:50 1:47 0:42	(2.1)	(1.5)					(2 joints at 40-50°, 1 joint at 80°, clay and orange iron staining)	
					42%	30%					(1 joint at 40°, 1 joint at 80°)	
250	250.3	25.6	5.0	0:31 1:37 1:04 1:46 1:43	(2.9)	(2.6)						
245	245.3	30.6	5.0	2:19 2:02 1:58 0:46 0:31	(1.7)	(1.7)		(0.0)	N/A		WEATHERED ROCK DIABASE (No recovery)	27.3
240	240.3	35.6	5.0	0:15 0:15 0:21 2:32 2:12	(1.4)	(0.4)						
					28%	8%						
235	235.3	40.6	5.0	3:45 4:25 5:06 3:50 2:15	(3.0)	(1.0)						
					60%	20%						
230	230.3	45.6	5.0	1:18 2:37 2:28 1:04 1:48	(2.8)	(0.0)						
					56%	0%						
225	225.3	50.6									Boring Terminated at Elevation 225.3 ft in Crystalline Rock: Hard, DIABASE	50.6
220												
215												
210												
205												
200												
195												
190												
185												

NCDOT CORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

Core Photos
MACTEC Proj. No. 6468-04-0743/6468-10-0203

Bridge No. 359 over Beaver Creek on Kelly Road
NCDOT TIP B-4991



PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST M. Lear
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. HA-2	STATION 19+68	OFFSET 28 ft RT	ALIGNMENT -L-
COLLAR ELEV. 273.5 ft	TOTAL DEPTH 5.0 ft	NORTHING 720,673	EASTING 2,031,267
DRILL MACHINE NA	DRILL METHOD Hand Auger	HAMMER TYPE N/A	
DRILLER NA	START DATE 02/05/07	COMP. DATE 02/05/07	SURFACE WATER DEPTH 0.1ft

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0-0.5ft	0.5-1.0ft	1.0-1.5ft	0	25	50	75	100					
275															
														WATER SURFACE (02/05/07)	0.0
														ALLUVIAL Brown, CLAY (A-7-5) with organics, wet	
															2.0
														ALLUVIAL Gray and orange mottled, sandy, silty, CLAY (A-7-5) with trace organics, saturated	
															3.5
														ALLUVIAL Gray and orange mottled, fine sandy, clayey, SILT (A-4) with trace organics, saturated	
															5.0
														Boring Terminated at Elevation 268.5 ft in Alluvium: Fine sandy, clayey SILT (A-4) with trace organics	

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

PROJECT NO. N/A	ID. B-4991	COUNTY Wake	GEOLOGIST J. Howard
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)			GROUND WTR (ft)
BORING NO. EB2-A	STATION 20+50	OFFSET 4 ft LT	ALIGNMENT -L-
COLLAR ELEV. 276.6 ft	TOTAL DEPTH 11.7 ft	NORTHING 720,734	EASTING 2,031,205
DRILL MACHINE CME-55	DRILL METHOD H.S. Augers	HAMMER TYPE Automatic	
DRILLER P. Pitts	START DATE 09/29/10	COMP. DATE 09/29/10	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0-0.5ft	0.5-1.0ft	1.0-1.5ft	0	25	50	75	100					
280															
														GROUND SURFACE	0.0
														ROADWAY EMBANKMENT Brown to orange, fine sandy, SILT (A-4) with trace organics and gravel	
														ALLUVIAL Brown, fine sandy, silty, CLAY (A-7-6) with trace of organics and gravel	
															7.5
														WEATHERED ROCK Blue-gray, DIABASE	
															11.7
														Boring Terminated with Standard Penetration Test Refusal at Elevation 264.9 ft on Crystalline Rock: DIABASE	

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST J. Howard									
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)								
BORING NO. EB2-B		STATION 20+34		OFFSET 22 ft RT		ALIGNMENT -L-									
COLLAR ELEV. 275.1 ft		TOTAL DEPTH 29.8 ft		NORTHING 720,729		EASTING 2,031,235									
DRILL MACHINE CME-55		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER P. Pitts		START DATE 09/28/10		COMP. DATE 09/28/10		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
280															
275	275.1	0.0												275.1	0.0
			1	1	2								M	GROUND SURFACE	
														271.6	3.5
270	271.0	4.1	2	2	3								M	ALLUVIAL Tan-brown, silty, fine to coarse SAND (A-2-4) with trace organics	
														266.8	8.3
265	266.0	9.1												266.8	8.3
			100/0.3												
260	261.0	14.1												266.8	8.3
			100/0.6												
255	256.0	19.1	53	47/0.1										266.8	8.3
250	251.0	24.1	15	46	54/0.2									252.1	23.0
245	246.0	29.1	60	40/0.2										252.1	23.0
240														245.3	29.8
235															
230															
225															
220															
215															
210															
205															
200															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11

PROJECT NO. N/A		ID. B-4991		COUNTY Wake		GEOLOGIST B. Deobald									
SITE DESCRIPTION Bridge 359 over Beaver Creek on Kelly Road (MACTEC Project 6468-04-0743/6468-10-0203)							GROUND WTR (ft)								
BORING NO. R-2		STATION 21+84		OFFSET 6 ft RT		ALIGNMENT -L-									
COLLAR ELEV. 285.5 ft		TOTAL DEPTH 23.5 ft		NORTHING 720,863		EASTING 2,031,166									
DRILL MACHINE D-50		DRILL METHOD H.S. Augers		HAMMER TYPE Manual											
DRILLER T. Hahn		START DATE 12/13/11		COMP. DATE 12/13/06		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
290															
285														285.5	0.0
														283.5	2.0
			2.2	15	19	23								283.5	2.0
280														277.8	7.2
275														273.3	12.2
270														268.3	17.2
265														263.3	22.2
260														263.3	22.2
255														263.3	22.2
250														263.3	22.2
245														263.3	22.2
240														263.3	22.2
235															
230															
225															
220															
215															
210															

NCDOT BORE SINGLE KELLY ROAD ALL BORINGS 6-30-11.GPJ NC_DOT.GDT 8/9/11



MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

N.C.D.O.T./AASHTO CLASSIFICATIONS

REPORT ON SAMPLES OF: SOILS FOR QUALITY

MACTEC PROJECT NAME AND NUMBER: Bridge No. 359 over Beaver Creek on Kelly Road (6468-06-0743/6468-10-0203)

PROJECT: B-4991 COUNTY: Wake OWNER: N.C.D.O.T.
DATE SAMPLED: December 2006 RECEIVED: 1/10/2007 REPORTED BY: MACTEC
SAMPLED FROM: Channel Bank, Channel Bed, R1, B2-C, B-1, B-2
SUBMITTED BY: MACTEC ENGINEERING AND CONSULTING, INC.

1992 STANDARD SPECIFICATIONS

TEST RESULTS

Lab Sample No.		S-1	S-2	SS-1	SS-2	SS-3	SS-4
Retained 4.75 mm Sieve (%)		0.0	0.0	0.0	0.0	2.7	3.8
Passing 2.00 mm Sieve (%)		99.9	99.9	98.8	99.9	94.0	94.7
Passing 425 µm Sieve (%)		97.3	97.5	81.0	95.3	44.2	73.4
Passing 75 µm Sieve (%)		74.6	73.0	47.7	88.4	32.9	54.2

MINUS 2.00mm FRACTION

SOIL MORTAR - 100%							
Coarse Sand Ret - 250 µm (%)		5.0	4.9	27.7	7.0	63.7	27.3
Fine Sand Ret - 53 µm (%)		27.9	28.9	29.1	6.8	2.1	20.7
Silt 0.05 - 0.005 mm (%)		38.0	31.7	23.5	46.3	11.2	36.5
Clay < 0.005 mm (%)		29.0	34.4	19.6	39.8	23.0	15.4
		100.0	100.0	100.0	100.0	100.0	100.0

Moisture Content (%)		ND	ND	44.5	24.5	ND	16.1
Liquid Limit, L.L.		40	33	51	35	28	21
Plasticity Index, P.I.		12	12	11	15	10	7
AASHTO Classification		A-6(9)	A-6(7)	A-7-5(4)	A-6(13)	A-2-4(0)	A-4(1)
Organic Content (%)		ND	ND	ND	ND	ND	ND

Boring No.	Channel Bank	Channel Bed	R1	B2-C	B-1	B-2
Station	19+35	19+45	16+76	18+71	19+03	19+69
Offset	5 ft LT	6 ft LT	8 ft RT	3 ft LT	1 ft LT	6 ft RT
Alignment	-L-	-L-	-L-	-L-	-L-	-L-
Depth (ft) From	0.0	0.0	3.9	2.7	0.0	4.2
to	1.0	1.0	5.4	4.2	1.5	5.7

REMARKS: ND=Not Determined

Reviewed by *Chana Sawanapudi*
104-04-0504



MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

N.C.D.O.T./AASHTO CLASSIFICATIONS

REPORT ON SAMPLES OF: SOILS FOR QUALITY

MACTEC PROJECT NAME AND NUMBER: Bridge No. 359 over Beaver Creek on Kelly Road (6468-06-0743/6468-10-0203)

PROJECT: B-4991 COUNTY: Wake OWNER: N.C.D.O.T.
DATE SAMPLED: Dec. 2006; Jan. 2007 RECEIVED: 1/10/07; 2/8/07 REPORTED BY: MACTEC
SAMPLED FROM: B-2, B2-A, B3-A
SUBMITTED BY: MACTEC ENGINEERING AND CONSULTING, INC.

1992 STANDARD SPECIFICATIONS

TEST RESULTS

Lab Sample No.		SS-5	SS-6	SS-7	ST-1
Retained 4.75 mm Sieve (%)		14.1	1.2	10.0	0.7
Passing 2.00 mm Sieve (%)		84.3	95.9	88.3	98.2
Passing 425 µm Sieve (%)		52.6	74.0	49.5	88.0
Passing 75 µm Sieve (%)		31.6	43.2	29.3	82.4

MINUS 2.00mm FRACTION

SOIL MORTAR - 100%							
Coarse Sand Ret - 250 µm (%)		42.0	35.1	53.2	12.6		
Fine Sand Ret - 53 µm (%)		23.4	24.7	16.9	4.7		
Silt 0.05 - 0.005 mm (%)		-1.4	25.4	13.8	82.7		
Clay < 0.005 mm (%)		36.1	14.7	16.1	ND		
		100.0	100.0	100.0	100.0		

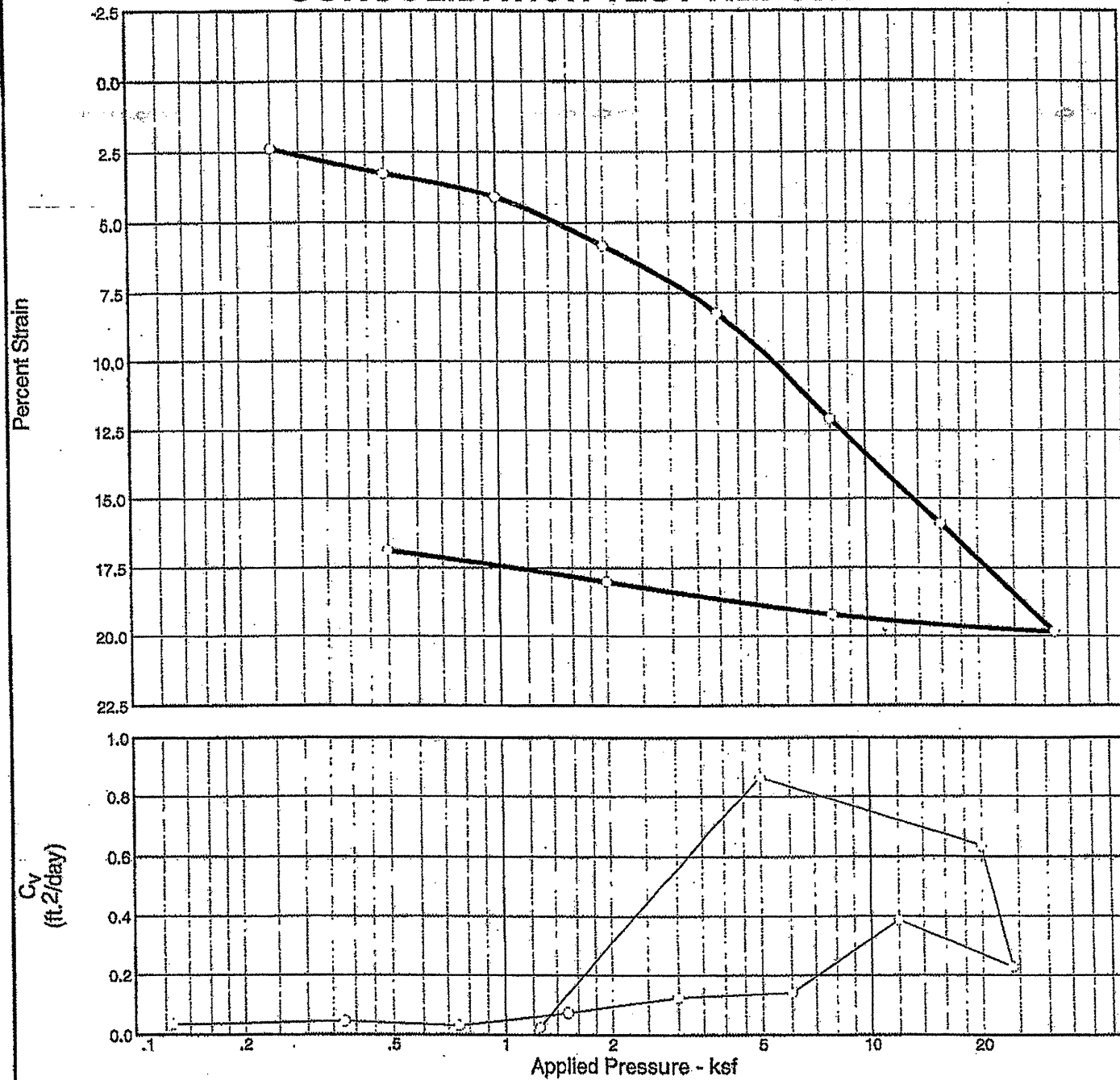
Moisture Content (%)		ND	ND	ND	38.6		
Liquid Limit, L.L.		65	34	37	40		
Plasticity Index, P.I.		24	13	8	17		
AASHTO Classification		A-2-7(2)	A-6(2)	A-2-4(0)	A-6(14)		
Organic Content (%)		ND	ND	ND	ND		

Boring No.	B-2	B2-A	B3-A	B2-A
Station	19+69	18+72	19+79	18+72
Offset	6 ft RT	13 ft LT	17 ft LT	13 ft LT
Alignment	-L-	-L-	-L-	-L-
Depth (ft) From	9.6	6.3	13.7	4.3
to	11.1	7.8	15.2	6.3

REMARKS: ND=Not Determined

Reviewed by *Chana Sawanapudi*
104-04-0504

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	Initial Void Ratio
Saturation	Moisture							
101.9 %	38.6 %	81.4	40	17	2.7	0.60	4.29	1.023

MATERIAL DESCRIPTION				USCS	AASHTO
Gray tan silty clay.				CL	A-6(14)

Project No. 6468040743.4991 Client: Stewart Engineering
 Project: Bridge No. 359 Over Beaver Creek on Kelly Road
 Source: BORING REV EBI-A Sample No.: ST-1 Elev./Depth: 4.3-6.3

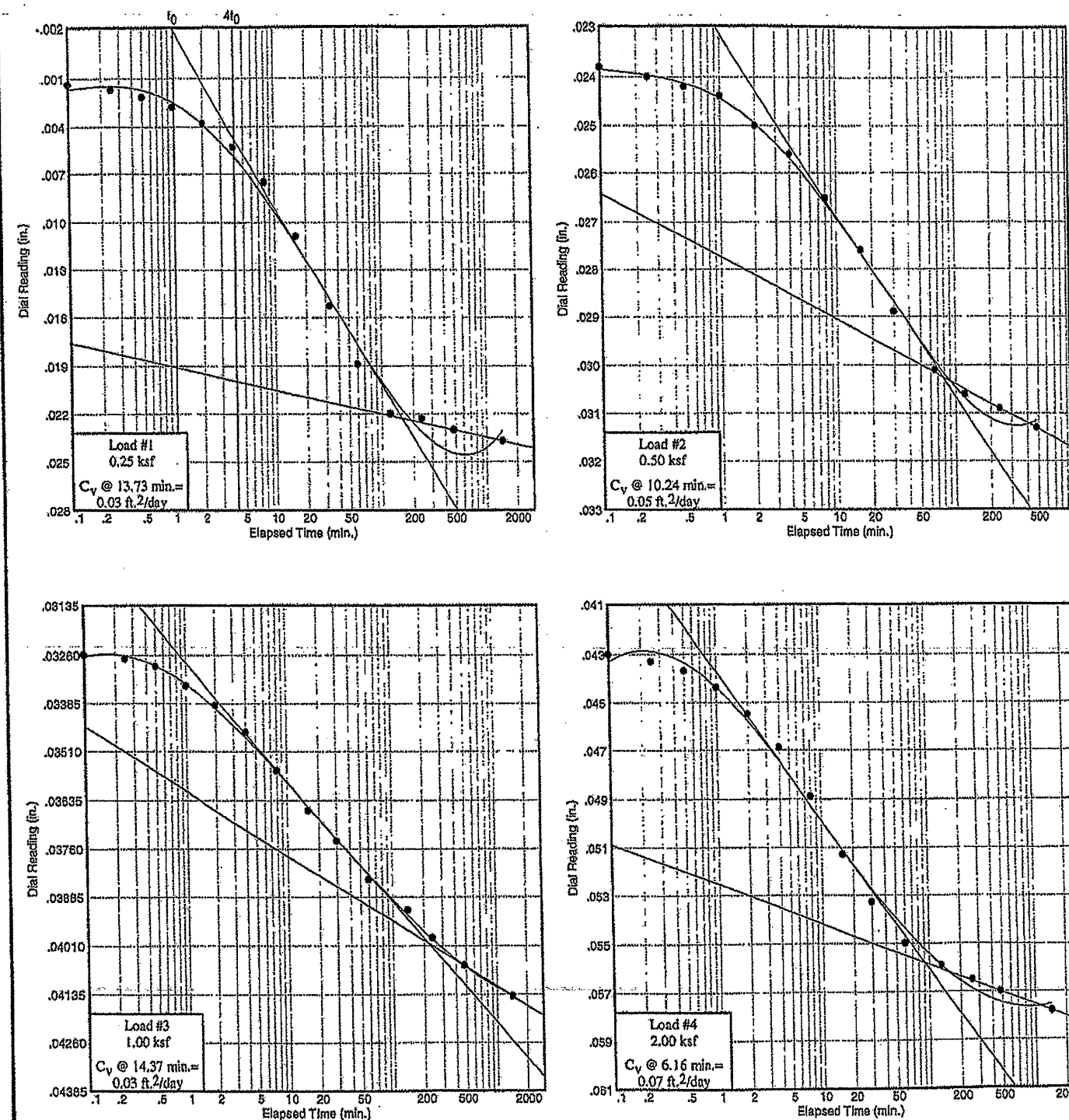
MACTEC, Inc.
 Raleigh, North Carolina

Remarks:

Figure

Dial Reading vs. Time

Project No.: 6468040743.4991
 Project: Bridge No. 359 Over Beaver Creek on Kelly Road
 Source: BORING REV EBI-A Sample No.: ST-1 Elev./Depth: 4.3-6.3

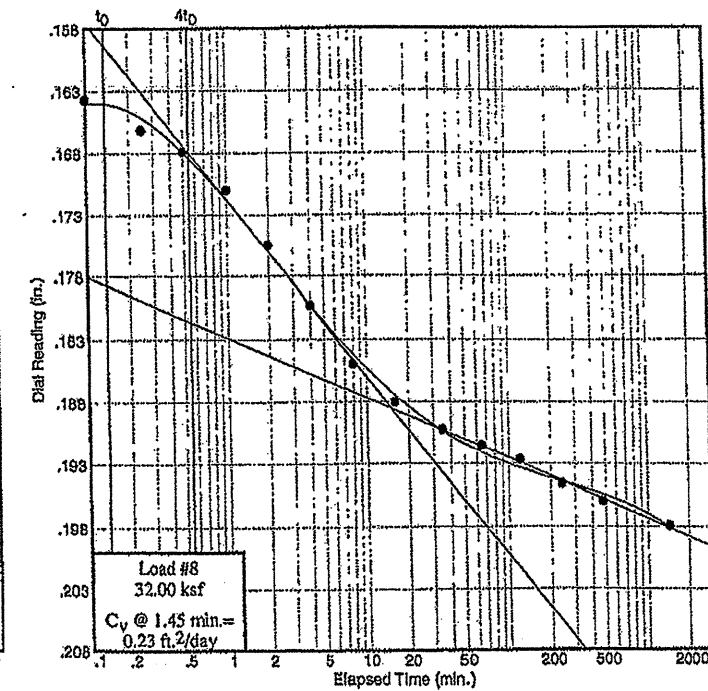
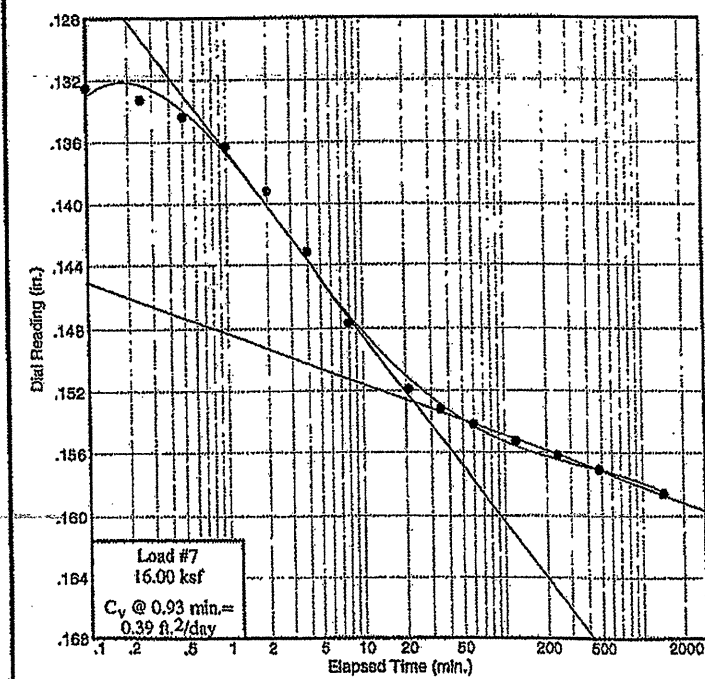
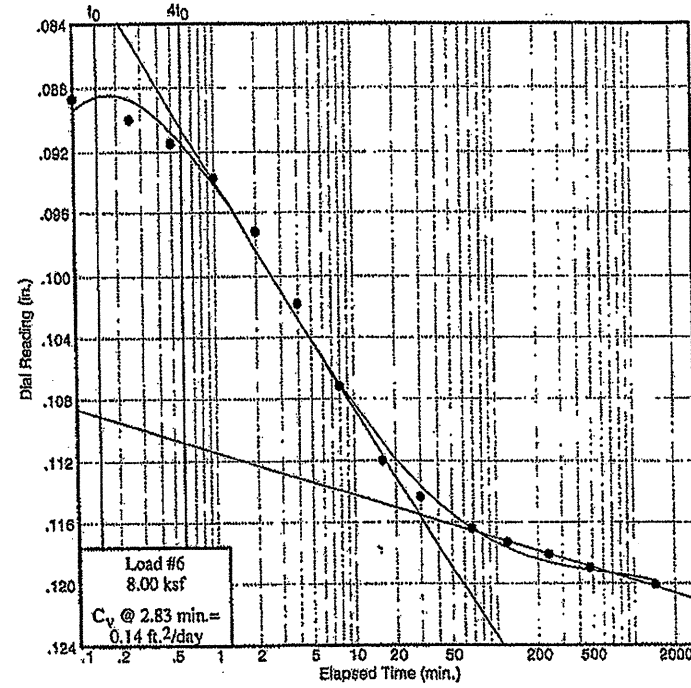
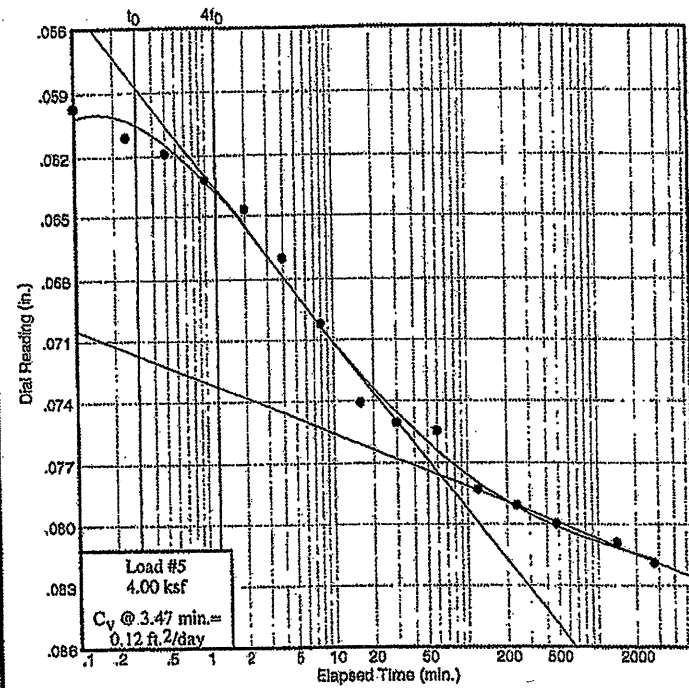


MACTEC, Inc.
 Raleigh, North Carolina

Figure

Dial Reading vs. Time

Project No.: 6468040743.4991
 Project: Bridge No. 359 Over Beaver Creek on Kelly Road
 Source: BORING REV EBT-1-A ^{BZ-A} Sample No.: ST-1 Elev./Depth: 4.3-6.3

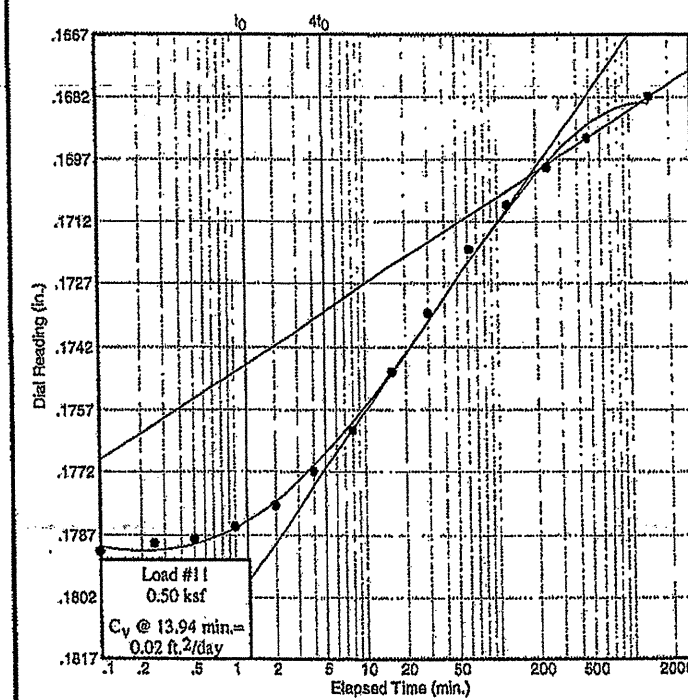
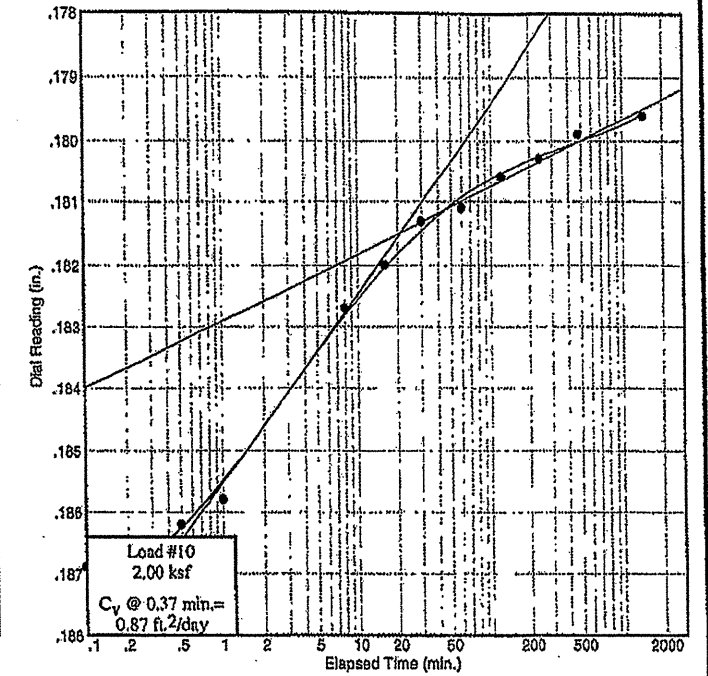
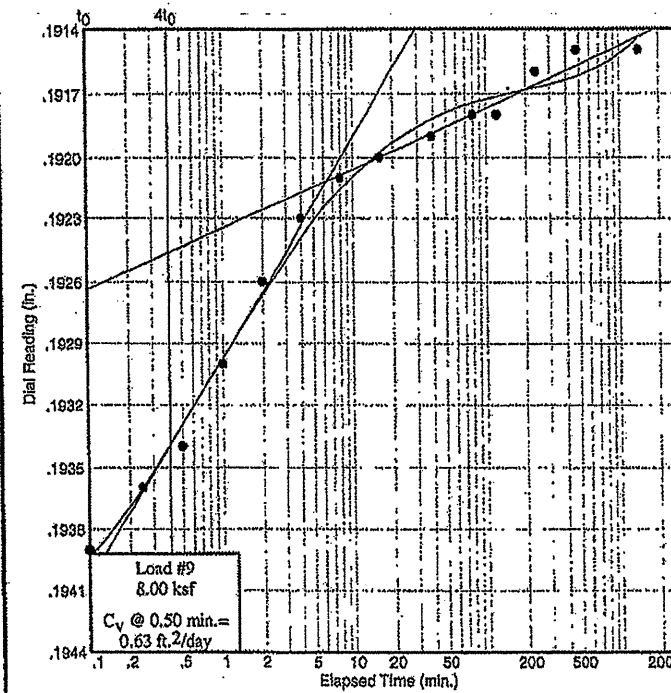


MACTEC, Inc.
Raleigh, North Carolina

Figure

Dial Reading vs. Time

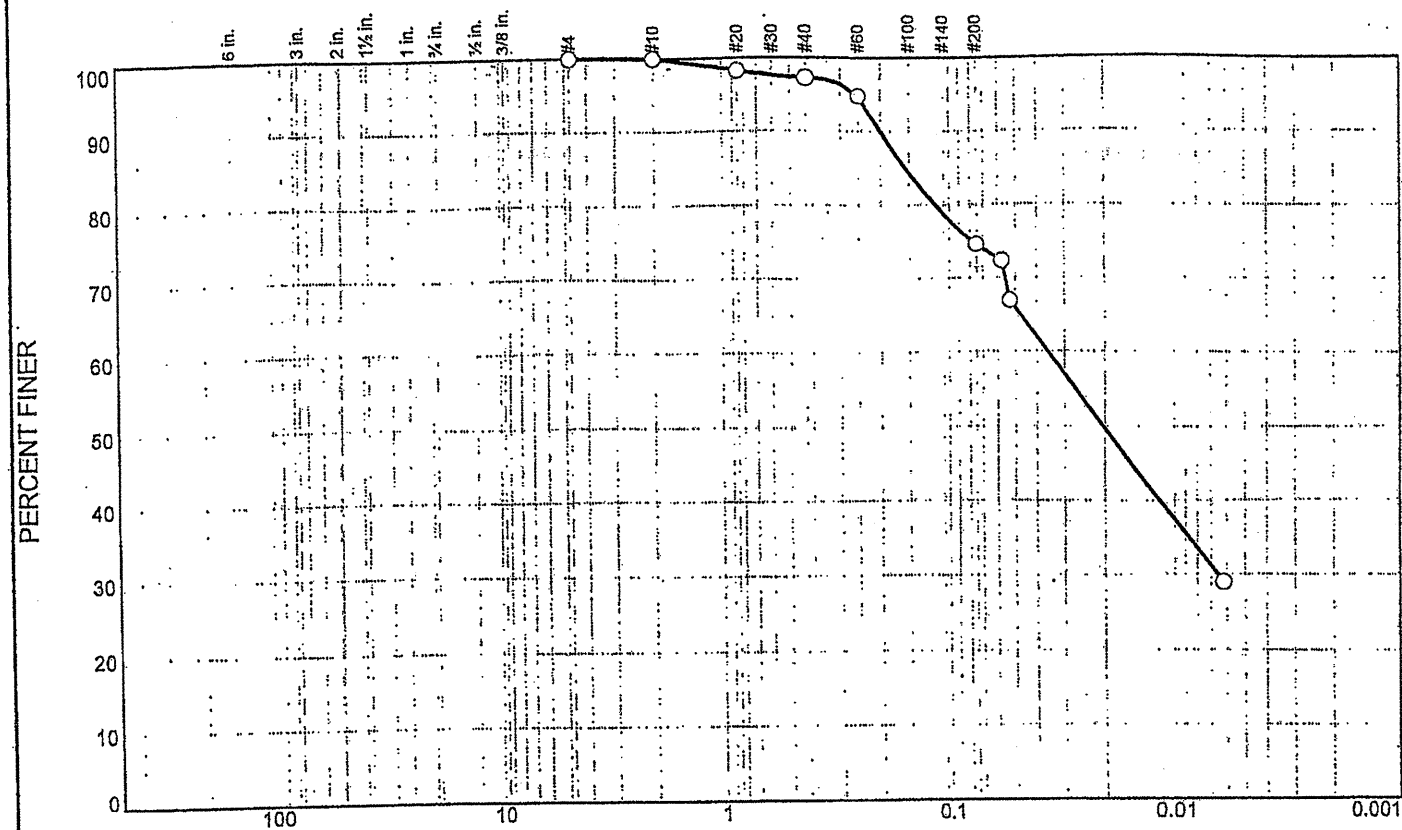
Project No.: 6468040743.4991
 Project: Bridge No. 359 Over Beaver Creek on Kelly Road
 Source: BORING REV EBT-1-A ^{BZ-A} Sample No.: ST-1 Elev./Depth: 4.3-6.3



MACTEC, Inc.
Raleigh, North Carolina

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	Clay
	Coarse	Fine	Coarse	Medium	Fine		
0.0	0.0	0.0	0.1	2.6	22.7	74.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	98.3		
#40	97.3		
#60	94.9		
#200	74.6		
0.0576 mm.	72.3		
#270	67.0		
0.0062 mm.	29.0		

Soil Description
Light brown sandy silt.

Atterberg Limits
PL= 28 LL= 40 PI= 12

Coefficients
D₈₅= 0.1558 D₆₀= 0.0358 D₅₀= 0.0203
D₃₀= 0.0066 C_c= D₁₀=
C_u=

Classification
USCS= ML AASHTO= A-6(9)

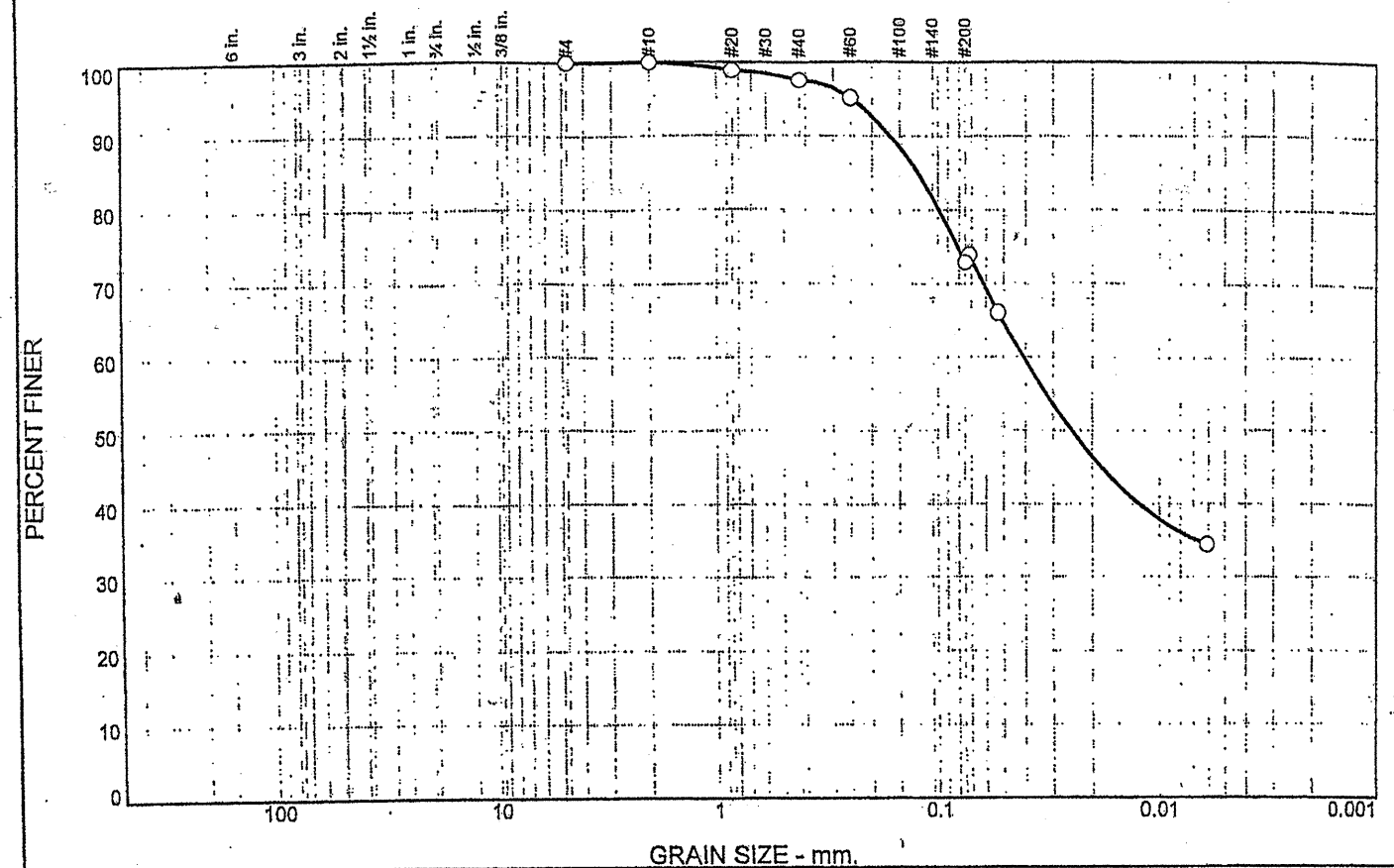
Remarks
Entire sample was tested.

(no specification provided)
 Sample No.: S-1 Source of Sample: Channel Bank Date: 12-12-06
 Location: Elev./Depth: 0-1'

MACTEC, Inc. Raleigh, North Carolina	Client: Stewart Engineering Project: Bridge No. 359 Over Beaver Creek on Kelly Road Project No: 6468-04-0743.4991	Figure
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Tested By: CS Checked By: CS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	2.4	24.5	73.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	98.8		
#40	97.5		
#60	95.0		
#200	73.0		
0.0719 mm.	74.0		
#270	66.1		
0.0061 mm.	34.4		

Soil Description
Light brown sandy silt.

Atterberg Limits
PL= 21 LL= 33 PI= 12

Coefficients
D₈₅= 0.1241 D₆₀= 0.0408 D₅₀= 0.0247
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification
USCS= CL AASHTO= A-6(7)

Remarks
Entire sample was tested.

(no specification provided)
 Sample No.: S-2 Source of Sample: Channel Bed Date: 12-12-06
 Location: Elev./Depth: ND

MACTEC, Inc. Raleigh, North Carolina	Client: Stewart Engineering Project: Bridge No. 359 Over Beaver Creek on Kelly Road Project No: 6468-04-0743.4991	Figure
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Tested By: CS Checked By: CS



**FIELD
 SCOUR REPORT**

WBS: NA TIP: B-4991 COUNTY: Wake

DESCRIPTION(1): Bridge No. 359 over Beaver Creek on Kelly Road

EXISTING BRIDGE

Information from: Field Inspection Microfilm _____ (reel _____ pos: _____)
 Other (explain) _____

Bridge No.: 359 Length: 41 Total Bents: 3 Bents in Channel: 1 Bents in Floodplain: 2
 Foundation Type: Steel and Timber piles

EVIDENCE OF SCOUR(2)

Abutments or End Bent Slopes: Slumps and washouts at creek edge and around wing walls

Interior Bents: Non observed

Channel Bed: Non observed

Channel Bank: Slumps and undercutting along banks.

EXISTING SCOUR PROTECTION

Type(3): Timber wing walls along with rip-rap and gravel slope protection

Extent(4): At end bent abutments and slopes, rip-rap on channel bed

Effectiveness(5): Moderately effective, timbers show decay and are falling apart

Obstructions(6): Small to large tree limbs and other debris caught on interior bent piles

INSTRUCTIONS

- 1 Describe the specific site's location, including route number and body of water crossed.
- 2 Note scour evidence at existing end bents or abutments (e.g. undermining, sloughing, degradations).
- 3 Note existing scour protection (e.g. rip rap).
- 4 Describe extent of existing scour protection.
- 5 Describe whether or not the scour protection appears to be working.
- 6 Note obstructions such as dams, fallen trees, debris at bents, etc.
- 7 Describe the channel bed material based on observation and/or samples. Include any lab results with report.
- 8 Describe the channel bank material based on observation and/or samples. Include any lab results with report.
- 9 Describe the material covering the banks (e.g. grass, trees, rip rap, none).
- 10 Determine the approximate floodplain width from field observation or a topographic map.
- 11 Describe the material covering the floodplain (e.g. grass, trees, crops).
- 12 Use professional judgement to specify if the stream is degrading, aggrading, or static.
- 13 Describe potential and direction of the stream to migrate laterally during the bridge's life (approx. 100 years).
- 14 Give the design scour elevation (DSE) expected over the life of the bridge (approx. 100 years). This elevation can be given as a range across the site, or for each bent. Discuss the relationship between the Hydraulics Unit theoretical scour and the DSE. If the DSE is dependent on scour counter measures, explain (e.g. rip rap armoring on slopes). The DSE is based on the erodability of materials, giving consideration to the influence of joints, foliation, bedding characteristics, % core recovery, % RQD, differential weathering, shear strength, observations at existing structures, other tests deemed appropriate, and overall geologic conditions at the site.

DESIGN INFORMATION

Channel Bed Material(7): Light brown, silty, sandy, CLAY (A-6)

Channel Bank Material(8): Light brown, silty, sandy, CLAY (A-6)

Channel Bank Cover(9): Small to large trees, brush and grasses

Floodplain Width(10): Approximately 200 feet.

Floodplain Cover(11): Small to large trees and brush, many trees are dead or show decay

Stream is(12): Aggrading _____ Degrading Static _____

Channel Migration Tendency(13): Slight migration tendency to the south

Observations and Other Comments: The creek spreads laterally outside of the main channel upstream and downstream of the bridge, where it is confined to a single channel.

Reported by: Michael B. L. Date: 2/9/2007
 MACTEC Engineering and Consulting, Inc.

DESIGN SCOUR ELEVATIONS(14) Feet Meters _____

BENTS

	B1	B2	B3	B4						

Comparison of DSE to Hydraulics Unit theoretical scour: _____

DSE determined by: _____ Date: _____

SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAL

Bed or Bank	Bank	Bed					
Sample No.	S-1	S-2					
Retained #4	0	0					
Passed #10	99.9	99.9					
Passed #40	97.3	97.5					
Passed #200	74.6	73					
Coarse Sand	5	4.9					
Fine Sand	27.9	28.9					
Silt	38	31.7					
Clay	29	34.4					
LL	40	33					
PI	12	12					
AASHTO	A-6(9)	A-6(7)					
Station	19+35	19+45					
Offset	3' RT -L-	4' RT -L-					
Depth	0.0-1.0 ft	0.0-1.0 ft					