Design Hydrogeological Report
includes Water Quality Monitoring Plan

Colon Mine Site Structural Fill

Charah, Inc.

Sanford, NC

November 2014

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DESIGN HYDROGEOLOGIC REPORT
COLON MINE RECLAMATION STRUCTURAL FILL SITE
1303 BRICKYARD ROAD
SANFORD, NORTH CAROLINA

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DESIGN HYDROGEOLOGIC REPORT
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1.0 INTRODUCTION

Buxton Environmental, Inc., respectfully submits the *Design Hydrogeologic Report* prepared for the proposed Colon Mine Reclamation Structural Fill Site (RSFS) located at 1303 Brickyard Road in Sanford, North Carolina. The subject property consists of two tracts including Parcel No. 9655-81-9374 (272.83 acres) which is owned by Cherokee Sanford Group, LLC, and Parcel No.: 9655-62-2672 (58.54 acres) which is owned by General Shale Brick, Inc., according to the Lee County GIS website. The proposed Colon Mine RSFS consist of 118.7 acres, which is located on portions of the two tracts. The primary purpose of this investigation is to provide detailed and localized hydrogeologic information for the engineering design of the proposed Colon Mine RSFS for coal combustion residuals and for the effective design of a water quality monitoring system. The investigation was conducted in general accordance with North Carolina Department of Environment and Natural Resources, Division of Waste Management-Solid Waste Section (NCSWS) rules and guidelines; the General Assembly of North Carolina Session 2013-Senate Bill 729 (ratified) regarding coal combustion residuals; and the HDR Engineering, Inc. of the Carolinas (HDR) Hydrogeologic Investigation and Reporting Scope-of-Work, Task 3 dated July 2014 which was prepared for Charah, Inc. The Design Hydrogeologic Report investigation was conducted by Buxton Environmental, Inc. on behalf of HDR. Site location, site layout and proposed Colon Mine RSFS plan maps are provided in Figures 1, 2 and 3, respectively. Photographic documentation is provided in Appendix A.

A summary of background information, and the methods and results of the Design Hydrogeologic Report investigation is provided below.

2.0 BACKGROUND INFORMATION

The Colon Mine RSFS property is located in Lee County, approximately 5 miles north northeast of downtown Sanford, North Carolina. The area immediately surrounding the site primarily consists of rural residential, wooded and agricultural property. The northern side of the site is bounded by an intermittent tributary creek of Roberts Creek and the southeastern property boundary is bounded by the Norfolk Southern Rail Road line. The former clay mining area is located on the central portion of Parcel No.: 9655-81-9374. Following cessation of on-site clay mining activities, deep erosional rills formed on the excavation side slopes, however, re-grading and seeding were recently conducted on the northeast side of the site. A high tension overhead power line easement, which runs northwest to southeast, bisects the two subject property tracts. The primary access to the subject property is via a dirt and brick gravel covered road that that intersects Brickyard Road approximately 1 mile to the southwest of the former mining area. Entrance to the site is partially secured by a locked gate along Brickyard Road. The northern ½ of Parcel No.: 9655-81-9374 and the entire portion of Parcel No.: 9655-62-2672 was heavily wooded property with numerous deer hunting trails and hunting stands (Figure 2).

In order to determine the relative time frame of clay mining at the subject property, an aerial photograph review was conducted at the Lee County Geographical Information System (GIS) website. The 1996-1999 aerial photograph indicated that the proposed Colon Mine RSFS area was primarily wooded property with no clay mining at the subject area, and contained the power line easement. The 2002-2005 aerial photograph indicated the first evidence of clay mining and clay stockpiling at the site, with the infiltration of groundwater into Excavation #1 (small area) and Excavation #2 (large area). The 2006-2008 aerial photograph indicated continued mining, with continued infiltration of groundwater into Excavations #1 and #2. The 2010 and 2013 aerial photographs indicated the mine area in its near current state. The aerial photographs are provided in Appendix B.

According to General Shale Brick, Inc. personnel, the subject property was utilized for clay mining for brick manufacturing until approximately 2008. The main brick manufacturing facility was located approximately 1 mile southwest of the site at 1303 Brickyard Road and is currently unoccupied.

A *Preliminary Subsurface Exploration* report, dated June 30, 2014, which was prepared by Geo Track Technologies, Inc., was reviewed to determine geotechnical characteristics of the subject property (Appendix C). A total of (8) eight soil borings (SB-1 through SB-8) were advanced in May 2014. Auger refusal was encountered at all eight borings at depths ranging from 23.5 to 43.5 feet. Depth to groundwater was estimated to range from 12.5 to 24 feet below grade, based on cave-in and/or observed groundwater. Shallow perched water conditions were suspected to be present at the site. Geotechnical soil analyses conducted at soil borings SB-3 and SB-7 indicated that site soils generally consisted of Unified Soil Classification System (USCS) classifications of CL and SC.

3.0 SITE TOPOGRAPHY AND GEOGRAPHICAL SETTING

According to the 1970 USGS topographic quadrangle, the topography of the Colon Mine site and immediately surrounding area can be characterized by moderately rolling hills, which are dissected by dendritic tributary creeks (Figure 1). The northern ½ of the site generally slopes to the north northeast from a topographic high ridge/saddle of approximately 310 feet above sea level (asl) towards the intermittent tributary of Roberts Creek located approximately 250 feet asl along the northern property boundary. The southern ½ of the site generally slopes to the southeast from the topographic high ridge/saddle of approximately 310 feet above sea level (asl) towards the headwaters Roberts Creek located approximately 260 feet asl on the southern side of the site.

The basic topographic morphology of the proposed Colon Mine site has remained similar to the 1970 USGS topographic map, with the exception of the former clay mining areas.

On October 1, 2014, Buxton Environmental, Inc. conducted a cursory assessment of the depth of water in Excavation #2, in order to determine the approximate mining excavation depths. Water levels in Excavation #2 remained relatively stable (ranging from 264.91 feet asl to 264.71 feet asl) during the Design Hydrogeologic Investigation, and appear to represent the approximate average water table surface across the area. The mining excavation depth below the water level ranged from 10 to 23 feet within 100 feet from the shoreline, and was 25 feet deep at the center of the excavation. These excavation depths do not account for sediment runoff accumulation at the base. Mining excavation above the water level and within the bounds of Excavation #2 appears to have ranged from 5 to 20 feet below original topography. Mining excavation beyond the limits of Excavation #2 appears to have ranged from zero to 20 feet below original topography, with excavation cuts thickest immediately adjacent to Excavation #2 and tapering to zero cut approximately 400 feet to the northwest and 1,000 feet to the northeast, respectively.

According to information obtained from the Lee County GIS website (Appendix D), FEMA Flood Hazard Maps (3710965500J and 3710965400J) (Appendix D), and survey maps prepared by Lawrence Surveying for this project (Figure 3), the only on-site 100-year flood zone appears to be located along Roberts Creek on the southern side of the site. The 100-year flood zone appears to correspond to the 262 foot asl topographic contour line. Based on this information, the proposed Colon Mine RSFS is located outside of the 100-year flood zone by approximately 6.78 vertical feet (ground elevation of PZ-1 located on the southeast corner of the proposed Colon Mine RSFS is 268.78 feet asl).

Buxton Environmental, Inc. understands that ClearWater recently conducted a wetland study of the proposed Colon Mine RSFS area. Identified wetland areas are illustrated on Figure 3. Wetland areas were primarily located along drainage ditches located on the northern and western sides of the site, and within the 100-year flood plain. An isolated wetland was also identified along the southeast property boundary, approximately 550 feet southeast of PZ-8. The report documenting the findings of the wetland study will be submitted by HDR.

No obvious naturally occurring springs or creeks with actively flowing water recharged by the subsurface aquifer were observed within the proposed Colon Mine RSFS fill boundary during the assessment.

4.0 REGIONAL GEOLOGIC AND HYDROGEOLOGIC SETTING

4.1 Regional Geology

The site is located within the Piedmont Physiographical Province of North Carolina, which is a northeast-southwest trending region extending from New York to Alabama.

The subject site is located in the Triassic Basin Belt of the Piedmont Physiographic Province, according to the 1985 *North Carolina Geologic Map* prepared by the North Carolina Geological Survey (Figure 4). The Triassic Period is generally recognized to have occurred from approximately 208 to 245 million years ago. The basement rocks of the Triassic Basin Belt primarily include conglomerate, sandstone, mudstone, limestone, coal and shale. The subject property is located within the Pekin Formation (T_{RCP}), which contains conglomerate, sandstone and mudstone. The Triassic Basin is bounded by felsic metavolcanic rock (CZ_{fv}) within the Carolina Slate Belt approximately 1.5 miles to the northwest; and is contacted by biotite gneiss and schist (CZ_{bg}) of the Raleigh Belt along a normal fault and Middendorf Formation (Km) of the upper Coastal Plain, approximately 4 miles to the southeast. Triassic Basin formations have been intruded by north northwest-south southeast trending igneous diabase dikes during the Jurassic Period (~144 to 208 million years ago), and contain northeast-southwest trending normal faults, however, none of these were indicated to exist at the subject site on the 1985 geologic map.

According to the *Field Guide to the Geology of the Durham Triassic Basin* (Bain and Harvey, 1977), the Triassic Basin formed in a rift valley (tectonic plates spread apart) following the formation of the Appalachian Mountains (colliding plates). The rifting event produced graben style normal faults, caused by tensional forces, and the basin was filled in with poorly sorted alluvial fan, braided stream and shallow water lake deposits.

In the Piedmont, the bedrock is typically overlain by a mantle of weathered rock (residuum/saprolite), which has an average thickness of approximately 25 feet. The residuum/saprolite consists of varying amounts of unconsolidated clays, silts and sands, with lesser amounts of rock fragments. Due to the range of the parent rock composition and the variable susceptibility to weathering of each rock type, the residuum/saprolite ranges widely in color, texture and thickness. Generally, the residuum/saprolite is thickest near interstream divides (ridges) and thins toward stream beds. In profile, the residuum/saprolite normally grades from clayey soils near the land surface to sandier partially weathered rock above the competent bedrock.

4.2 Regional Hydrogeology

The occurrence and movement of groundwater in the Piedmont Physiographic Province is within two separate but interconnected water-bearing zones that typically comprise one aquifer. A shallow water-bearing zone occurs within the residuum/saprolite and a deeper zone within the underlying bedrock.

Groundwater in the residuum/saprolite zone occurs in the interstitial pore spaces between the individual grains comprising the residuum/saprolite. Groundwater in this zone is typically under water table conditions and generally flows from topographic highs to topographic lows. The occurrence and movement of groundwater in the underlying bedrock zone is controlled by joints and fractures within the bedrock. Groundwater within this deeper zone may occur under confined or semi-confined conditions, depending on the extent of fracturing at the saprolite/bedrock interface. Deeper groundwater movement is typically controlled by the distribution of openings in the bedrock and can be variable.

5.0 DRILLING ACTIVITIES

Buxton Environmental, Inc. prepared a *Health & Safety Plan*, dated July 15, 2014. Prior to site entry, each drilling personnel was briefed on and signed/dated the Health and Safety Plan, which was maintained on-site. In addition, each drilling personnel signed a mining waiver provided by General Shale Brick, Inc. The Health and Safety Plan is provided in E.

5.1 Soil Boring/Piezometer Installation and Rock Coring

From July 15 through August 29, 2014, Mr. Ross Klingman, P.G. (North Carolina Geologist License No.: 1266) with Buxton Environmental, Inc. conducted the oversight of drilling activities at the proposed Colon Mine RSFS area. During these activities, fourteen (14) shallow and intermediate depth stand-alone soil borings/piezometers (PZ-1, PZ-5, PZ-6, PZ-7, PZ-8, PZ-10, PZ-11, PZ-12, PZ-13, PZ-14, PZ-16, PZ-18, PZ-19 and PZ-20); five (5) nested shallow and intermediate depth soil boring/piezometer pairs were installed in the same boring (PZ-2s and PZ-2, PZ-3s and PZ-3, PZ-9s and PZ-9, PZ-15s and PZ-15, PZ-17s and PZ-17); and one (1) nested intermediate and deep soil boring/piezometer pair (PZ-4 and PZ-4D) were installed. Rock coring activities were conducted at PZ-4D. Additional rock coring was not conducted due drilling difficulties caused by inconsistencies of the layered rock and the general absence of shallow competent rock across the site. In addition, the layered rock exposure (produced during mining activities) on the northwest side Excavation #2 was able to be utilized for more detailed on-site rock characterization. These activities were conducted to determine geologic and hydrogeologic conditions at the site. The soil boring and piezometer locations are provided in Figure 3.

The drilling activities were conducted by Mr. Mark Seiler (NC Well Contractor Certification No.: 2789A) with Red Dog Drilling of Midland, North Carolina; Mr. Robert Cassell (NC Well Contractor Certification No.: 4143A) with Summit Engineering & Construction Services, Inc. of Charlotte, North Carolina; Mr. Johnny Burr (NC Well Contractor Certification No.: 3098A) with Geologic Exploration, Inc. of Statesville, North Carolina; and Mr. Tommy Bolyard (NC Well Contractor Certification No.: 3307) with Environmental Drilling & Probing, LLC of Charlotte, North Carolina. Drilling methods primarily consisted of hollow-stem auger drilling (6-inch outer diameter/2 1/4-inch inner diameter or 8-inch outer diameter/4 1/4-inch inner diameter) with split-spoon sampling technology. Rock coring and installation of piezometer PZ-4D was conducted with hollow-stem auger (10-inch outer diameter/6 1/4-inch inner diameter), mud-rotary drilling (5 5/8–inch boring diameter), and non-directional rock coring (HQ 3 5/8–inch boring diameter). The type of drilling utilized was contingent upon site geologic conditions and the type of information needed.

During the drilling activities, one-hundred fifty-four (154) spilt-spoon Standard Penetration Tests (SPT) (American Society for Testing Materials (ASTM D 1586)) and seven (7) undisturbed thin-walled "Shelby Tube" soil samples (ASTM D 1587) were collected. Additional "Shelby Tubes" were not collected, due to generally high blow counts below 10 foot depth and they did not appear warranted to further characterize the upper lithologic zones. Split-spoon soil samples were generally collected at each boring at 0-1.5 feet and 3.5-5 feet, then at 5-foot intervals to the terminus of the boring. SPT blow counts were recorded every 6-inches in three increments (18-inch total) over the 24-inch length of the split-spoon sampler. Blow counts for the second and third 6-inch increments are added together to determine Standard Penetration Resistance (N). The "Shelby Tubes" were collected by pushing 3-

inch diameter by 3-foot long thin-wall sample tubes into undisturbed soil. Drilling cave-in was cleaned out of the "Shelby Tube" and each end of the tube was sealed with drillers bees wax, capped, secured with duct-tape, labeled and stored in a vertical position to preserve the sample. The lithology of the each soil sample was logged in the field by Mr. Ross Klingman, P.G with Buxton Environmental, Inc. in general accordance with ASTM D 653 standards (included moisture content, Munsell (2000) soil color, density or consistency, grain size, plasticity, cohesion and geologic unit). ASTM standard protocols are provided in Appendix F.

The shallow and intermediate depth stand-alone piezometers (PZ-1, PZ-5, PZ-6, PZ-7, PZ-8, PZ-10, PZ-11, PZ-12, PZ-13, PZ-14, PZ-16, PZ-18, PZ-19 and PZ-20) were constructed with 10-foot sections of 2-inch diameter, Schedule 40, 0.01-foot mill slotted PVC well screen; an appropriate length of 2-inch diameter, Schedule 40 PVC riser pipe; with a sand pack around the screen; a minimum of 2-feet of hydrated bentonite above the sand pack; and grout (cement and sodium bentonite) above the bentonite seal to the ground surface. The piezometers were completed at grade with a concrete well pad and lockable steel stand-up cover. However, piezometers PZ-10 and PZ-13 were anticipated to be dry immediately following the drilling activities and were equipped only with a locked well caps (no pads or stand-up covers installed).

Nested shallow and intermediate piezometers (PZ-2s and PZ-2, PZ-3s and PZ-3, PZ-9s and PZ-9, PZ-15s and PZ-15, PZ-17s and PZ-17) were installed in the same boring. The intermediate piezometers were constructed with 10-foot sections of 2-inch diameter, Schedule 40, 0.01-foot mill slotted PVC well screen; an appropriate length of 2-inch diameter, Schedule 40 PVC riser pipe; with a sand pack around the screen; hydrated bentonite seal above the sand pack to near the base of the shallow piezometer; and a 1-foot thick sand pack above the bentonite to prevent the bentonite oozing upward. The shallow piezometers were constructed immediately above the 1-foot sand pack and were equipped with a 10-foot section of 2-inch diameter, Schedule 40, 0.01-foot mill slotted PVC well screen; an appropriate length of 2-inch diameter, Schedule 40 PVC riser pipe; with a sand pack around the screen; a minimum of 2-feet of hydrated bentonite above the sand pack; and grout above the bentonite seal to the ground surface. The piezometers were completed at grade with a concrete well pad and lockable steel stand-up cover.

The deep stand-alone piezometer (PZ-4D) was constructed with a 5-foot section of 2-inch diameter, Schedule 40, 0.01-foot mill slotted PVC well screen; an appropriate length of 2-inch diameter, Schedule 40 PVC riser pipe; with a sand pack around the screen; a minimum of 2-feet of hydrated bentonite above the sand pack; and grout above the bentonite seal to the ground surface. The piezometers were completed at grade with a concrete well pad and lockable steel stand-up cover.

Water levels were obtained to the nearest 0.01 foot with a depth-to-water meter approximately 1 hour and 24 hours following installation.

Non-directional rock coring activities were conducted at PZ-4D from 45 to 55 feet below grade utilizing a five foot long HQ sized (3 5/8-inch outer diameter) core barrel equipped with a diamond bit. Prior to conducting rock coring activities, the boring was advanced from 35 to 45 feet below grade with mud-rotary drilling with a roller cone bit (5 5/8-inch outer diameter), in order to confirm competent rock. The rock core was advanced in two 5-foot runs for a total of 10 feet. The rock core was logged in the field and at the office of Buxton Environmental, Inc. Rock core characterization included rock type (based on mineral composition and texture); extent of weathering; fracture size, frequency and orientation; recovery; and Rock Quality Designation (RQD). The methods for determining RQD were developed by D.U. Deere, 1964 (Appendix F).

Following installation, each piezometer was developed until it was relatively free of sediment with a Proactive® Monsoon pump. The pump was rented from Enviro-Equipment, Inc. located in Pineville, North Carolina.

The drilling activities were conducted in accordance with North Carolina Department of Environment and Natural Resources (NCDENR) Well Construction Standards (15A NCAC 02C .0108). Each piezometer was equipped with a permanently affixed well tag indicating the well contractor name and driller certification number, date of well completion, total depth of well, screen length and well identification number. Well Construction Records and boring logs are provided in Appendix G.

Following completion of the permitting process and prior to construction of the proposed Colon Mine RSFS, all borings and piezometers (not utilized as permanent monitor wells) should be appropriately abandoned in accordance with NCDENR Well Construction Standards (15A NCAC 2C Rule .0113). Copies of abandonment records and/or well construction records should be forwarded to the NCSWS.

6.0 GEOTECHNICAL LABORATORY ANALYSES

In order to quantify soil characteristics at the proposed Colon Mine RSFS, seven (7) undisturbed thin-walled "Shelby Tube" soil samples, nineteen (19) selected bagged split-spoon soil samples, and two (2) bulk samples (for potential clay liner use) were submitted for geotechnical laboratory testing at Summit Engineering & Construction Services, Inc. located in Charlotte, North Carolina.

The undisturbed thin-walled "Shelby Tube" soil samples were analyzed for grain size with hydrometer (ASTM D 422), specific gravity (ASTM D 854), saturated hydraulic conductivity (permeability) (ASTM D 2850), total porosity (ASTM D 5084) and Atterberg Limits (plastic limit (PL), liquid limit (LL) and plastic index (PI)) (ASTM D 4318) (if needed to determine United Soil Classification System (USCS) classification for clayey soils). The bagged split-spoon soil samples were analyzed for grain size with hydrometer (ASTM D 422) and Atterberg Limits (PL, LL and PI) (ASTM D 4318) (if needed to determine USCS classification for clayey soils). Based on the laboratory analyses, each of the undisturbed "Shelby Tube" and bag soil samples were assigned an USCS classification (ASTM D 2487). In addition, effective porosity (i.e. specific yield) was estimated by plotting grain size distribution data in a textural classification triangle (Johnson, 1967) for each undisturbed "Shelby Tube" and bagged soil sample. A summary of geotechnical laboratory results including lithologic unit, USCS classification, grain size distribution, specific gravity, hydraulic conductivity, total porosity, effective porosity and Atterberg Limits are provided in Table 1 and in boring logs (Appendix G). Geotechnical laboratory data sheets are presented in Appendix H.

The bulk soil samples were analyzed for grain size with hydrometer (ASTM D 422), specific gravity (ASTM D 854), re-molded saturated hydraulic conductivity (permeability), optimum moisture content and compaction tests (ASTM D698), total porosity and Atterberg Limits (plastic limit (PL), liquid limit (LL) and plastic index (PI)) (ASTM D 4318). Geotechnical laboratory data sheets are presented in Appendix H.

7.0 EXCAVATION WATER AND SURFACE WATER MONITORING LOCATIONS

On July 28, 2014, Buxton Environmental, Inc. established two (2) excavation water monitoring stakes (STK-1 and STK-2) and three (3) surface water monitoring stakes (STK-3, STK-4 and STK-5) at the site, in order to assist with preparation of groundwater flow maps and to assess the impacts of surface water on the groundwater aquifer. STK-1 was installed at the edge of Excavation #1 located adjacent to piezometer PZ-1; STK-2 was installed at the edge of Excavation #2 located adjacent to piezometers PZ-2s and PZ-2; and STK-3, STK-4 and STK-5 were installed along the center line of the intermittent tributary of Roberts Creek located along the northern property boundary.

8.0 SURVEY ACTIVITIES

Following completion of the piezometer installation by Buxton Environmental, Inc., the top-of-casing and ground surface elevations, and the horizontal locations of piezometers (PZ-1 through PZ-20) were surveyed by Lawrence Surveying of Monroe, North Carolina. The top-of-stake and ground surface elevation, and the horizontal locations of excavation water stakes STK-1 and STK-2 were determined. The horizontal locations of STK-3, STK-4 and STK-5 were determined. The horizontal locations of Geo Track Technologies, Inc. soil borings B-1, B-3, B-6, B-7 and B-8 were also determined by Lawrence Surveying. Available survey information is provided in Figure 3 and Table 2.

9.0 SITE GEOLOGY AND HYDROGEOLOGY – COLON MINE RSFS

9.1 Groundwater, Excavation Water and Surface Water Level Gauging Activities

On July 28 and 29, 2014, August 8, 2014, August 21, 2014, September 3 and October 31, 2014, Buxton Environmental, Inc. conducted groundwater level gauging at piezometers (PZ-1 through PZ-18) and water stake locations (STK-1 through STK-5), in order to determine water levels conditions at the Colon Mine site. Groundwater gauging was only conducted at piezometers PZ-19 and PZ-20 on September 3 and October 31, 2014, since they were installed on August 29, 2014. The water levels were obtained to the nearest 0.01 foot with a depth-to-water meter. Several piezometers, including PZ-2s and PZ-10, are still stabilizing three months following installation, due to very slow aquifer conditions. Piezometer PZ-12 has remained dry since installation on July 22, 2014. Surface water stakes STK-4 and STK-5, which are located along the upper reaches of the intermittent tributary on the northern property, have remained dry during the investigation. Groundwater gauging data is provided in Table 2.

Excavation water level elevations at Excavation #1 and #2 appear to represent the expected average water table surface (which reflects average horizontal and vertical gradient changes across the exposed water area), based on a comparison water level elevations at STK-1 (Excavation #1) and STK-2 (Excavation #2) relative to water levels at adjacent piezometers and anticipated projected gradients across the site. Excavation water levels at Excavation #1 and #2 would be expected to vary slightly with time, based on changing weather conditions, however, no substantial changes in water levels were observed during this investigation, even though numerous heavy rain events occurred during this time.

The groundwater, excavation water and surface water levels were obtained to assist with hydrogeologic assessment at the proposed Colon Mine RSFS including, groundwater flow direction, hydraulic gradients and seasonal and long-term high groundwater level determinations.

9.2 Slug and Recovery Test Activities to Determine Hydraulic Conductivity

On August 21, 2014, Buxton Environmental, Inc. conducted rising head slug tests at piezometers PZ-1, PZ-4, PZ-4D, PZ-9s, PZ-9 and PZ-15, in order to determine hydraulic conductivity. Prior to conducting the slug tests, static water levels were obtained at each piezometer to the nearest 0.01 foot with a depth-to-water meter. The slug tests were conducted by lowering one disposable PVC bailer attached to new nylon rope below the water level at each piezometer. Water levels were allowed to equilibrate to near static conditions. A slug of water was then removed from the piezometer by withdrawing the bailer and water levels were measured with time.

From July 21 through October 31, 2014, rising water levels have been collected at piezometer PZ-10 as part of routine water level gauging activities at the site. Groundwater recharge at piezometer PZ-10 appears to continue to be stabilizing (as of date of this report) at one of the slowest on-site rates (besides PZ-2s). The historical recovery data at the piezometer was complied and utilized to determine a hydraulic conductivity estimate, utilizing slug test methods.

The slug and recovery test data was evaluated utilizing AQTESOLV software developed by Hydrosolve, Inc. (2007) and in accordance with the methods developed by Bouwer and Rice in 1976 and 1987 (update). The Bouwer-Rice method was developed to determine the hydraulic conductivity of the aquifer immediately surrounding the screened portion of partially or fully penetrating wells in unconfined aquifers. The slug and recovery test data, and corresponding hydraulic conductivity results are presented in Appendix I. The slug and recovery test results are summarized below.

Piezometer	*Hydraulic Conductivity (cm/sec)*
PZ-1	5.629×10^{-5}
PZ-4	2.700×10^{-6}
PZ-4D	5.523×10^{-7}
PZ-9s	5.425×10^{-7}
PZ-9	6.828×10^{-7}
PZ-10	6.051×10^{-8}
PZ-15	6.738×10^{-5}

9.3 Seasonal High Groundwater Level Determination

The seasonal high groundwater level determination was conducted by evaluating 1) stabilized groundwater elevations at the Colon Mine site from July 28 to October 31, 2014; 2) historical monthly median groundwater levels at two USGS wells including NC-126 (Chapel Hill), and NC-194 (Marston); 3) monthly precipitation totals for 2014 from the Raleigh-Durham Airport; and 4) precipitation totals in 2014 for North Carolina (as reported by the NOAA, National Climatic Data Center website).

Based stabilized groundwater high elevations collected at single stand-alone shallow or intermediate depth piezometers, and the shallow nested pair piezometers, which have four or more observations from July 28 & 29, 2014 (4 highs), August 8, 2014 (1 high), August 21, 2014 (6 highs), September 3, 2014 (1 high) and October 31, 2014 (2 highs), the groundwater high occurred on August 21, 2014 (Table 2).

A review of historical groundwater level data at two USGS wells including NC-126 (Chapel Hill, located 26 miles north) and NC-194 (Marston, located 45 miles southwest) was conducted to determine historical monthly median groundwater highs (Appendix J). These wells were selected due to their relative proximity to the site and long gauging histories. The NC-126 well is installed into crystalline rock of the Piedmont to a depth of 48 feet below grade and ground surface is located 511.50 feet asl. Monthly groundwater levels have been collected from March 1948 to December 17, 2013 (65 years). The monthly median groundwater high at NC-126 occurs in June of each year (41.03 feet below grade), which is 0.94 feet higher than monthly median groundwater levels in August of each year. The NC-194 well is installed into Coastal Plain sediments to a depth of 39 feet below grade and ground surface is located 433 feet asl. Monthly groundwater levels have been collected from November 1993 to April 23, 2014 (21 years). The monthly median groundwater high at NC-194 occurs in May of each year (30.83 feet below grade), which is 0.66 feet higher than monthly median groundwater levels in August of each year. Based on this information, it appears that historical seasonal high groundwater levels typically occur from May to June (late spring to early summer), with a median departure of less than 1 foot from the seasonal groundwater high until the August of each year.

A review of monthly precipitation totals was obtained for the first ten months (January through October) for 2014 at the Raleigh-Durham Airport (located approximately 30 miles northeast of the site) from the National Weather Service and NOAA website (Appendix K). The graph indicates below average precipitation in January and February; above average precipitation from March to May (up to 2.3 inches above average); slightly below average precipitation in June; well above average precipitation in July (8.96 inches above average); above average precipitation in August and September (up to 2.61 inches above average); and below average precipitation in October 2014. These same trends were also reflected in the precipitation totals in 2014 for North Carolina (as reported by the NOAA, National Climatic Data Center website) (Appendix M). Precipitation totals and trends at the Colon Mine site are anticipated to be similar to the Raleigh-Durham airport, due to their relatively close proximity and since weather patterns typically migrate in a northeastward direction (placing them in a similar weather pattern).

Based on this evaluation and considering the exceptionally rainy July (as reported at the Raleigh-Durham Airport) and above average rainy summer (as reported by NOAA for North Carolina), the water levels encountered on August 21, 2014 at the Colon Mine RSFS have been interpreted to represent a reasonable seasonal groundwater high for the site.

9.4 Shallow & Intermediate Groundwater Potentiometric Map – August 21, 2014

Groundwater elevation data collected on August 21, 2014 was utilized to create a Shallow & Intermediate Groundwater Potentiometric Map (Figure 5). Groundwater elevations obtained on September 3, 2014 were utilized at piezometers PZ-19 and PZ-20 (due to August 29, 2014 installation date), and the groundwater elevation obtained on October 31, 2014 was utilized at piezometer PZ-18 (as water levels appeared to finally stabilize), to prepared the groundwater potentiometric map. In addition, the excavation water elevation recorded on August 21, 2014 at STK-2 at Excavation #2 was utilized to assist with the groundwater potentiometric map.

Several inferences were made to create a complete and more realistic depiction of groundwater surfaces across the site. The inferences included: 1) water levels at the Excavation #1 represent the average water table across the area (264.90'); 2) groundwater levels at the five (5) drainage features located along the north and west side of the site would be anticipated to be 5 feet below topographic grade; 3) groundwater levels at piezometer PZ-10 would eventually stabilize to 10 feet below topographic grade (253.48'); and 4) groundwater levels at the isolated wetland located along the southeast property boundary would be anticipated to be 5 feet below the 272' topographic grade (267'). These inferences are supported by stabilized water level observations at remaining on-site piezometers, excavation water and surface water levels, horizontal hydraulic gradient trends, and were intended to be conservative in nature. The 5 foot correction appeared appropriate along drainage features and the wetland area, since the two shallowest depths to water across the entire site during the investigation were 5.41 feet below grade at PZ-1 on July 28 & 29, 2014, and 5.44 feet below grade at PZ-19 on September 3, 2014. As further support for the 5 foot correction along drainage features and wetland area, piezometers PZ-11 and PZ-16 are installed immediately adjacent to drainage features, and the shallowest depths to water were 8.45 feet and 8.33 feet below grade, respectively, during this investigation. The 10 foot correction at PZ-10 appeared appropriate, since this piezometer is located approximately 100 feet sidegradient and 3.5 vertical feet above a nearby drainage feature.
The predominant shallow & intermediate groundwater flow direction across the proposed Colon Mine

RSFS appears to generally mirror surface topography with groundwater flow to the northeast and northwest on the northern ½ of the site toward the intermittent tributary creek on the northern property boundary; and to the to the southeast and southwest towards the Excavations #1 and #2 and the headwaters of Roberts Creek on the southern ½ of the site.

9.5 Hydraulic Gradients

Average horizontal hydraulic gradients were determined across the site. A horizontal hydraulic gradient of 0.02 ft/ft was observed on August 21, 2014 from PZ-14 (topographic high) to PZ-1 (topographic low) on the southern ½ of the site; and a horizontal topographic gradient of 0.03 ft/ft was observed from PZ-14 (topographic high) to PZ-11 (topographic low) on the northern ½ of the site. Horizontal hydraulic gradients in the immediate vicinity of selected piezometers are provided in Table 4.

Vertical hydraulic gradients observed on August 21, 2014 for stabilized nested piezometers (PZ-3s and PZ-3, PZ-4 and PZ-4D, PZ-9s and PZ-9, and PZ-15s and PZ-15 are summarized below.

Nested Piezometer/Well	*Location*	*Vertical Hydraulic Gradient (August 21, 2014)*
PZ-3s and PZ-3	Ridge on East Side	0.05 ft/ft upward (consistent upward)
PZ-4 and PZ-4D	Ridge Saddle (center site)	0.04 ft/ft upward (consistent upward)
PZ-9s and PZ-9	Northeast Slope	0.07 ft/ft downward (transitioned upward to downward)
PZ-15s and PZ-15	Head of Drainage Feature	0.05 ft/ft downward (transitioned upward to downward)

Downward vertical hydraulic gradients are generally associated with groundwater recharge zones (generally located in topographically elevated areas on ridges and side slopes) and upward vertical hydraulic gradients are generally associated with groundwater discharge zones (topographic lows near creeks/streams/rivers).

Vertical hydraulic gradients at nested piezometers PZ-9s and PZ-9, and PZ-15s and PZ-15 transitioned from upward vertical gradients to downward vertical gradients in late July and early August 2014. This transition in vertical gradient appears to be the result of stabilization to prevailing environmental factors (i.e., precipitation or barometric pressures).

In addition, the moderate vertical hydraulic gradients observed at the nested piezometers appear to indicate that the shallow, intermediate and deep portion of the aquifer are interconnected, therefore, are under predominately unconfined hydraulic conditions. The near vertical fractures observed in the partially weathered rock and layered rock at the site appear to be the principal mechanism interconnecting the shallow, intermediate and deeper portions of the aquifer at the site. An aquifer pumping test would be required to determine the extent of vertical connectivity. Based on water levels at on-site nested piezometers, no evidence of obvious perched water or artesian conditions were observed at the site.

9.6 Average Linear Groundwater Velocity

Average linear groundwater velocities were calculated at piezometers PZ-1, PZ-2s, PZ-4, PZ-4D, PZ-6, PZ-7, PZ-9s, PZ-9, PZ-10, PZ-11 and PZ-15 using the following equation developed by Darcy (1856) (as described in Fetter (1988)).:

$$V_x = K/n \times dh/dl$$

Where: V_x = average linear groundwater velocity (ft/day)
K = hydraulic conductivity (ft/day) (derived from slug tests or laboratory analyses)
n = total porosity (unitless)
dh/dl = horizontal hydraulic gradient (ft/ft) in the vicinity of the respective well

Average linear groundwater velocities ranged from 0.000023 ft/day (0.0084 ft/year) at piezometer PZ-10 to 0.05 ft/day (18.62 ft/year) at piezometer PZ-15.

Average linear groundwater velocity estimates (including lithologic unit, USCS classification, hydraulic conductivity, horizontal hydraulic gradient, effective porosity and groundwater flow direction information) are provided in Table 4.

9.7 Estimated Long-Term High Groundwater Level Determination

The estimated long-term high ground water level for the Colon Mine RSFS was determined by evaluating historical groundwater elevation data at the Lee County Landfill (Permit No.: 53-01) and an evaluation of historical precipitation data from 1895 to 2014 obtained from the NOAA Satellite and Information Service website.

Lee County Landfill is located at 331 Landfill Road in Lemon Springs, North Carolina, approximately 11.5 miles south southeast of the Colon Mine RSFS site. According to the 1985 Geologic Map of North Carolina, the Lee County Landfill is within the Middendorf Formation (Cretaceous Period, ~65 to 144 million years ago), which is located in the upper Coastal Plain Physiographical Province, with sediments primarily consisting of sand, sandstone and mudstone. The groundwater gauging data was obtained from monitoring reports available at the NCSWS website and electronic files obtained from their Freedom of Information (FOI) department. Groundwater gauging data was available for ten (10) wells including MW-4, MW-5, MW-6, MW-7, MW-9, MW-10, MW-11, MW-12, MW-13 and MW-14 from September 12, 1995 to April 10, 2014 (approximately 19 year time-span) (Table 3). The monitor well installation depths range from 13.30 to 40.40 feet below grade, and boring logs for MW-4, MW-5 and MW-6 indicated primarily sandy clay and clayey sand sediments, which are similar with piezometer depth and soil characteristics observed at the Colon Mine site. A summary of historical groundwater elevation data, including graphed data, pertinent groundwater sampling reports, boring logs and well construction records are provided in Appendix L.

According to a graph of historical precipitation for North Carolina from 1895 to 2014 obtained from the NOAA Satellite and Information Service website, the single most monthly average precipitation occurred in late 1999 (13+ inches), with 2003 experiencing the most precipitation ever recorded based on a 1-year moving average (Appendix M). This rainy period corresponds to a period of historical groundwater high elevations observed at Lee County Landfill, which occurred from 1998 to 2003.

Based on this information and the close proximity to the site, the Lee County Landfill appeared to be a suitable site to estimate long-term high groundwater levels for the Colon Mine RSFS.

A reasonable conservative estimated long-term groundwater high correction factor for the Colon Mine RSFS site was determined with historical groundwater elevation data at the Lee County Landfill by the following method. A geometric mean of +3.5 feet (groundwater elevation correction factor) was calculated by taking the difference in historical groundwater high elevations (which occurred from 1998 to 2003) from groundwater elevations obtained on October 1, 2013 (second most recent water level readings) for the 10 monitor wells at the Lee County Landfill. The above approach appeared more conservative than utilizing the most recent gauging data collected on April 10, 2014, by which a geometric mean groundwater correction factor of +0.75 feet would be applied (with the 10 well data set having minimum difference of 0.1 foot at MW-13 and a maximum difference of 2.21 feet at MW-11). Above average precipitation which occurred during the summer of 2014, as outlined in Section 9.3, would be expected to have elevated the water levels observed at the Lee County Landfill in April 2014 even further, resulting in a long-term groundwater high correction factor less than +0.75 feet.

Based on this evaluation, Buxton Environmental, Inc. recommends that a +3.5 foot correction factor be uniformly applied to the Shallow & Intermediate Groundwater Potentiometric Map – August 21, 2014 (interpreted seasonal high groundwater level) (Figure 5) to generate an estimated long-term high groundwater potentiometric surface for the Colon Mine RSFS site.

9.8 Site Geologic Units

The geology of the proposed Colon Mine RSFS area can be subdivided into six lithologic units, which include fill, flood plain, soil horizon, residuum, partially weathered rock and layered rock. These geologic units generally grade downward from a soil horizon, to residuum, to partially weathered rock and finally layered rock. The fill materials were only identified in the road bed and berm located around the south and east sides of the Excavation #1 and #2. The flood plain sediments were only identified at PZ-2 located adjacent to Roberts Creek on the southeast side of the site. The summary of the site geologic units is based on boring logs PZ-1 through PZ-20 (Appendix G) and is provided below.

Fill

The fill materials were only identified in the road bed and berm located around the south and east sides of the Excavations #1 and #2. The fill material generally consisted of mottled red, brown or yellow; fine to coarse sandy silty clay with brick fragments, gravel and roots.

Flood Plain

The flood plain sediments were only identified at PZ-2 located adjacent to the headwaters of Roberts Creek on the southeast side of the site. The flood plain sediments are associated with the adjacent Roberts Creek. The flood plain sediments can be generally characterized by a mottled light gray; coarse quartz sandy clayey silt. The flood plain sediments were only approximately 5 feet thick at PZ-2 and had been deposited above partially weathered rock. Based on geotechnical laboratory data, the flood plain sediments consisted of USCS group symbol CH and had a hydraulic conductivity value of 6.23×10^{-5} cm/sec.

Soil Horizon

The soil horizon can generally be characterized by mottled yellowish, brown, orange and red color consisting of fine to coarse sandy clayey silt, silty clay and clayey sand with gravel. Root structures were common. The soil horizon at the site is formed from the continued weathering and biologic reworking of residuum, and ranges from 2 to 8 feet in thickness. Based on geotechnical laboratory data, the soil horizon consisted of USCS group symbols SC-SM, CL and CH, and had hydraulic conductivity values ranging from 2.42×10^{-6} cm/sec to 1.35×10^{-7} cm/sec.

Residuum

The residuum can generally be characterized by a red, reddish brown or purple color with black and white specks and stringers, primarily consisting of fine sandy clayey silt and silty clays which often contain a horizontal fissile characteristic (breaks in horizontal sheets). The residuum generally retains the remnant texture, structure and mineral content of the rock from which it was formed, and ranges from 5 to 20 feet in thickness. The residuum has a Standard Penetration Resistance (N) of less than 100 blows per foot. Based on geotechnical laboratory data, the residuum consisted of USCS group symbols SM, SC and CL. Hydraulic conductivity values ranged from 6.01×10^{-6} cm/sec to 2.43×10^{-7} cm/sec, according to geotechnical laboratory and slug test data (for wells screened solely in residuum).

Partially Weathered Rock

The partially weathered rock can generally be characterized by a red and weak red color with white and black stingers, primarily consisting of quartz and phyllite gravely clayey silt, silt and clayey silty sand with quartz and phyllite gravel which often contain a horizontal fissile characteristic. Vertical to horizontal manganese filled fractures were often observed. The partially weathered rock generally retains the remnant texture, structure and mineral content of the rock from which it was formed, and ranges from 15 to 30 feet in thickness. Partially weathered rock has a Standard Penetration Resistance (N) of 100 blows per foot or greater and can generally be drilled with standard hollow-stem auger drilling technology. Based on geotechnical laboratory data, the partially weathered rock consisted of USCS group symbols SM, SC and CL. Hydraulic conductivity values ranged from 5.629×10^{-5} cm/sec to 7.154×10^{-8} cm/sec, according slug or recovery test data (for wells screened solely in partially weathered rock).

Layered Rock

Based on rock coring activities conducted at nested piezometer PZ-4D and visual inspection of the layered rock exposure located on the northwest side of Excavation #2, layered rock at the site is primarily composed of mudstone, muddy sandstone, and muddy sandy conglomerate and/or fanglomerate (angular to rounded quartz, and rounded flat disc-shaped phyllite gravel and cobbles). The layered rock generally occurs as horizontally oriented and relatively thin intermittent layers (especially within the upper 20 feet of contacting layered rock) across the site, based on rock coring and the horizontal fissile nature of residuum and partially weathered rock. However, the layered rock exposure to the northwest of Excavation #2 indicated a strike orientation of N 50° E with a 10° dip to the southeast, which appears to be the result of an isolated alluvial fan wedge deposit. Several manganese stained fracture planes were observed parallel to the 10° rock contact planes, along with numerous near vertical fractures. The near vertical fractures were generally oriented N 10° E and N 60° W at the layered rock exposure. Rock Quality Designation (RQD) values at PZ-4D ranged from poor to very poor (39.2% to 23.3%). The occurrence of layered rock at the site was generally defined by auger refusal. Based on slug test activities, the hydraulic conductivity of the layered rock at deep piezometer PZ-4D was 5.523×10^{-7} cm/sec.

The near vertical fractures observed in the partially weathered rock and layered rock at the site appear to be the principal mechanism interconnecting the shallow, intermediate and deeper portions of the aquifer at the site.

10.0 NATURAL AND MAN-MADE ACTIVITES AFFECTING THE WATER TABLE

As part of the investigation, natural and man-made activities which could affect the water table at the proposed landfill area were evaluated.

Natural Activities Affecting Water Table

The primary natural processes affecting water table levels at the site appears to be: 1) short-term (daily to monthly) precipitation which was reflected during the five groundwater gauging events conducted from July to October 2014; 2) seasonal precipitation/evapotranspiration trends (causing yearly fluctuations); and 3) sustained periods of rain or drought (causing longer-term trends).

Man-Made Activities Affecting Water Table

Man-made activities which could potentially affect the water table at the proposed Colon Mine RSFS include structural fill areas, associated storm water structures, clay mining and potential water supply well pumping activities.

The installation of the impermeable geosynthetic liner at the base of the proposed Colon RSFS is anticipated to deprive the aquifer of normal groundwater recharge, resulting in a gradual lowering of the water table within and immediately adjacent to site.

The construction of storm water structures immediately adjacent to the proposed Colon Mine RSFS would result in localized elevated water levels during rainy periods, as a result of increased groundwater recharge potential.

Continued clay mining within the footprint of the Colon Mine RSFS footprint could cause slight temporary increases in groundwater table levels.

During this investigation, Buxton Environmental, Inc. conducted a water supply well survey within a 500 foot perimeter beyond the proposed Colon Mine RSFS. No water supply wells were identified during the survey. However, the surrounding area has historically been utilized for rural residential and agricultural use, therefore, water supply wells could be present beyond the search area at adjacent properties. Low volume pumping from potential surrounding residential wells would not be expected to substantially impact shallow water levels at the site, due to the unconfined nature of the water-table aquifer. According to the information obtained from the Lee County GIS website, municipal water supply is available to the entire area surrounding site (Appendix D).

11.0 OTHER GEOLOGIC AND HYDROGEOLOGIC CONSIDERATIONS

Other geologic and hydrogeologic considerations including earthquakes, which have not been previously mentioned in the report were evaluated.

According to an *Earthquake Epicenters in North Carolina and Portions of Adjacent States (1698-1997)* map obtained from the North Carolina Geological Survey website, no earthquake epicenters were identified within the immediate area of the site (Appendix N). The probability of an earthquake occurring with a magnitude of greater than or equal to 4.75 within the next 100 years at the site is between 0.01 (1%) and 0.02 (2%), based on the August 25, 2014 Earthquake Probability Map downloaded from the USGS website (Appendix N).

Based on this information, earthquake activity does not appear to pose an imminent threat to the proposed Colon Mine RSFS.

12.0 VERTICAL SEPARATION AND FOUNDATION STANDARDS

The vertical separation and foundation standard as required by the NCSWS and the General Assembly of North Carolina Session 2013 – Senate Bill 729 (ratified) regarding coal combustion residuals will be discussed in detail in the engineering design report being prepared by HDR. Vertical settlement calculations for determination of the post settlement subgrade will be submitted by HDR.

The General Assembly of North Carolina Session 2013-Senate Bill 729 (ratified) regarding coal combustion residuals, requires that the post settlement subgrade be a minimum of 4 feet above the seasonal high groundwater table. The proposed post settlement subgrade, which will be established by HDR, will meet or exceed these requirements. Buxton Environmental, Inc. recommends a minimum separation of 4.5 feet at the Colon Mine RSFS, based on seasonal high and long-term high groundwater evaluations.

13.0 PROPOSED WATER QUALITY MONITORING PLAN

Water quality monitoring will be conducted at the proposed Colon Mine RSFS, in accordance with NCSWS rules and guidance documents, and General Assembly of North Carolina Session 2013-Senate Bill 729 (ratified) regarding coal combustion residuals. The water quality monitoring plan has been prepared to effectively provide early detection of any release of hazardous constituents, as to be protective of human health and the environment. Applicable NCSWS regulatory rules will be followed if a release of hazardous constituents is confirmed, however, required assessment and/or corrective measures have not been specifically outlined in this plan.

The monitoring activities will also be conducted in general accordance with NCSWS memorandums dated October 27, 2006, February 23, 2007 and October 16, 2007 concerning changes to laboratory detection limits and reporting requirements, and the *Solid Waste Section Guidelines for Groundwater, Soil and Surface Water Sampling* dated April 2008.

In developing the proposed water quality monitoring plan, we have considered structural fill configuration, waste stream, surrounding land use, site geologic and hydrogeologic characteristics (including but not limited to aquifer thickness, groundwater flow rate and direction, lithology, hydraulic conductivity, porosity and effective porosity). Supporting documentation concerning these considerations has been previously addressed in the report.

13.1 Groundwater Points of Compliance

Buxton Environmental, Inc. proposes to conduct shallow groundwater quality monitoring at nine (9) permanent shallow compliance monitor wells (Figure 6). The wells will include the eight (8) downgradient/sidegradient compliance wells and one (1) upgradient background well (topographic high saddle along power line on near southwest corner of the site). Piezometers PZ-1 and PZ-7, which were installed during the Design Hydrogeologic investigation, will be utilized as compliance wells. The monitor wells will be generally installed at the review boundary (125 feet off the fill boundary) (where room allows); or ½ the distance from the fill boundary toward the property boundary then again ½ the distance towards the property boundary (where the fill boundary is 50 foot off the property boundary). The permanent compliance wells should be completed prior to issuance of the Permit to Operate.

13.2 Compliance Monitor Well Construction

The compliance monitor wells should be constructed in a manner in which shallow groundwater quality and hydrogeologic characteristics can be adequately monitored.

The monitor wells will be installed by advancing a soil boring into the upper portion of the shallow aquifer. The wells will be constructed with 10 foot sections of 2-inch diameter mill slotted PVC screen attached to an appropriate length of 2-inch diameter PVC casing. A sand pack will be placed in the annual space of the boring to approximately 2-feet above the well screen, an approximately 2-foot thick bentonite seal will be placed above the sand, and the remaining annual space will be filled to grade with bentonite grout. The wells will be completed at grade with a 3 x 3 foot x 6-inch thick concrete pad and lockable stand-up cover. Three well guard posts will be placed around each well to protect the well from vehicle damage. The proposed compliance monitor wells will be completed in accordance with North Carolina Well Construction Standards (15A NCAC 02C .0108). A typical compliance well construction diagram is provided in Appendix O.

Following the completion activities, each well will be developed to the fullest extent possible.

13.3 Surface Water Sampling Locations

Surface water sampling is proposed to be conducted at two locations, including the intermittent tributary of Roberts Creek located to the immediate northeast of the site and the head waters of Roberts Creek to the southeast of the site (Figure 6).

13.4 Leachate Sampling Location

Buxton Environmental, Inc. understands that leachate from the Colon Mine RSFS will collect into three (3) sumps, which will then be pumped into an aboveground holding tank. One (1) composite leachate sample is proposed to be conducted from the aboveground holding tank, in order to determine site specific characteristics of the leachate.

13.5 Initial Background Groundwater and Surface Water Monitoring Activities

A minimum of four independent initial background groundwater monitoring events should be conducted at the nine (9) proposed compliance wells. A minimum of one initial background sampling event should be conducted at the two surface water sample locations. The background groundwater and surface water monitoring events should be conducted prior to issuance of the Permit to Operate.

At each compliance monitor well, groundwater level measurements will be made to within 0.01 of a foot with a depth to water electrode.

The purging and sampling of the wells will be conducted with low flow sampling techniques specified in the *Solid Waste Section Guidelines for Groundwater, Soil and Surface Water Sampling* dated April 2008. Field parameters including temperature, pH, specific conductance, temperature, dissolved oxygen and turbidity will be collected until field parameters have stabilized within specific tolerances for three consecutive readings.

The groundwater and surface water samples will be analyzed for Appendix I constituents (volatile organic compounds (VOC's) and metals (including mercury) outlined in 40 CFR Part 258 and in general accordance with applicable NCSWS guidance and Senate Bill 729. For quality control purposes, one trip blank and one equipment blank will analyzed for Appendix I VOC's and metals (including mercury) during each event. The laboratory analyses will be conducted by a North Carolina certified laboratory in accordance with Level I (standard) QA/QC procedures. Sample collection, handling and storage will be conducted in general accordance with accepted protocol, including chain-of-custody documentation.

13.6 Semi-Annual Groundwater, Surface Water and Leachate Monitoring Activities

Semi-annual groundwater, surface water and leachate monitoring activities will be conducted at the site. These activities are anticipated to be conducted in April and October of each year during the active life and post-closure period of the proposed Colon Mine RSFS.

At each compliance monitor well, groundwater level measurements will be made to within 0.01 of a foot with a depth to water electrode.

The low flow purging and sampling of the wells should be conducted as specified in the *Solid Waste Section Guidelines for Groundwater, Soil and Surface Water Sampling* dated April 2008. Field parameters including temperature, pH, specific conductance, temperature, dissolved oxygen and turbidity will be collected until field parameters have stabilized within specific tolerances for three consecutive readings.

The groundwater, surface water and leachate samples will be analyzed for Appendix I constituents including VOC's and metals (including mercury) outlined in 40 CFR Part 258 and in general accordance with applicable NCSWS memos and the *Solid Waste Section Guidelines for Groundwater, Soil and Surface Water Sampling* dated April 2008, and Senate Bill 729. The leachate sample will also be analyzed for biologic oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), sulfate, nitrate and phosphate. For quality control purposes, one trip blank and one equipment blank will analyzed for Appendix I VOC's and metals (including mercury) during each event. The laboratory analyses are proposed to be conducted by a North Carolina certified laboratory in accordance with Level I (standard) QA/QC procedures. Sample collection, handling and storage will be conducted in general accordance with accepted protocol, including chain-of-custody documentation.

Following receipt of the analytical data, a groundwater, surface water and leachate monitoring report will be prepared in general accordance NCSWS guidelines. The report will include an executive summary, methods, results, conclusions and recommendations, tables of gauging and sample results, groundwater flow rates and groundwater flow direction map. The report will be prepared by a North Carolina Professional Geologist or Engineer.

A copy of the report should be submitted to the NCSWS within 120 days of the sampling date. The owner or operator shall notify the NCSWS of any exceedance of NCSWS, Groundwater Protection Standards (NCGPS's) within 14 days of this finding. An Assessment Monitoring Program will be required to be implemented within 90 days following an exceedance of the NCGPS, unless a successful alternate source demonstration can be made justifying an alternate cause of the exceedance.

14.0 REFERENCES

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FIGURES

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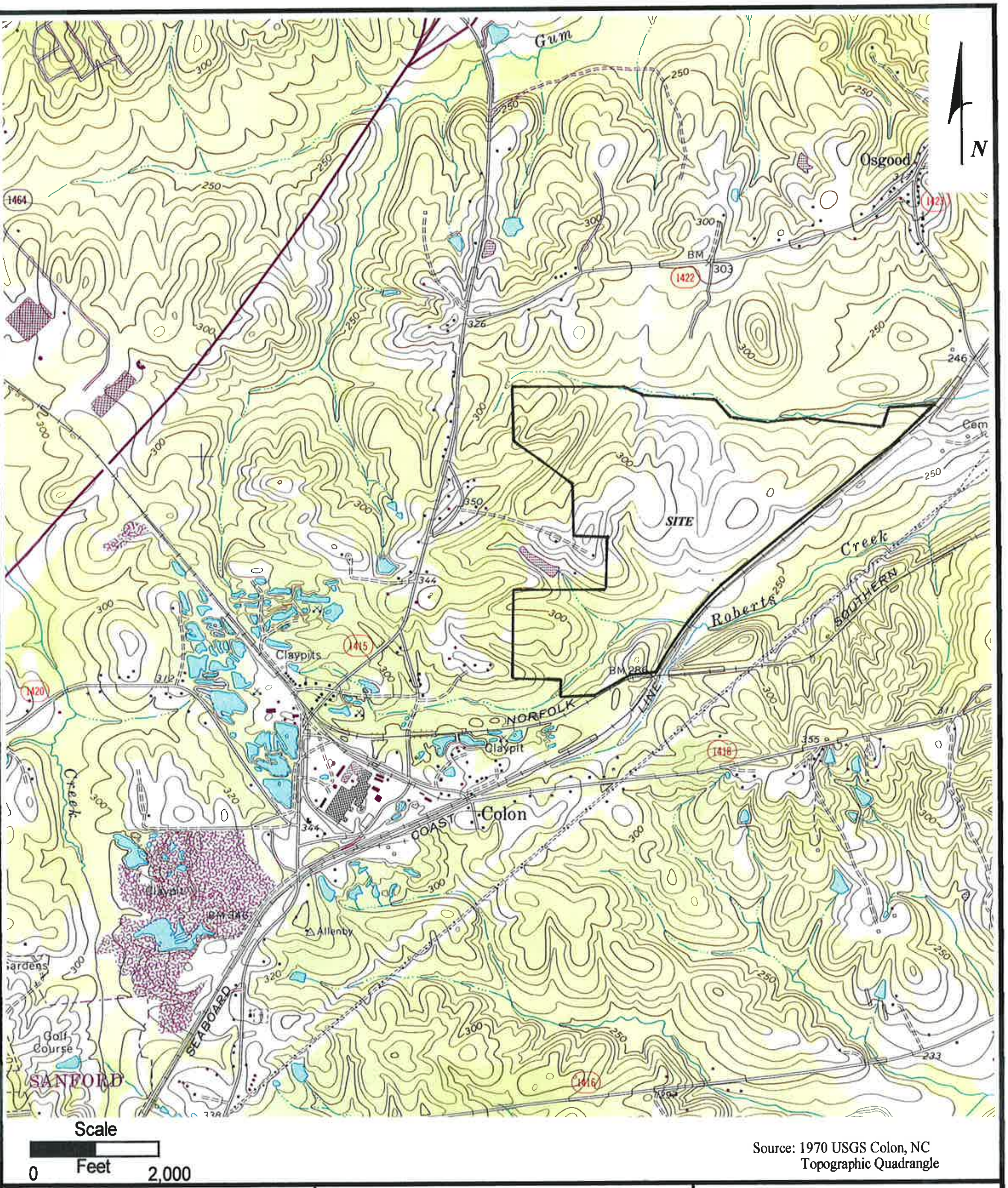
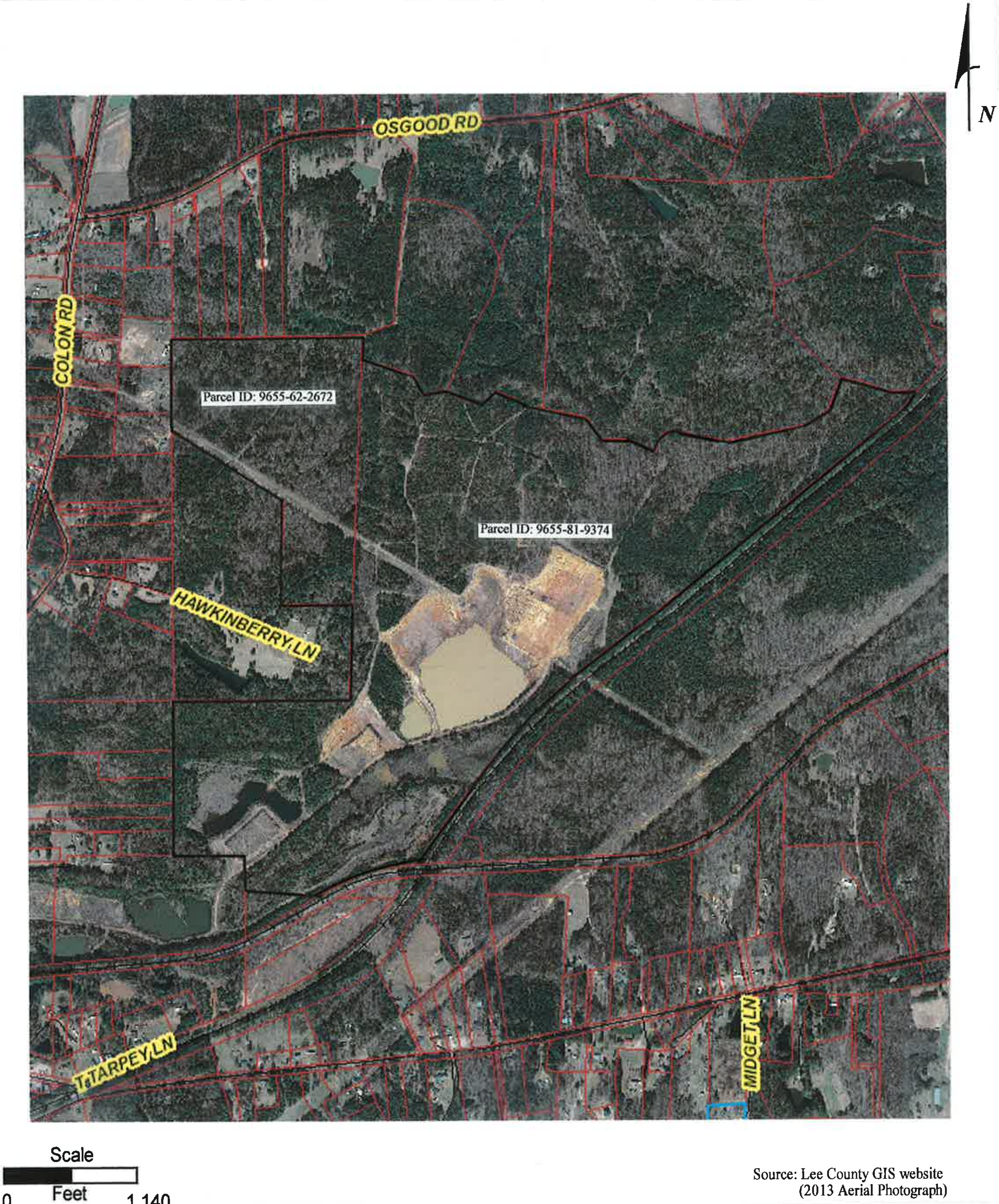


Source: 1970 USGS Colon, NC Topographic Quadrangle

Colon Mine Reclamation Fill Site 1303 Brickyard Road Sanford, North Carolina	Buxton Environmental, Inc.	Figure 1. Site Location Map

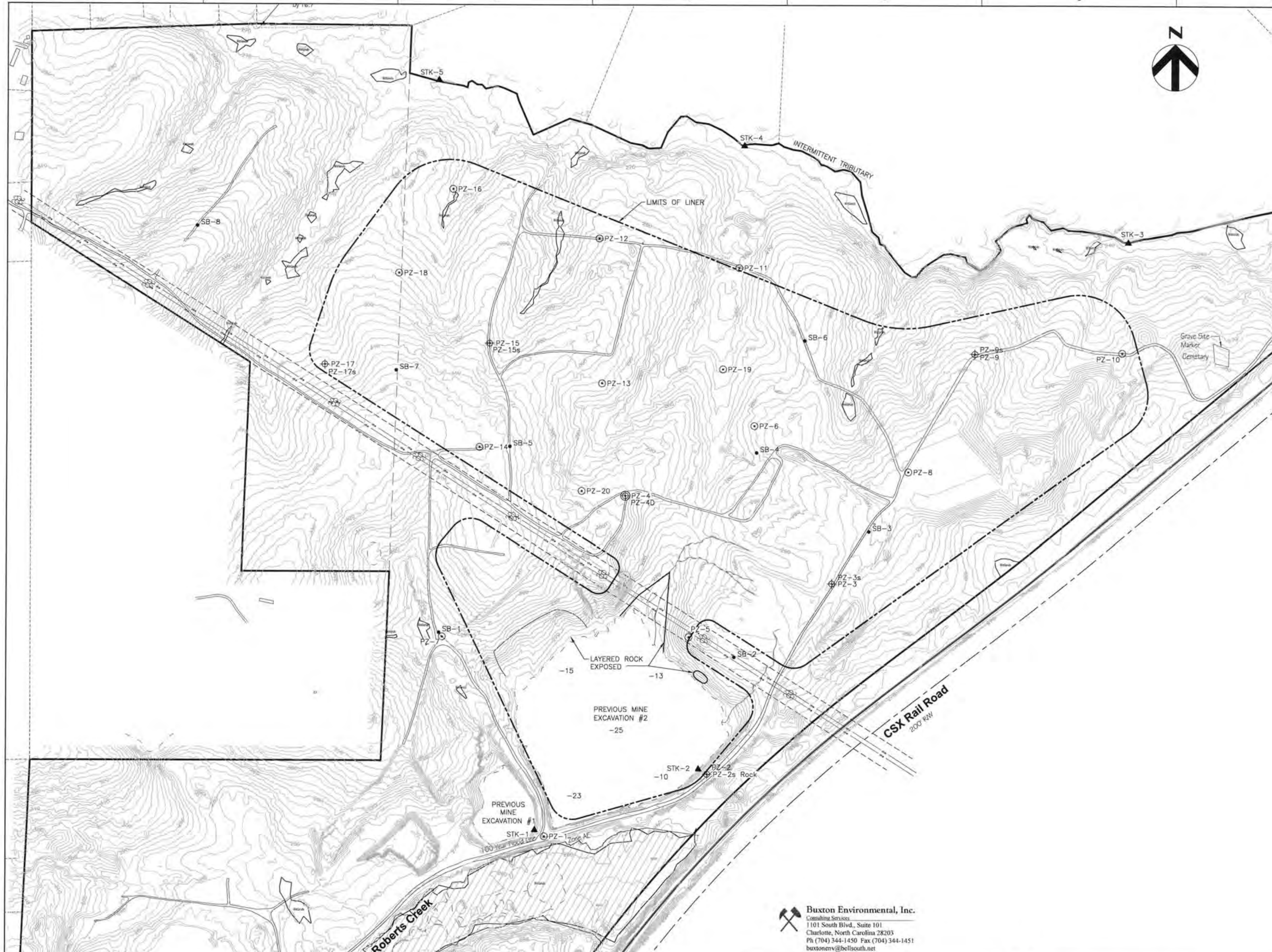


Source: Lee County GIS website
(2013 Aerial Photograph)

Colon Mine Reclamation Fill Site 1303 Brickyard Road Sanford, North Carolina	Buxton Environmental, Inc.	Figure 2. Site Layout Map

NOTES:

1. SURVEY BASE MAP PREPARED BY LAWRENCE SURVEYING OF MONROE DATED AUGUST 21, 2014.



LEGEND

- ⊙ SINGLE SHALLOW OR INTERMEDIATE PIEZOMETER
- NESTED SHALLOW AND INTERMEDIATE PIEZOMETER PAIR
- NESTED INTERMEDIATE AND DEEP PIEZOMETER PAIR (WITH ROCK CORE)
- • GEOTECHNICAL SOIL BORING (GEOTRACK) (APPROX. LOCATIONS FOR B-2, B-4 & B-5)
- ▲ EXCAVATED WATER AND SURFACE WATER STAKE LOCATION

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ISSUE	DATE	DESCRIPTION
A	11/2014	ISSUED FOR APPROVAL

PROJECT MANAGER	M.D. PLUMMER, P.E.
	R. KLINGMAN, P.G.
	J. GAUL
PROJECT NUMBER	

NORTH CAROLINA LICENSED GEOLOGIST SEAL 1266 CHARLES ROSS KLINGMAN

11-5-14

Charah®

COLON MINE SITE STRUCTURAL FILL
SANFORD, NC

PROPOSED COLON MINE RECLAMATION STRUCTURAL FILL SITE PLAN WITH PIEZOMETER AND SOIL BORING LOCATIONS

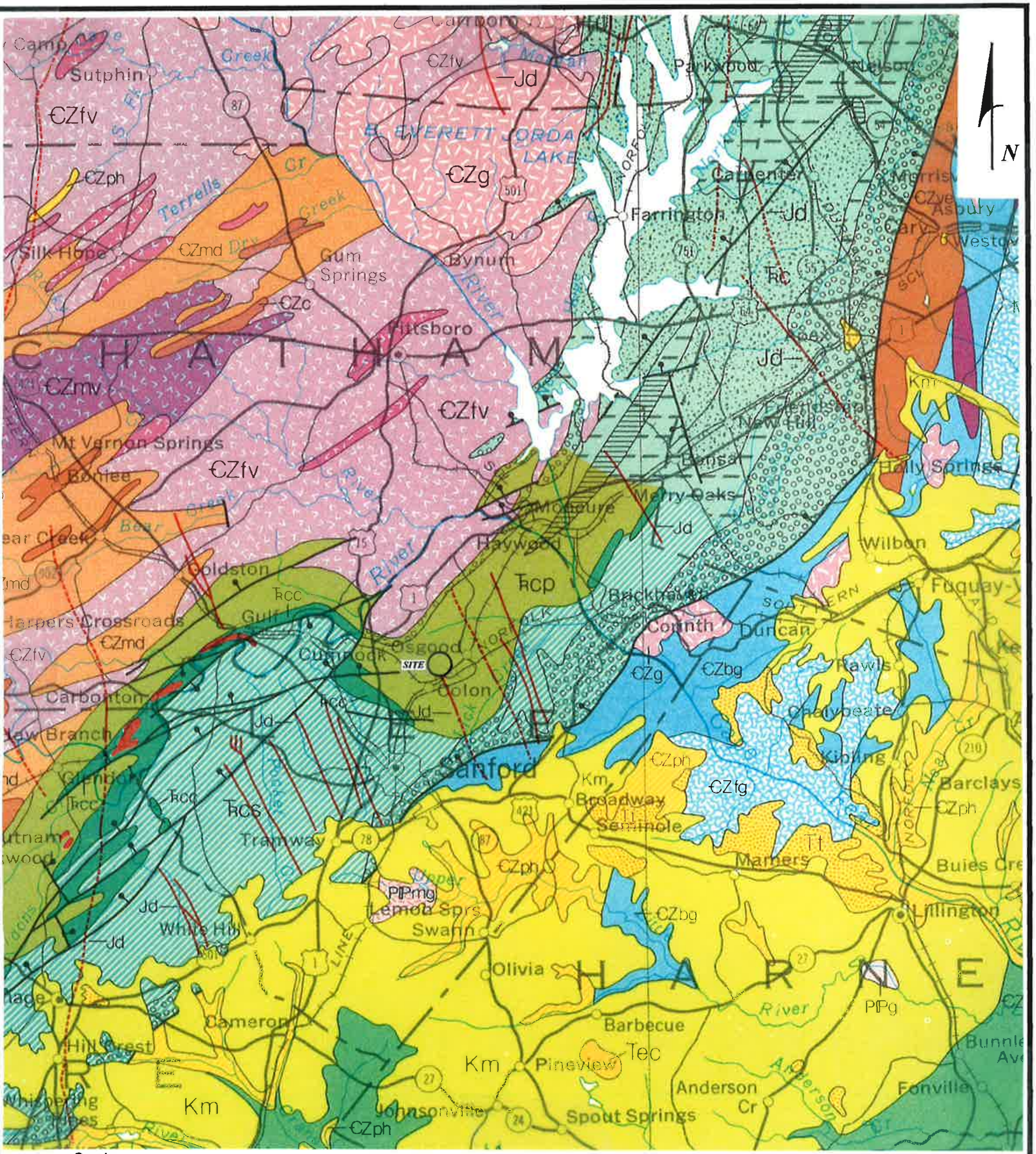
0 1" 2"

FILENAME 00G-03.dwg

SCALE 1"=200'

SHEET

FIGURE 3



Scale

0 Feet 28,000

Source: 1985 Geologic Map of North Carolina
by NC Geological Survey

Colon Mine Reclamation Fill Site 1303 Brickyard Road Sanford, North Carolina	Buxton Environmental, Inc.	Figure 4. Geologic Map

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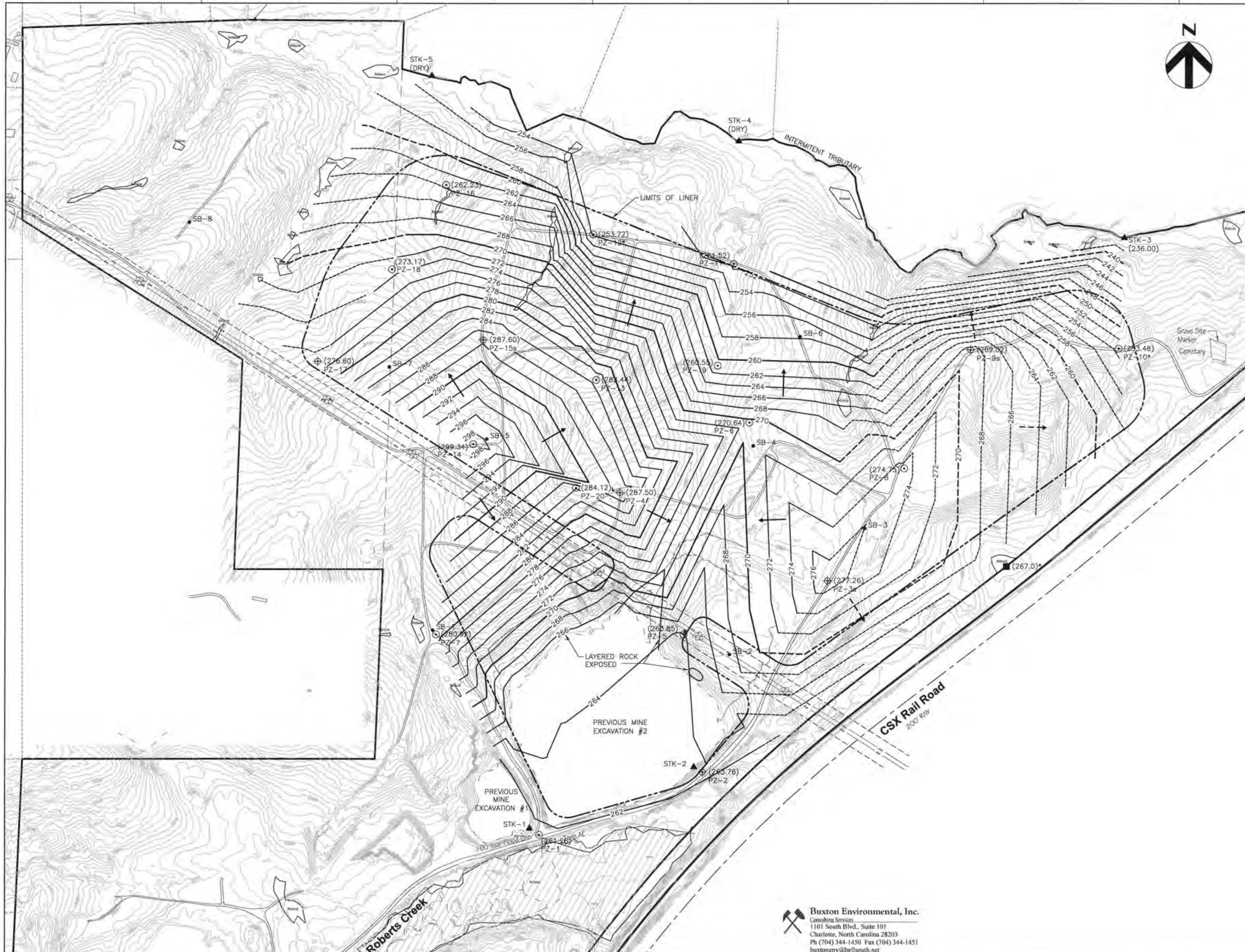

NOTES:

1. SURVEY BASE MAP PREPARED BY LAWRENCE SURVEYING OF MONROE DATED AUGUST 21, 2014.
2. GROUNDWATER POTENTIOMETRIC CONTOURS GENERATED UTILIZING AUTOCAD DRAFTING AND INTERPOLATION SOFTWARE BY HDR ENGINEERING, INC. WITH OVERSIGHT BY ROSS KLINGMAN, P.G. WITH BUXTON ENGINEERING, INC.
3. THE GROUNDWATER POTENTIOMETRIC CONTOURS WERE GENERATED UTILIZING WATER LEVEL ELEVATIONS COLLECTED ON 8-21-14 (INTERPETED SEASONAL HIGH WATER LEVEL @ SHALLOW AND INTERMEDIATE PIEZOMETERS AND SURFACE WATER LOCATIONS. GROUNDWATER ELEVATIONS AT PZ-19 AND PZ-20 WERE OBTAINED ON 9-13-14 AND PZ-18 ON OCTOBER 31, 2014. INFERRED GROUNDWATER LEVELS OF -5' BELOW GRADE WERE UTILIZED ALONG DRAINAGE DITCHES ON NORTH AND WEST SIDE OF SITE AND WETLAND AREA ON SOUTHEAST PROPERTY BOUNDARY AND -10' BELOW GRADE AT PZ-10.

LEGEND

⊙	SINGLE SHALLOW OR INTERMEDIATE PIEZOMETER
⊕	NESTED SHALLOW AND INTERMEDIATE PIEZOMETER PAIR
⊕	NESTED INTERMEDIATE AND DEEP PIEZOMETER PAIR (WITH ROCK CORE)
•	GEOTECHNICAL SOIL BORING (GEOTRACK) (APPROX. LOCATIONS FOR B-2, B-4 & B-5)
▲	SURFACE WATER STAKE
■	INFERRED WETLAND GROUNDWATER ELEVATIONS
(277.26')	TOP OF WATER ELEVATION (8-21-14)
—270—	GROUNDWATER POTENTIOMETRIC CONTOUR
--270--	INFERRED GROUNDWATER POTENTIOMETRIC CONTOUR
←	GROUNWATER FLOW DIRECTION
*	INFERRED WATER LEVEL ELEVATION

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
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704.338.6700
N.C.B.E.L.S. License Number F-0116

ISSUE	DATE	DESCRIPTION
A	11/2014	ISSUED FOR APPROVAL

PROJECT MANAGER	M.D. PLUMMER, P.E.
	R. KLINGMAN, P.G.
	J. GAUL
PROJECT NUMBER	

NORTH CAROLINA LICENSED GEOLOGIST SEAL 1266 CHARLES ROSS KLINGMAN
11-5-14

Charah®

COLON MINE SITE STRUCTURAL FILL
SANFORD, NC

SHALLOW AND INTERMEDIATE GROUNDWATER POTENTIOMETRIC MAP AUGUST 21, 2014

0 1" 2"
FILENAME 00G-05.dwg
SCALE 1"=200'

SHEET
FIGURE 5

NOTES:

1. SURVEY BASE MAP PREPARED BY LAWRENCE SURVEYING OF MONROE DATED AUGUST 21, 2014.

LEGEND

- ○ SURFACE WATER LOCATION
- ⊕ MONITOR WELL LOCATION (AT REVIEW BOUNDARY)
- COMPLIANCE BOUNDARY
- REVIEW BOUNDARY

HDR Engineering, Inc.
of the Carolinas

440 S. Church St. Suite 1000
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704.338.6700

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11-5-14

Charah®

COLON MINE SITE STRUCTURAL FILL
SANFORD, NC

WATER QUALITY MONITORING PLAN

FILENAME 00G-12.dwg

SCALE 1"=200'

SHEET

FIGURE 6

TABLES

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TABLE 1
SUMMARY OF GEOTECHNICAL LABORATORY RESULTS
COLON MINE RECLAMATION STRUCTURAL FILL SITE
1303 BRICKYARD ROAD
SANFORD, NORTH CAROLINA

Sample ID	Lithologic Unit	USCS Classification	Grain Size				Specific Gravity (unitless)	Hydraulic Conductivity (cm/sec)	Total Porosity (%)	Effective Porosity* (%)	Atterberg Limits		
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)					PL	LL	PI
PZ-1 BAG (19-20')	PWR	SC	12.1	58.9	22.7	6.3	--	--	--	26	17	29	12
PZ-1 BAG (24-25')	PWR	CL	0	38.9	47.1	14.0	--	--	--	15	17	30	13
PZ-2 UD (9-11')	Flood Plain	CH	2.1	15.3	40.2	42.4	2.66	6.23×10^{-5}	40.7	2	25	50	25
PZ-2 BAG (29-30.5')	PWR	CL	0	2.2	70.7	27.1	--	--	--	4	22	43	21
PZ-3 UD (0-2')	Soil Horizon	CL	0	6.7	52.8	40.5	2.67	2.42×10^{-6}	39.3	2	27	48	21
PZ-3 BAG (34-34.5')	PWR	SM	12.8	59.7	27.5		--	--	--	30	--	--	--
PZ-4 BAG (4-5.5')	Soil Horizon	CH	0	3.0	50.9	46.1	--	--	--	2	27	60	33
PZ-4 BAG (24-24.5')	PWR	CL	0	21.0	61.6	17.4	--	--	--	11	16	31	15
PZ-5 UD (6-8')	Residuum	CL	0	2.2	62.1	35.7	2.69	2.43×10^{-7}	30.6	2	26	48	22
PZ-5 BAG (34-34.5')	PWR	CL	0	13.7	73.6	12.7	--	--	--	8	20	32	12
PZ-6 UD (10.5-11')	Residuum	CL	0	11.3	72.5	16.2	2.68	6.01×10^{-6}	30.7	8	23	37	14
PZ-6 BAG (19-19.5')	PWR	SC	0	59.9	27.1	13.0	--	--	--	16	18	33	15
PZ-7 UD (6-8')	Residuum	CL	0	3.2	67.5	29.3	2.74	1.76×10^{-6}	30.1	3	24	40	16
PZ-7 BAG (14-14.5')	PWR	CL	0	0.4	76.8	22.8	--	--	--	4	22	41	19
PZ-8 BAG (13.5-15')	Residuum	CL	0	3.1	68.1	28.8	--	--	--	3	23	39	16
PZ-9 BAG (13.5-15')	Residuum	SC	0.4	52.2	35.9	11.5	--	--	--	17	20	34	14
PZ-10 BAG (28.5-30')	Residuum	CL	0	5.7	74.0	20.3	--	--	--	5	18	36	18
PZ-11 UD (6-6.5')	Residuum	SM	4.8	65.5	22.6	7.1	2.71	3.86×10^{-6}	19.7	25	--	--	--
PZ-11 BAG (23.5-25')	Residuum	CL	0	15.1	56.6	28.3	--	--	--	4	19	38	19
PZ-12 BAG (18.5-20')	Residuum	CL	0	0.7	66.5	32.8	--	--	--	2	20	42	22
PZ-13 BAG (0-1.5')	Soil Horizon	SC-SM	36.1	37.2	19.4	7.3	--	--	--	25	17	21	4
PZ-14 UD (6-7.5')	Soil Horizon	CH	1.8	18.4	37.7	42.1	2.67	1.35×10^{-7}	38.6	2	28	55	27
PZ-15 BAG (23.5-24')	PWR	CL	0.7	4.5	52.8	19.9	--	--	--	8	16	32	16
PZ-16 BAG (18.5-20')	Residuum	CL	0	3.1	65.5	31.4	--	--	--	3	19	38	19
PZ-17 BAG (43.5-44.5')	PWR	CL	0	40.2	48.9	10.9	--	--	--	16	19	32	13
PZ-18 BAG (18.5-19.5')	PWR	CL	0	24.4	55.7	19.9	--	--	--	8	17	32	15

Notes:
Geotechnical analyses conducted by Summit Engineering & Construction Services, Inc. in Fort Mill, South Carolina
PL = plastic limit; LL = liquid limit; PI = plasticity index
USCS = Unified Soil Classification System
* = effective porosity (i.e. specific yield) calculated by Summit Engineering from the Textural Classification Triangle for unconsolidated materials showing the relationship between particle size and specific yield.
PWR = partially weathered rock
BAG = bagged split spoon soil sample; UD = undisturbed (Shelby tube)
"--" = not tested

TABLE 2
GROUNDWATER, EXCAVATION WATER AND SURFACE WATER GAUGING DATA
COLON MINE RECLAMATION STRUCTURAL FILL SITE
1303 BRICKYARD ROAD
SANFORD, NORTH CAROLINA

									Date: 7-28&29-14		*Date: 8-8-14*		*Date: 8-21-14*		*Date: 9-3-14*		*Date: 10-31-14*	
Well ID	*Northing*	*Easting*	*Ground Elev. (ft)*	*TOC Elev. (ft)*	*TD BGS (ft)*	*TD BTOC (ft)*	*Screen Length (ft)*	*Screen Interval (ft)*	*DTW BTOC (ft)*	*DTW Elev. (ft)*	*DTW BTOC (ft)*	*DTW Elev. (ft)*	*DTW BTOC (ft)*	*DTW Elev. (ft)*	*DTW BTOC (ft)*	*DTW Elev. (ft)*	*DTW BTOC (ft)*	*DTW Elev. (ft)*
Piezometers																		
PZ-1	649839.1274	1957694.6096	266.78	269.36	29.55	32.13	10	247.23 - 237.23	7.99	**261.37**	8.07	261.29	8.10	261.26	8.38	260.98	8.25	261.11
PZ-2s	650106.2993	1958395.6518	274.31	276.93	14.85	17.47	10	269.46 - 259.46	dry*	--	16.92*	--	16.68*	--	16.48*	--	16.07*	--
PZ-2	650106.2993	1958395.6518	274.31	276.84	30.10	32.63	10	254.21 - 244.21	13.03	**263.81**	13.17	263.67	13.08	263.76	13.19	263.65	13.41	263.43
PZ-3s	650924.7874	1958931.4060	296.20	299.12	23.45	26.37	10	282.75 - 272.75	23.80*	275.32	22.94	276.18	21.86	277.26	20.91	278.21	19.84	**279.28**
PZ-3	650924.7874	1958931.4060	296.20	299.29	37.05	40.14	10	269.15 - 259.15	22.90*	276.39	22.36	276.93	21.31	277.98	20.66	278.63	19.62	279.67
PZ-4	651300.4613	1958039.1979	296.82	299.50	36.70	39.38	10	270.12 - 260.12	14.50	285.00	13.94	285.56	12.00	**287.50**	12.19	287.31	12.33	287.17
PZ-4D	651300.4613	1958039.1979	297.25	299.76	52.00	54.54	5	250.25 - 245.25	13.35*	--	18.42*	--	11.65	288.11	12.05	287.71	11.89	287.87
PZ-5	650694.3781	1958314.5239	289.11	291.66	33.80	36.35	10	265.31 - 255.31	28.61	263.05	28.72	262.94	27.81	263.85	27.46	264.20	26.65	**265.01**
PZ-6	651600.8528	1958594.8783	283.48	286.13	33.80	36.45	10	259.68 - 249.68	16.30	269.83	17.13	269.00	15.49	**270.64**	15.73	270.40	16.75	269.38
PZ-7	650694.8524	1957250.0758	287.92	290.57	20.00	22.65	10	277.92 - 267.92	9.34	**281.23**	9.84	280.73	9.65	280.92	9.93	280.64	11.15	279.42
PZ-8	651403.7593	1959260.0922	302.56	304.85	41.90	44.19	10	270.66 - 260.66	34.12*	--	30.32	274.53	30.10	**274.75**	30.64	274.21	33.65	271.20
PZ-9s	651911.8614	1959545.1871	285.74	288.11	25.00	27.37	10	270.74 - 260.74	19.73	268.38	19.00	**269.11**	19.09	269.02	19.80	268.31	21.68	266.43
PZ-9	651911.8614	1959545.1871	285.74	288.11	39.00	41.37	10	256.74 - 246.74	19.59	268.52	20.10	268.01	20.12	267.99	20.72	267.39	22.57	265.54
PZ-10	651917.0792	1960181.3457	263.48	266.51	27.15	30.18	10	246.33 - 236.33	30.12*	--	29.01*	--	28.22*	--	27.70*	--	26.89*	--
PZ-11	652280.8059	1958527.1881	259.56	262.30	24.75	27.49	10	244.81 - 234.81	11.19	251.11	11.20	251.10	10.78	**251.52**	12.25	250.05	12.44	249.86
PZ-12	--	--	284.32	287.15	30.60	33.43	10	263.72 - 253.72	dry	--	dry	--	dry	--	dry	--	dry	--
PZ-13	651783.8317	1957937.0226	293.48	296.59	33.65	36.73	10	269.83 - 259.83	31.34*	--	18.54*	--	13.15	283.44	13.48	283.11	14.89	281.70
PZ-14	651508.8837	1957409.2367	319.44	322.15	35.00	37.71	10	294.44 - 284.44	35.90*	--	29.59*	--	22.81	299.34	21.47	**300.68**	23.48	298.67
PZ-15s	651954.8447	1957451.5553	300.63	303.11	14.00	16.48	10	296.63 - 286.63	16.13	286.98	16.55	286.56	15.51	**287.60**	15.59	287.52	15.53	287.58
PZ-15	651954.8447	1957451.5553	300.63	303.24	28.70	31.31	10	281.93 - 271.93	15.92	287.32	16.41	286.83	16.31	286.93	16.53	286.71	17.19	286.05
PZ-16	652618.1656	1957291.7517	270.63	272.78	24.00	26.15	10	256.63 - 246.63	10.48	**262.30**	10.84	261.94	10.55	262.23	11.14	261.64	12.11	260.67
PZ-17s	651861.7974	1956740.0471	304.00	306.62	25.00	27.62	10	289.00 - 279.00	dry	--	dry	--	dry	--	dry	--	dry	--
PZ-17	651861.7974	1956740.0471	304.00	306.56	44.70	47.26	10	269.30 - 259.30	30.02	276.54	30.49	276.07	29.96	**276.60**	30.76	275.80	31.02	275.54
PZ-18	652256.1078	1957059.0998	292.27	294.72	43.50	45.95	10	302.27 - 292.27	dry*	--	44.62*	--	39.43*	--	34.51*	--	21.55	*273.17*
PZ-19	651844.7690	1958458.4688	265.99	269.30	24.70	28.01	10	251.29 - 241.29	--	--	--	--	--	--	8.75	*260.55*	9.51	259.79
PZ-20	651321.0579	1957850.9119	296.51	299.56	24.50	27.55	10	282.01 - 272.01	--	--	--	--	--	--	15.44	*284.12*	17.25	282.31
Excavation Water																		
STK-1	--	--	260.54	263.45	--	--	--	--	1.80	261.65	1.80	261.65	1.84	261.61	1.99	261.46	1.92	261.53
STK-2	--	--	263.65	268.00	--	--	--	--	3.09	264.91	3.12	264.88	3.10	264.90	3.25	264.75	3.29	264.71
Surface Water																		
STK-3	--	--	~236	--	--	--	--	--	2.89	--	3.06	--	2.96	--	dry	--	dry	--
STK-4	--	--	~250	--	--	--	--	--	dry	--	dry	--	dry	--	dry	--	dry	--
STK-5	--	--	~260	--	--	--	--	--	dry	--	dry	--	dry	--	dry	--	dry	--

Notes:

Depth to water measurements obtained on 7-28 & 29-14, 8-8-14, 8-21-14, 9-3-14 and 10-31-14 by Buxton Environmental, Inc. to the nearest 0.01 foot with a depth to water meter.
Top-of-casing and ground surface elevations and horizontal locations determined by Lawrence Surveying of Monroe, North Carolina.
TD=total depth;BGS=below ground surface;BTOC=below top of casing;TOC=top of casing;DTW=depth to water;ft=feet;"--" = no data
Bold and Shade denotes most elevated groundwater elevation (used shallowest piezometers (no deep nested piezometers) having 4 or more readings)
Italics and light stipple denotes groundwater elevation other than 8-21-14 readings utilized to generate groundwater flow map (due to new piezometer or stabilizing conditions)
* = stabilizing groundwater levels
"-- = no data

TABLE 3

HISTORICAL GROUNDWATER ELEVATION DATA W/ ESTIMATED LONG-TERM HIGH CORRECTION FACTOR

LEE COUNTY LANDFILL

331 LANDFILL ROAD

LEMON SPRINGS, NORTH CAROLINA

PERMIT NO.: 53-01

Monitor Well ID	***MW-4***	***MW-5***	***MW-6***	***MW-7***	***MW-9***	***MW-10***	***MW-11***	***MW-12***	***MW-13***	***MW-14***
Well Depth (feet bgs)	19.00	19.50	40.40	22.17	22.85	22.80	22.75	13.30	24.25	18.25
Top-of Casing Elevation (feet)	345.90	351.10	402.10	360.30	384.20	377.00	399.60	337.40	363.93	358.61
Date:	***Groundwater Elevation (feet)***									
09/12/95	--	--	--	347.56	375.43	369.09	380.22	329.87	--	--
05/13/96	--	--	--	351.77	375.06	369.98	388.73	329.26	--	--
10/09/97	334.21	344.23	391.86	350.33	374.41	368.95	386.72	333.04	--	--
04/15/98	337.89	344.96	394.21	**352.94**	**377.82**	370.15	392.18	333.69	--	--
10/14/98	333.58	344.13	390.99	350.30	374.89	368.98	385.52	333.10	--	--
10/19/99	**338.40**	**345.35**	**395.24**	**352.91**	370.70	**370.27**	392.63	**334.06**	--	--
05/04/00	336.0	344.6	392.3	352.0	375.6	369.7	388.8	333.2	355.5	352.7
10/17/00	334.60	341.30	392.80	350.20	375.10	368.90	386.60	333.10	**356.50**	351.50
04/17/01	336.6	344.6	392.7	351.9	375.0	369.8	389.8	333.2	355.5	352.6
04/22/02	335.3	344.4	392.4	351.4	375.5	368.1	388.7	333.1	355.2	352.4
10/21/02	--	**345.53**	392.56	--	375.55	--	--	**334.45**	355.76	352.64
10/30/03	**338.10**	344.93	**394.77**	352.62	377.07	369.86	**393.25**	333.89	356.18	**353.51**
04/21/04	335.1	344.5	392.2	351.5	374.0	369.7	388.7	333.2	355.1	352.5
10/28/04	334.5	344.5	393.4	350.9	374.0	369.4	388.3	333.3	354.3	351.8
04/18/05	337.11	344.99	394.73	352.35	**377.76**	**370.19**	**392.74**	333.50	356.35	**353.34**
10/31/05	333.6	344.3	393.0	350.5	372.9	369.2	388.4	333.1	354.6	351.9
04/10/06	334.8	344.4	392.0	351.4	374.0	369.7	388.5	333.2	355.2	352.4
10/20/06	331.2	343.9	392.1	349.9	372.1	367.3	387.9	332.1	347.5	350.1
04/23/07	336.0	344.6	--	351.7	375.6	370.0	390.2	333.3	355.7	352.8
10/31/07	332.0	344.5	391.8	349.5	374.5	368.4	388.8	333.1	354.45	350.64
04/09/08	338.0	345.0	393.5	352.5	377.4	370.1	392.1	333.5	**356.4**	353.1
10/21/08	335.1	344.6	394.0	351.0	376.7	369.3	389.3	333.6	354.9	352.1
04/24/09	336.60	--	393.46	351.82	377.27	369.77	390.44	333.59	355.87	352.89
11/24/09	335.10	344.85	393.15	351.45	375.05	369.05	389.05	333.75	354.69	351.83
04/09/10	337.10	344.90	392.68	351.75	376.44	369.67	390.30	333.85	355.98	352.91
10/04/10	330.59	344.55	392.16	349.24	374.82	367.84	388.54	332.98	353.38	350.52
10/10/11	dry	341.64	391.18	347.76	370.56	363.44	383.59	328.87	348.94	347.68
10/18/12	331.62	344.35	392.48	349.73	374.91	367.55	387.62	332.50	353.19	350.71
04/17/13	335.45	344.80	392.55	351.87	375.92	369.61	389.65	333.62	356.24	352.48
10/1/2013*	330.32	344.24	392.48	349.23	374.09	366.60	386.83	331.55	352.92	350.35
04/10/14	336.95	344.76	393.35	351.90	377.45	369.76	391.04	333.57	**356.40**	352.82
Groundwater High - 10/1/2013 Levels*	8.08'	1.29'	2.76'	3.71'	3.73'	3.67'	6.42'	2.90'	3.58'	3.16'
Geometric Mean (Correction Factor)*	***+3.5'***									

Notes:

Lee County Landfill is located 11.5 miles south southwest of the Colon Mine site.

Lee County Landfill is located in the upper Coastal Plain Province within the Middendorf Formation (Cretaceous) consisting of sand, sandstone and mudstone according to 1985 Geologic Map of North Carolina; boring logs for MW-4, MW-5 and MW-6 indicated a primarily sandy clay and clayey sand formation.

Groundwater gauging information obtained from monitoring reports (listed below), which were provided on the NCDENR-Solid Waste Section website and historical database.

bold and shade denotes historical groundwater high; which occurred between 1998 and 2003

bold denotes second most historical groundwater high

light stipple* = a reasonable conservative "Estimated Long-Term Groundwater High" correction factor for the Colon Mine site was determined by subtracting historical groundwater high elevations from groundwater elevations on 10/1/2013, and then calculating the geometric mean of the 10 differences.

"--" = no data

TABLE 4

AVERAGE LINEAR GROUNDWATER VELOCITY

COLON MINE RECLAMATION STRUCTURAL FILL SITE

1303 BRICKYARD ROAD

SANFORD, NORTH CAROLINA

Well ID	Lithologic Unit	USCS	Screen or Sample Depth (bgs) (ft)	Method for Determining Hydraulic Conductivity	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (ft/day)	Total Porosity (unitless)	Effective Porosity (unitless)	Horizontal Hydraulic Gradient (ft/ft)	Groundwater Flow Direction	Average Linear Groundwater Velocity (ft/day)	Average Linear Groundwater Velocity (ft/year)
PZ-1	PWR	CL**	18.55 - 29.55	slug test	5.629×10^{-5}	0.16	0.3*	0.26	0.003	S 12° E	0.0016	0.58
PZ-2s	Flood Plain	CH	9 - 11	laboratory	6.23×10^{-5}	0.18	0.407	0.02	0.003	S 37° W	0.0013	0.47
PZ-4	PWR	CL**	26.70 - 36.70	slug test	2.70×10^{-6}	7.65×10^{-3}	0.3*	0.11	0.06	S 15° W	0.0015	0.55
PZ-4D	Layered Rock	Rock/CL**	47 - 52	slug test	5.523×10^{-7}	1.57×10^{-3}	0.3*	0.11	0.06	S 15° W	0.00031	0.11
PZ-6	Residuum	CL	10.5 - 11	laboratory	6.01×10^{-6}	0.017	0.307	0.08	0.04	N 10° E	0.0022	0.80
PZ-7	Residuum	CL	6 - 8	laboratory	1.76×10^{-6}	4.99×10^{-3}	0.301	0.04	0.04	S 40° E	0.00066	0.24
PZ-9s	Residuum/PWR	SC**	15 - 25	slug test	5.425×10^{-7}	1.54×10^{-3}	0.25*	0.17	0.08	N 8° W	0.0005	0.18
PZ-9	PWR	CL**	29 - 39	slug test	6.828×10^{-7}	1.94×10^{-3}	0.3*	0.17	0.08	N 8° W	0.00052	0.19
PZ-10	PWR	CL**	16.15 - 27.15	recovery test	6.051×10^{-8}	1.71×10^{-4}	0.3*	0.05	0.04	N 18° E	0.000023	0.0084
PZ-11	Residuum	SM	6 - 6.5	laboratory	3.86×10^{-6}	0.011	0.197	0.25	0.04	N 30° E	0.0022	0.80
PZ-15	Residuum/PWR	CL**	18.70 - 28.70	slug test	6.738×10^{-5}	0.19	0.3*	0.08	0.04	N 12° E	0.05	18.62

Notes:

Hydraulic gradient and groundwater flow direction data obtained from the " Shallow and Intermediate Groundwater Potentiometric Map - August 21, 2014" (Figure 5)

Hydraulic conductivity values either obtained from undisturbed saturated hydraulic conductivity tests conducted by Summit Engineering & Construction Services, Inc. (laboratory) or rising head slug tests or well recovery tests conducted by Buxton Environmental, Inc.

* = estimated porosity based on laboratory determination for similar USCS classification.

** = USCS approximation based on laboratory USCS classifications ithin or in close proximity to the piezometer screen interval.

See report text for average linear groundwater velocity equation (Darcy)

APPENDIX A
Photographic Documentation

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Photograph 1. View of the Sanford Mine site looking to the northwest across Excavation #2. Note the former clay excavation and rock outcrop on the far bank.

Photograph 2. View of the muddy conglomerate located at the rock outcrop. Note the linear excavation equipment claw mark.

Photograph 1. View of the Colon Mine site looking to the northwest across Excavation #2. Note the former clay excavation and the layered rock exposure on the far bank.

Photograph 2. View of the muddy conglomerate located at the layered rock exposure. Note the linear excavation equipment claw mark.

Photograph 3. View of muddy sandstone at the layered rock exposure. Note the near vertical fractures oriented ~N 10° E and ~N 60° W.

Photograph 4. View of a black manganese stained fracture plane (10° dip) located parallel to the contact between a muddy sandstone (lower surface) and muddy conglomerate (upper surface). The layered rock exposure has a strike orientation of N 50° E.

Photograph 5. View remnant hexagonal mud crack features preserved in the mudstone at the layered rock exposure. The mud cracks formed during desiccation of ancient mud during the Triassic Period (approximately 200 to 250 million years ago), which was subsequently lithified into rock.

Photograph 6. View of exposed soil horizon and residuum on the northwest side of Excavation #2 and adjacent to the layered rock exposure. Note the yellow soil horizon lying directly above the red colored residuum and 10° dip to the southeast, which appears to be the result of alluvial wedge deposition.

Photograph 7. View of rock core PZ-4D.

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APPENDIX B

Aerial Photograph Review of Mining Progression

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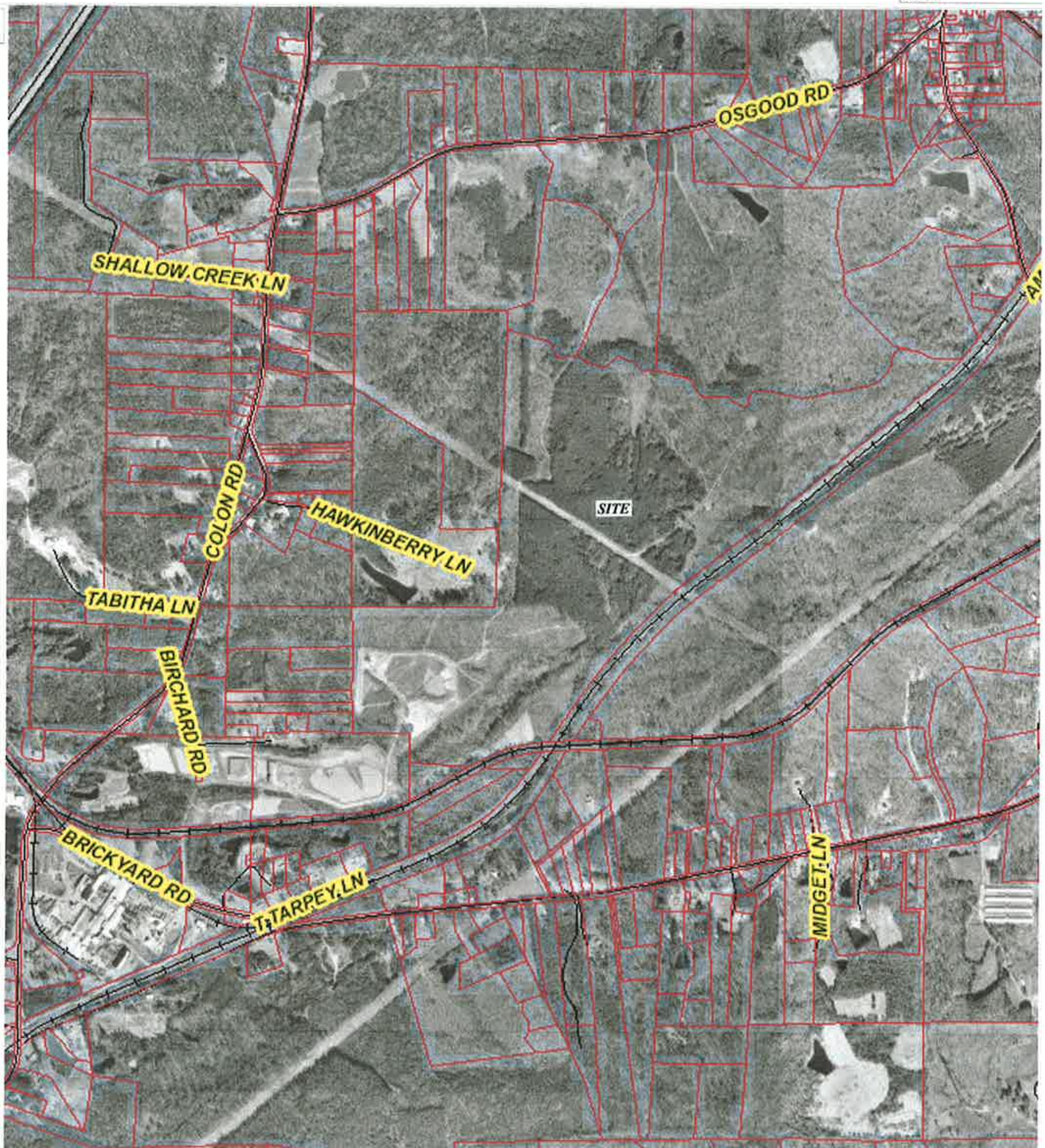
1996-1999 Aerial Photograph

1:1554

Search



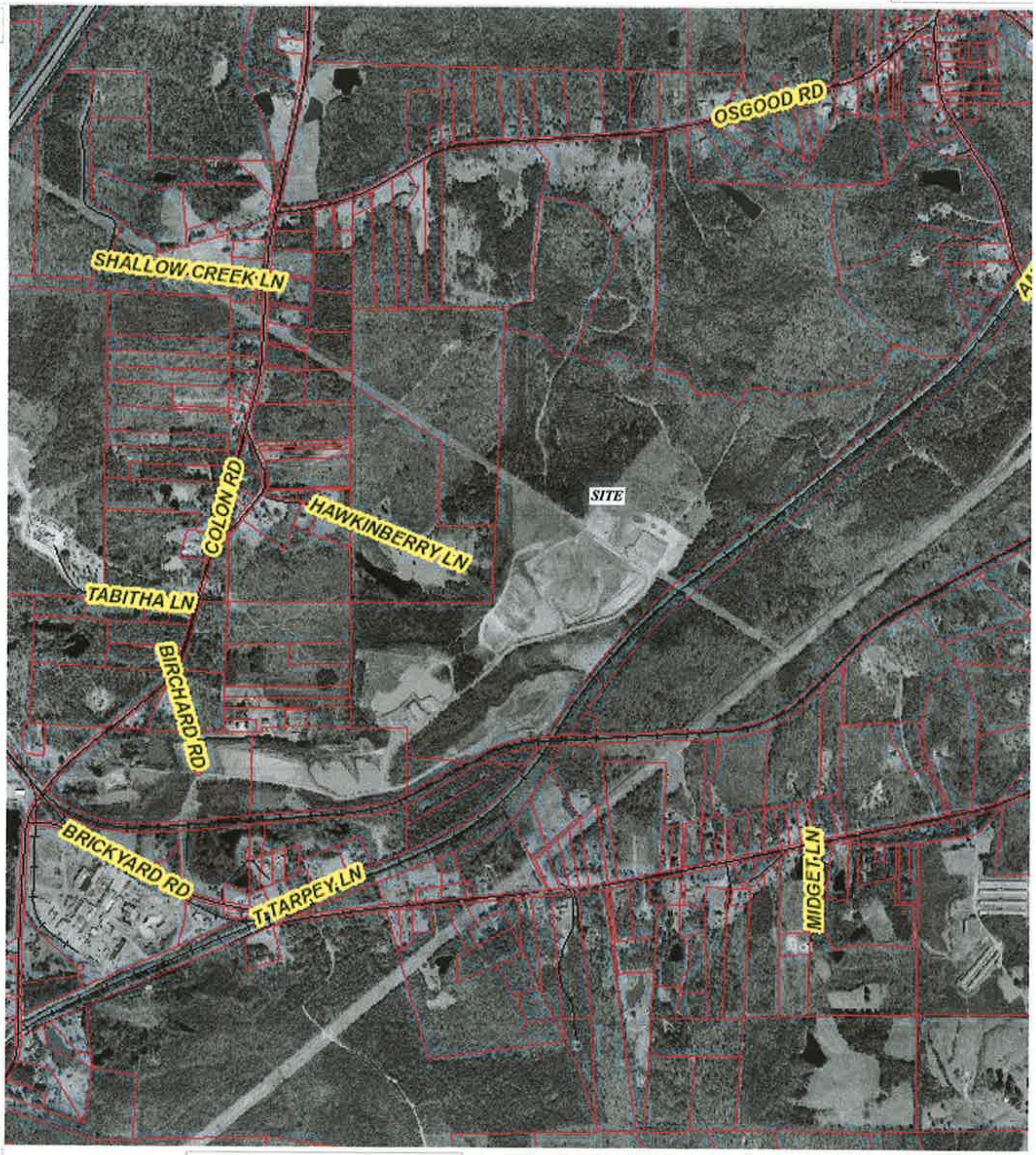
Excel 2000/2003 **Results**

CONNECTGIS WEB HOSTING

2002-2005 Aerial Photograph

1:1554

Search



Excel 2000/2003 Results

2006-2008 Aerial Photograph

1: 1554

Search

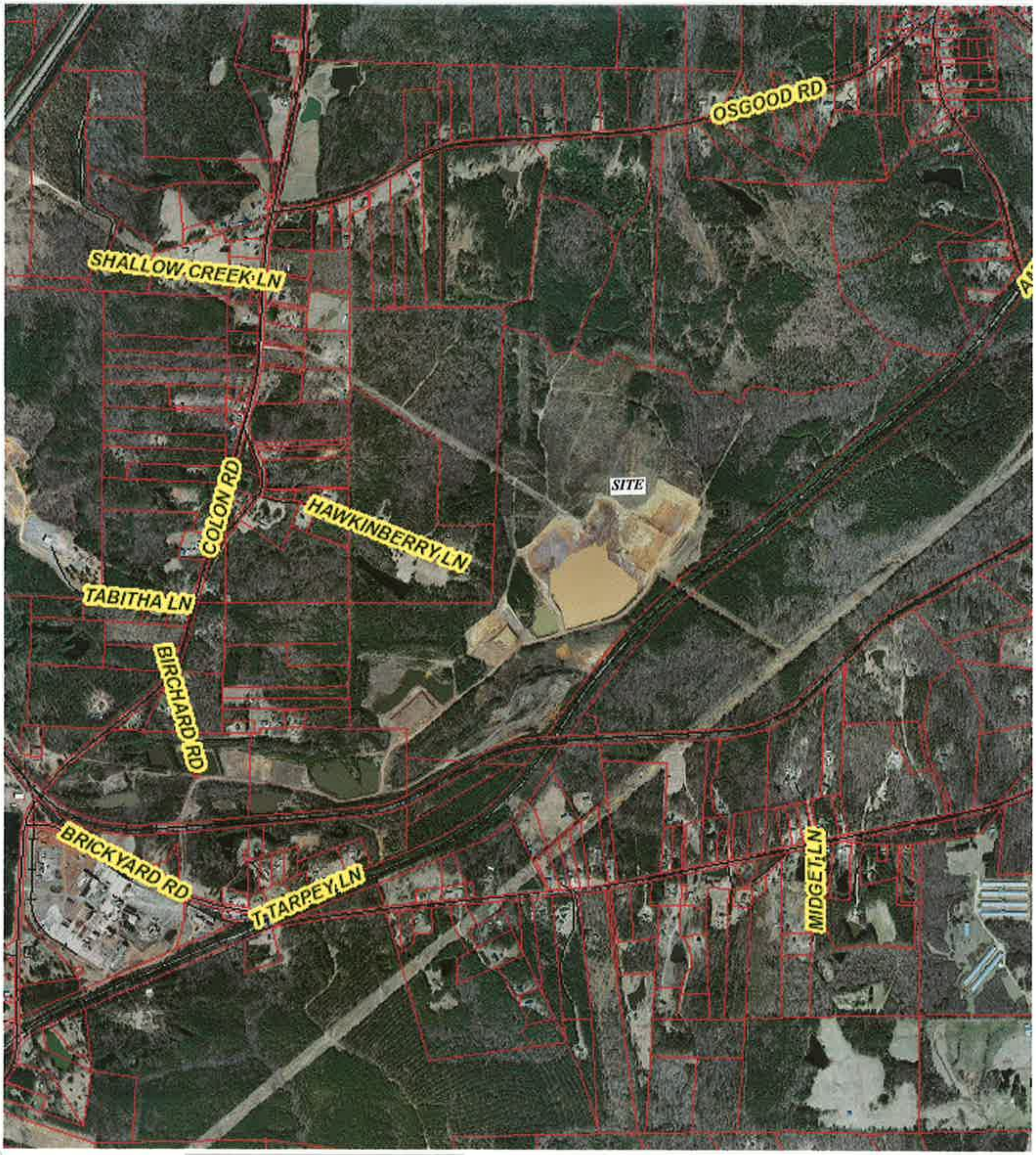
Excel 2000/2003 **Results**

CONNECTGIS WEB HOSTING

2010 Aerial Photograph

1:1554

Search



Excel 2000/2003 **Results**

CONNECTGIS WEB HOSTING

2013 Aerial Photograph

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Search

Excel 2000/2003 Results

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APPENDIX C

GEOTRACK Technologies, Inc. – Preliminary Subsurface Exploration Report

GEOTRACK Technologies, Inc.

3620 Pelham Road, PMB #292 Phone: 864-329-0013
Greenville, SC 29615-5044 FAX: 864-329-0014

PRELIMINARY SUBSURFACE EXPLORATION

Proposed CCB Fill at Sanford Mine
Sanford, NC
GeoTrack Project No. 14-3420-N

Prepared For:

Charah®
Innovative Solutions and Superior Service

Charah, Inc.
12601 Plantside Drive
Louisville KY, 40299

Attention: Mr. Norman E. Divers, III

June 30, 2014

GEOTRACK
Technologies, Inc.

3620 Pelham Road, PMB #292 Phone: 864-329-0013
Greenville, SC 29615-5044 FAX: 864-329-0014

June 30, 2014

Charah, Inc
12601 Plantside Drive
Louisville, KY 40299

Attention: Mr. Norman E. Divers, III

Re: Preliminary Subsurface Exploration
Proposed CCB Fill at Sanford Mine
Sanford, NC
GeoTrack Project No. 14-3420-N

Gentlemen:

GeoTrack Technologies, Inc. has completed a preliminary subsurface exploration for the proposed facility. The work was performed as requested and authorized by Mr. Divers. The purposes of the work were to evaluate the site subsurface conditions relative to the proposed installation, and provide preliminary design recommendations. This report presents our understanding of the project, the subsurface exploration performed, the results, and our recommendations.

SUMMARY OF RECOMMENDATIONS

The following is an outline of our exploration. These recommendations are discussed in more detail in the report text.

- Eight borings were drilled to depths of approximately 23.5 to 43.5 feet below the existing ground surface.

- Hard silty clays were encountered in all of the borings. The consistency of the soils increased with depth, and penetration resistances consistently exceeded 100 blows per foot at depths greater than about 10 to 18 feet.

- The borings encountered discontinuous cemented sandy clay (siltstone) that increases in thickness and consistency with depth. All eight borings met auger refusal on massive siltstone layers. Some difficult excavation will occur, and the siltstone fragments will generally not be satisfactory for re-use as structural fill.

- Ground water is interpreted to be at depths of 12.5 to 20 feet below the existing ground surface. Thus, ground water levels will most likely influence design and construction of the CCB fill. We recommend installing French drains to lower perched water levels.

- The subsurface conditions were assessed to be generally satisfactory for construction of the CCB fill.

- The on-site soils are assessed to be satisfactory for use as structural fill. Moisture changes during construction could influence the stability and compaction characteristics of the clayey soils.

PROJECT DESCRIPTION

Project information was obtained from discussions with Mr. Norman Divers of Charah, and review of the Proposed Boring Plan which indicates existing site topographic lines without the elevations labeled. We have also reviewed the USGS 7.5 Minute Topographic Map of the site area. GeoTrack has also performed characterization testing and gained experience with similar construction installations and materials.

The planned CCB structural fill project will be on property of the General Shale Sanford brick mine to the northeast of the intersection of Brickyard Road and Colon Road near Sanford, North Carolina. The area to be developed is located to the northeast of the existing mined areas. Most of the project area will be located between an overhead power transmission line and Roberts Creek. Portions will extend southwest of the power line near a pond that was previously mined.

Currently, construction plans have not been finalized. We understand that the fill area will be excavated to remove the usable brick-making soils and they will be stockpiled. The excavation depths will be selected based on the depths of ground water, rock, and/or the base of the usable soils relative to the brick manufacture.

The CCB structural fill will be underlain by a composite liner system supported by a graded soil subgrade. Then the composite liner will be constructed in the excavations and CCB fill will be placed to approximately the planned grades. The liner will include a geosynthetic clay liner (GCL) placed on a prepared soil subgrade, and a flexible geomembrane liner (FML) immediately above the GCL. A geocomposite drainage layer will most likely be installed above the liner. The upper surfaces of the fill will include a geomembrane cap and protective soil cover a few feet thick.

SCOPE OF EXPLORATION

The subsurface exploration included a site reconnaissance by professional staff, and eight soil test borings (designated SB-1 through SB-8). The boring locations were established by GeoTrack based on the requested locations as indicated on the Proposed Boring Plan. The boring locations were established in the field by referencing topography and other landmarks such as utility lines and mine areas. The final boring locations were influenced by the existing site features, drill rig accessibility, and actual topography. The approximate boring locations are shown on the Boring Location Plan in the Appendix. After the borings were performed, the coordinates of the borings were obtained with a hand held GPS unit. The coordinates are shown on the Test Boring Records. Because of the methods used to locate the borings, the referenced locations and elevations are approximate.

The borings were drilled with a truck-mounted, CME 45 drilling rig using hollow-stem augers. The borings extended to auger refusal at depths ranging from 23.5 to 43.5 feet below existing grades. Standard Penetration Tests were performed approximately every five vertical feet. The boreholes were checked for ground water levels after a period of about 24 hours, and after several days. The boreholes were then sealed above the ground water levels with bentonite pellets, and the remaining boreholes backfilled with soil cuttings.

A geotechnical engineer reviewed the data and visually classified the soil samples. The boring results are summarized in the attached Test Boring Records. A more thorough description of our exploration procedures is also attached.

The geotechnical engineer selected representative soil samples for soil classification testing. The tests included moisture content, wash over the number 200 sieve (percent fines), and Atterberg limits (plasticity) tests. The results are summarized in the Laboratory Testing Summary in the Appendix.

EXPLORATION RESULTS

AREA GEOLOGY

The site is located in the Coastal Plain Physiographic (geologic) Province of North Carolina. The surficial geology consists of interbedded layers of sands and clays that were deposited in the distant geologic past when the ocean extended to the site area. As the ocean receded, the portions of the ancient deposits have been eroded and re-deposited geologically recently. As a result of the original ocean deposition and the post-depositional loading history, the ancient soils are over-consolidated to a firm to hard condition. The ground water within the soils is typically recharged by surface infiltration in areas of relatively high elevation (ridges and knolls), and it discharges to the nearest surface streams. Water can be locally *perched* within the upper soil zones on the hard clay and siltstone layers of relatively low permeability.

SITE CONDITIONS

The proposed development site consists of a mixture of thick woods, open fields, and land previously excavated during mining activities. Overall, the project area is gently rolling, and the ground surface varies from highs along several ridges, and lows along several dry drainage swales, that generally slope to the northeast, toward Roberts Creek.

Southwest of the power line, an open mine pit occupies most of the project area. Water is present in the pit, and the ground surface adjoining the pond appears to have been excavated. An open area visually estimated to encompass on the order of 40 to 60 acres is located to the northeast of the power line and in the eastern extremity of the project area. That area is covered with planted grass, suggesting that the area has previously been partially mined. The ground surface is gently rolling in that area, and characterized by a relatively deep swale that extends to near the elevation of the water within the pond. Cemented sandy clay (siltstone) is present in the base of the swale. Based on surface exposures, the siltstone appears to be relatively continuous at the base of the swale. The western part of the site is heavily wooded and characterized by more steeply sloping topography.

SUBSURFACE CONDITIONS

Very stiff to hard silty clays were encountered at the boring locations immediately beneath the topsoil. Standard penetration resistances increased with depth. The penetration resistances ranged from 16 to 81 blows per foot (bpf) in the upper 8 to 17 feet. At greater depths, the penetration resistances exceeded 100 bpf. The results of the selected index testing indicated that upper layers have slightly higher sand contents than lower layers, and one layer had slightly more sand than clay (clayey sand). The soil samples below about 10 feet had percent fines (silt and clay size material) ranging from 83.7 to 98.5 percent. One deeper sample had 43.5 percent fines; however, that result is interpreted to be influenced by siltstone fragments or a localized sand seam. In general, the higher percent fines contents are more representative of the soil zones with depth.

The lower silty clay zones contain cemented clayey sand layers (siltstone) that were estimated to vary in thickness from a couple of inches to several feet thick, based on observed drill resistance. The upper siltstone layers were encountered at depths of about 12 to 18 feet and they increased in frequency and thickness with depth. All of the borings encountered auger refusal within thicker and higher consistency siltstone layers at depths of 23.5 to 43.5 feet.

Evidence of ground water was not immediately encountered in the borings at the time of drilling. The moisture contents of the split-spoon samples and the auger cuttings were qualitatively assessed to be consistent with depth, and the laboratory moisture testing indicated relatively low moisture contents with depth. Those low moisture contents are assessed to be characteristic of the hard and over-consolidated condition of the soils, and not indicative of proximity to ground water. With two exceptions, moist soil zones were generally not identified during drilling. Also, water did not seep into the augers during drilling. The exceptions were in SB-1, where noticeably moist cuttings were retrieved as the augers approached the refusal depth, and in SB-4, where water entered the borehole within several hours after drilling.

Immediately after drilling, several of the boreholes caved at depths ranging from 12.5 to 24 feet below the ground surface. Often, boreholes cave at or near the prevailing ground water level. The caved depths measured in these borings are believed to correspond to the ground water levels for several reasons:

- The borings penetrated very high consistency, clayey soils that should remain stable (remain open) for considerable time due to the inherent soil strength and the high clay content (resulting in soil cohesion); however, collapse of the boreholes occurred almost immediately upon removal of the drilling augers.
- At the caved depths in SB-3 and SB-6, moist soils were present on the borehole base about one day after drilling was complete.
- The measured ground water level in SB-4 appears to correspond to similar caved depths in the surrounding boreholes.

The water level in SB-4 and the caved depths (inferred water levels) are summarized in the following table. Once we are provided existing elevations, we will be glad to modify the table in include elevations.

Boring No.	Ground Surface Elevation	Ground Water or Caved Depth	Ground Water or Caved Elevation	Auger Refusal Depth
SB-1		Caved at 14.5 ft		23.5 ft
SB-2		Caved at 15 ft		28 ft
SB-3		Caved at 20 ft		40 ft
SB-4		24 ft		43.5 ft
SB-5		Caved at 12.5 ft		37 ft
SB-6		Caved at 20 ft		38.5 ft
SB-7		Caved at 15 ft		38.5 ft
SB-8		Caved at 15 ft		36 ft

RECOMMENDATIONS

LIMITATIONS

Our conclusions and recommendations are based on the project described above and the data obtained from our field work. The recommendations are based on generally accepted geotechnical engineering practice in North Carolina at the time of the report. No other warranties are expressed or implied.

The borings performed at this site were widely spaced and represent the subsurface conditions only at the exploration and test locations. Some variation in the subsurface conditions should be expected between boring locations due to natural variations or previous site activities. Consequently, subsurface conditions may be encountered during construction that will require alternative recommendations.

GENERAL DISCUSSION

From a geotechnical standpoint, the site is assessed to be generally adaptable for construction of the planned CCB fill. The excavations will generally extend into high consistency (hard) soils that will be stable under the conditions of excavation and within the completed fill. The ground surface should typically be satisfactory for placement of new fill with only limited need for special preparation, and excavated soils will typically be satisfactory for use as new fill.

Ground water is assessed to be present at depths of 12.5 to 24 feet, and shallower ground water might be present in areas of lower elevation. Depending on selection of final excavation depths and elevations, it might be necessary to control ground water levels on a permanent basis. Also, the very hard clay zones and discontinuous siltstone layers may result in excavation difficulty. These concepts are discussed in the following sections.

SUBSURFACE AND SURFACE WATER MANAGEMENT

Ground water levels are interpreted to be at depths of 12.5 to 24 feet below present grades, as shown in the tabulation in the Subsurface Conditions section of this report. The boring results and the soil conditions indicate that the water encountered in the borings might be hydraulically separate from the underlying, deeper ground water aquifers. That is, the uppermost ground water aquifer encountered by the borings might be perched above the hard clay and siltstone zone, which limits the downward migration of the water into the lower aquifer(s), which are confined by the clays. However, the extent to which the boreholes caved under the influence of the water, and the presence of the caving conditions throughout the site suggest that the shallow ground water is extensive and most likely occurs across the property. Additional exploration and piezometer installation might be necessary to definitively evaluate whether the uppermost ground water is hydraulically separate from the deeper aquifers.

The ground water levels are expected to influence excavation and site development. Either the excavation bases must be selected above ground water levels, or the ground water levels must be permanently controlled beneath the CCB fill. We recommend that aggregate base (French) drains be installed as water relief systems to maintain water levels below the final base grades. Water that collects in the French drains should be hard-piped beyond the CCB fill area so it may permanently drain by gravity.

Typically, the base drains should be about 2 feet wide and they should extend to depths necessary to maintain water levels below project requirements (typically at least 5 feet below the liner base). They should be filled with No. 57 stone that is wrapped in a filter fabric. A minimum 4-inch perforated pipe should be placed about 2 to 3 inches off the bottom of the French drain. The drains should be separated from the bottom of the structural fill liner by at least 2 to 3 feet of compacted soil. Depending on the construction sequence, the cross sectional area of the drain could be revised slightly, under guidance of the geotechnical engineer.

Surface water should be diverted away from the construction area with drainage berms and swales.

GENERAL SITE EARTHWORK

Site Preparation and Subgrade Evaluation

We anticipate that the site stripping will average less than about one-half to one foot, to remove topsoil, vegetation and roots. In isolated areas, deeper stripping might be required to remove large root systems or materials disturbed by weather. Deeper stripping might be required in drainage swales and areas of relatively low elevation due to potential sedimentation of soils eroded from higher areas.

Depending on final grades, some fill might be required in low areas. The geotechnical engineer should evaluate the exposed subgrades in construction areas prior to new fill or backfill placement. The evaluation should include proofrolling with a loaded dump truck or similar pneumatic tired vehicle, where possible, to help identify isolated soft, wet or otherwise unstable areas that should be repaired prior to placing fill, or other construction. Unstable areas that are identified should be undercut to stable soils, or be otherwise repaired as recommended by the geotechnical engineer.

Exposed subgrade soils can be degraded by rainfall, ground water seepage, and construction traffic. As such, exposed subgrades should be sealed and graded to direct run-off water away from the construction area. Construction traffic should be routed around any wet areas or otherwise susceptible subgrade soils.

New Soil Fill Placement

After the stripped subgrade is properly prepared and evaluated, new soil fill may be placed to raise grades to the design elevations (base grades), where needed. New fill for support of the CCB fill, roadways and other structures should be free of excessive organics, large cobbles or boulders, and other debris.

Where the existing ground surface is steeper than about 5H:1V, shallow benches should be excavated several feet horizontally into the existing slopes to provide a smooth transition between the fill and natural soils, and to reduce the potential for weak zones in the embankment.

It is GeoTrack's experience with similar soils and CCB, that structural fill soils uniformly compacted to at least 95 percent of their standard Proctor maximum dry densities (ASTM D 698) will provide a fill mass with engineering properties (strength, stability, and settlement characteristics) satisfactory for the anticipated site usage. It may be necessary to adjust the moisture content of the soil fill to achieve the specified compaction. Typically, soils with moisture contents within 3 percent of their optimum moisture content can be sufficiently compacted using proper equipment and methods. We suggest that final project requirements allow some flexibility for variations in moisture content, particularly in the lower fill extremities and in the CCB.

The excavated on-site clays can typically be re-used as new structural fill, although some moisture adjustment will likely be needed. Depending on specific construction sequencing, the soils that are excavated from below the water table might be too wet to be used as new fill. The clays will be susceptible to loss of subgrade stability and difficult compaction if exposed to moisture variations during construction. Also, the discontinuous siltstone layers will most likely fracture into large fragments (cobbles or boulders) that will be too large to routinely use those material in structural fills. The larger rock fragments should be separated from the soil fill and stockpiled for use as stabilization materials or in landscaping.

If it is necessary to import fill to the site, the fill should be free of excessive organic matter and debris, and have a maximum particle size of 6 inches. The soil should generally have a liquid limit of less than 60 and a plasticity index of less than 25. The fill should have a maximum dry density of at least 90 pounds per cubic foot as determined by the standard Proctor compaction test (ASTM D-698). Proposed fill soils should be tested by the geotechnical laboratory prior to use. A qualified engineering technician should check the fill compaction during construction by performing periodic density tests.

Site Slopes

Typically, 3H:1V slopes are planned for new containment embankments and for new excavated slopes around the perimeter of CCB structural fill areas, and these slopes are anticipated to be stable when excavated into the natural soils, or when placed as structural fill. In general, we recommend permanent cut and fill slopes for all CCB fill areas be constructed no steeper than 3H:1V due to the clayey nature of the materials and the proximity to the ground water. Flatter slopes are suggested to reduce potential erosion and ease maintenance. Slopes for temporary excavations should conform to OSHA regulations.

Fill used to construct slopes should be compacted as discussed above. To help maintain a compacted slope face, the slopes can be overfilled beyond the planned toe, and then the face can be cut-back to expose well compacted fill.

Excavation Difficulty

The borings penetrated discontinuous cemented cemented sandy clay (siltstone) layers that increased in frequency and thickness with depth. Auger refusal eventually occurred at depths of 23.5 to 43.5 feet. These siltstone layers will cause some excavation difficulty, with the severity depending on selection of final grades. The thinner layers, and the surrounding hard clays, will most likely require pre-loosening by ripping with a large bulldozer utilizing a single-tooth ripper. Ripping will most likely increase in difficulty with depth, and isolated large fragments may need to be excavated separately.

Eventually, due to increasing thickness and frequency, ripping and directional excavation will not successfully excavate the siltstone layers. Blasting or the use of powerful pneumatic tools will likely be needed. Because the siltstone layers are not continuous, the depths to excavation refusal will likely vary. As a general guide, the penetration resistances greater than about 50 blows per inch may correlate to excavation refusal depths.

CCB AND SOIL COVER FILL PLACEMENT

Depending on the effectiveness of dewatering measures, we anticipate that the hard clay in the excavation bases will be satisfactory for liner support. After the bottom liner is placed and approved, CCB placement may begin. The initial CCB lift placed should be about 1 to 2 feet thick. That initial lift should be dumped at the edge of the fill and pushed over the drainage system by tracked equipment operating on top of the lift. The surface should be lightly compacted to help avoid potential damage to the liner system.

Subsequent lifts of CCB should be placed in lifts nominally about 8 inches thick and they should be compacted to the project specifications. Those requirements are at least 95 percent of the soil's standard Proctor (ASTM D 698) maximum dry density. It may be necessary to adjust the moisture content of the CCB fill to achieve the specified compaction. Our experience indicates that CCB is not sensitive to compaction moisture content, and adequate compaction can often be achieved a relatively widely varying moisture contents.

After the cover FML (cap) is placed and approved, placement of the soil cover may begin. The soil cover should conform to the previous recommendations for structural fill. Immediately over the FML, the soil should be placed in an initial protective lift as described above. Then, cover soils should be compacted to at least 95 percent of the soil's standard Proctor (ASTM D 698) maximum dry density at moistures contents, and generally within 3 percent of optimum.

CLOSING

GeoTrack Technologies, Inc. appreciates the opportunity to assist you during this phase of the project. Please call if there are any questions concerning this report, or if you need additional assistance.

NORTH CAROLINA PROFESSIONAL PE 17088 ENGINEER DAVID D. WILSON

Respectfully submitted,
GeoTrack Technologies, Inc.

David D. Wilson, P.E.
Senior Professional
SC Registration No. 11701

Kenneth W. Weinel

Kenneth W. Weinel, P.E.
Senior Professional
NC Registration No. 21531

APPENDIX

Boring Location Plan
Test Boring Records
Summary of Soil Tests
Exploration and Testing Procedures

VICINITY MAP
NTS

Charah

PROGRESS DRAWINGS - NOT FOR CONSTRUCTION
FOR REVIEW PURPOSES ONLY

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STOP
CALL 1-800-632-4949
N.C. ONE-CALL CENTER
IT'S THE LAW.

SCALE: 1"=400'
0 200 400 800

REV.	DESCRIPTION	BY	DATE

JOB NAME:	SANFORD MINE RECLAMATION	DRAWN BY:	CHECKED BY:
LOCATION:	GS - SANFORD MINE BRICKYARD ROAD SANFORD, NC 27332	SCALE: 1"= 400'	
		DATE: 03/22/2014	
		JOB NUMBER	SHEET
DESCRIPTION:	PROPOSED BORING PLAN		1 of 1 △

BORING RECORD

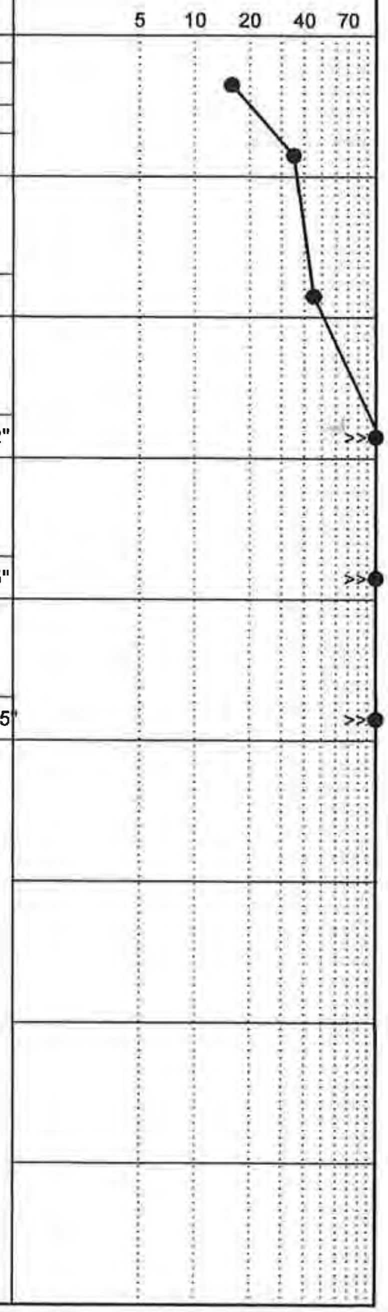
GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation **Sanford, NC** **GeoTrack Project No.: 14-3420-N**	**BORING No. SB-1** Boring Location: N 35°32.272'; W 79°08.627'

Date Drilled: 5/14/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: Caved @ 14.5 ft 1 hr	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff Yellowish Brown, Reddish Brown, and Gray Mottled Silty Clay with Some Sand		1.0	SS-1	8	8	8	16
	3.0	Hard Reddish Brown Silty Clay		3.5	SS-2	10	16	19	35
	7.0	Hard Yellowish Brown and Gray Silty Clay		8.5	SS-3	19	19	26	45
	12.0	Very Hard Reddish Brown and Yellowish Brown Silty Clay with Siltstone Layers		13.5	SS-4	50/2"			50/2"
				18.5	SS-5	50/5"			50/5"
	23.5	Auger Refusal at 23.5 feet		23.5	SS-6	50/0.5"			50/0.5"

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

BORING RECORD
GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation
Sanford, NC
GeoTrack Project No.: 14-3420-N

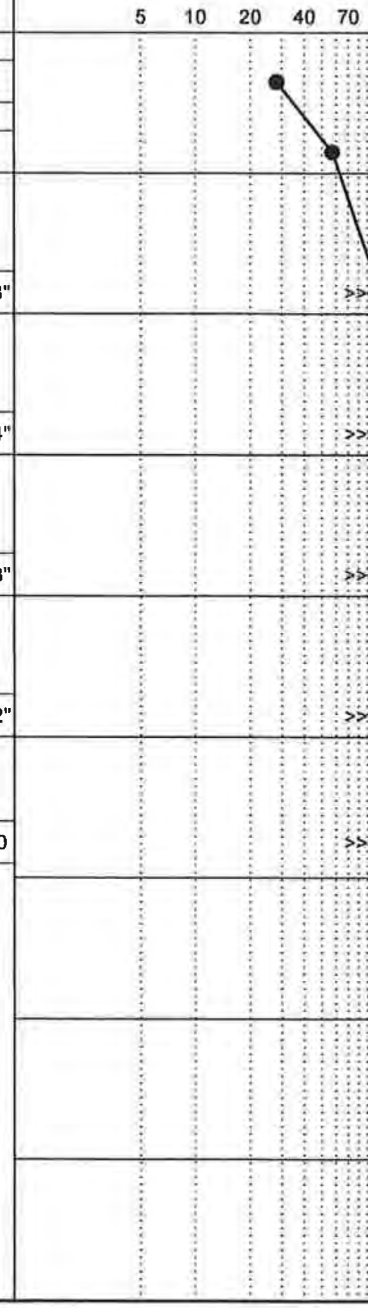
BORING No. SB-2

Boring Location: N 35°32.255'; W 79°08.344'

Date Drilled: 5/13/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: Caved @ 15 ft 24 hrs	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff Reddish Brown, Yellowish Brown, and Gray Mottled Silty Clay with Some Sand		1.0	SS-1	11	13	15	28
	3.0	Hard to Very Hard Reddish Brown Silty Clay		3.5	SS-2	19	26	31	57
				8.5	SS-3	38	50/3"		50/3"
				13.5	SS-4	50/4"			50/4"
	18.0	Very Hard Reddish Brown and Light Gray Silty Clay		18.5	SS-5	50/3"			50/3"
	23.0	Very Hard Reddish Brown and Gray Silty Clay with Siltstone Layers		23.5	SS-6	50/2"			50/2"
	28.0	Auger Refusal at 28 feet		28.0	SS-7	50/0			50/0

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

BORING RECORD

GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation
Sanford, NC
GeoTrack Project No.: 14-3420-N

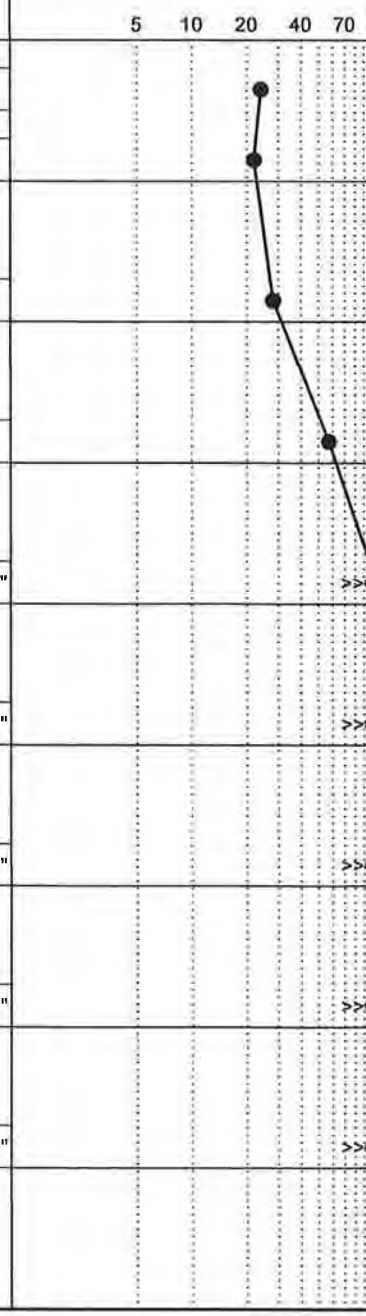
BORING No. SB-3

Boring Location: N 35°32.346'; W 79°08.251'

Date Drilled: 5/13/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: Caved @ 20 ft 24 hrs	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff Reddish Brown, Light Reddish Brown, and Light Gray Mottled Silty Clay with Some Sand		1.0	SS-1	10	12	12	24
				3.5	SS-2	9	10	12	22
	6.0	Very Stiff Dark Reddish Brown and Light Gray Mottled Silty Clay		8.5	SS-3	7	11	17	28
	12.0	Very Hard Reddish Brown Silty Clay		13.5	SS-4	13	25	32	57
	17.0	Very Hard Dark Reddish Brown and Gray Silty Clay		18.5	SS-5	50/5"			50/5"
				23.5	SS-6	49	50/3"		50/3"
	27.0	Very Hard Reddish Brown and Gray Silty Clay with Siltstone Layers		28.5	SS-7	50/4"			50/4"
				33.5	SS-8	50/4"			50/4"
				38.5	SS-9	50/3"			50/3"
	40.0	Auger Refusal at 40 feet							

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

BORING RECORD

GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation
Sanford, NC
GeoTrack Project No.: 14-3420-N

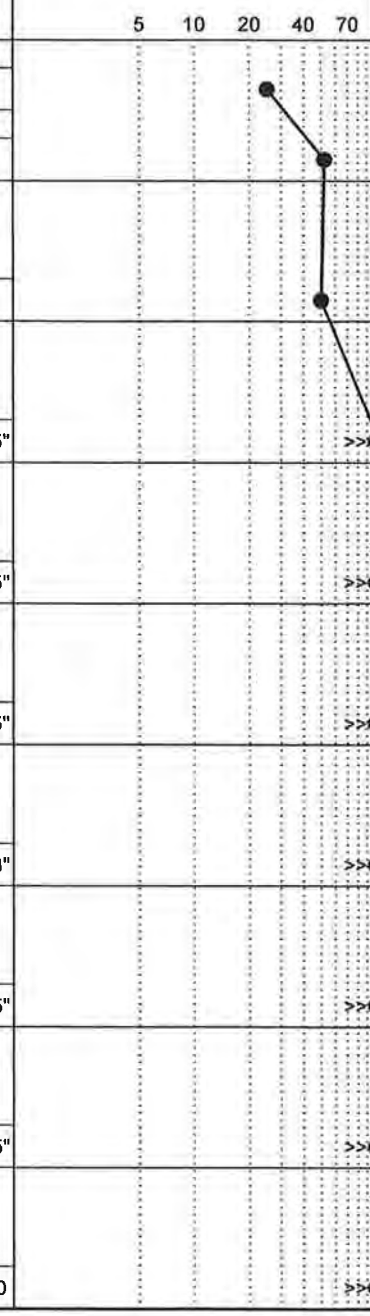
BORING No. SB-4

Boring Location: N 35°32.364'; W 79°08.299'

Date Drilled: 5/14/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: 24.0 ft 6 hrs	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff Reddish Brown and Yellowish Brown Fine Silty Clay with Some Sand		1.0	SS-1	8	12	13	25
	3.0	Hard Reddish Brown Silty Clay		3.5	SS-2	14	23	29	52
	8.0	Hard to Very Hard Reddish Brown Silty Clay		8.5	SS-3	17	21	29	50
				13.5	SS-4	50/5"			50/5"
	18.0	Very Hard Reddish Brown Silty Clay		18.5	SS-5	24	50/5"		50/5"
				23.5	SS-6	50/5"			50/5"
	27.0	Very Hard Reddish Brown, Light Gray, and Yellowish Brown Mottled Silty Clay with Siltstone Layers		28.5	SS-7	50/3"			50/3"
				33.5	SS-8	50/5"			50/5"
				38.5	SS-9	50/5"			50/5"
	43.5	Auger Refusal at 43.5 ft		43.5	SS-10	50/0			50/0

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

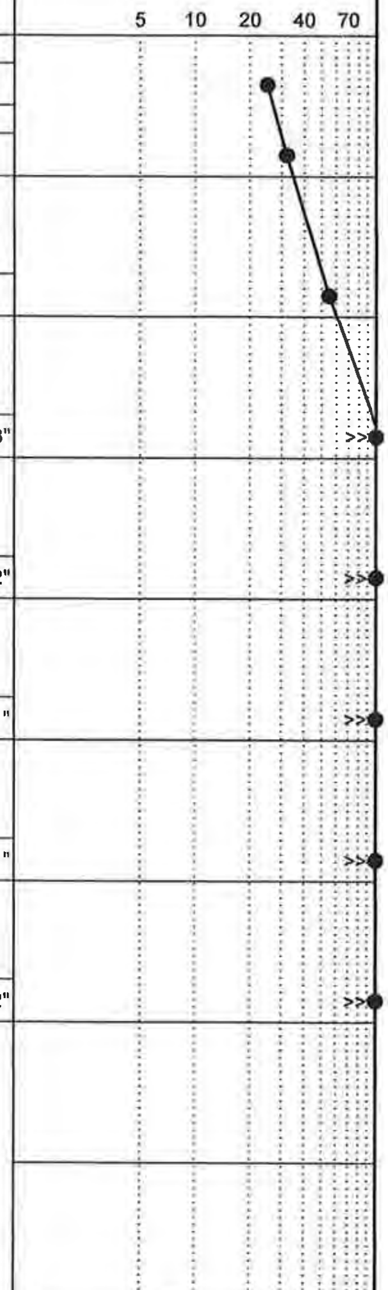
BORING RECORD
GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation Sanford, NC GeoTrack Project No.: 14-3420-N	BORING No. SB-5 Boring Location: N 35°32.404'; W 79°08.563'

Date Drilled: 5/15/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: Caved @ 12.5 5 days	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff to Hard Reddish Brown, Yellowish Brown, and Gray Mottled Silty Clay with Some Sand		1.0	SS-1	8	12	13	25
				3.5	SS-2	11	15	17	32
				8.5	SS-3	13	24	31	55
	13.0	Very Hard Reddish Brown Silty Clay with Siltstone Layers		13.5	SS-4	28	50/3"		50/3"
				18.5	SS-5	50/2"			50/2"
				23.5	SS-6	50/1"			50/1"
				28.5	SS-7	50/1"			50/1"
				33.5	SS-8	50/2"			50/2"
	37.0	Auger Refusal at 37 feet							

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

BORING RECORD
GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation
Sanford, NC
GeoTrack Project No.: 14-3420-N

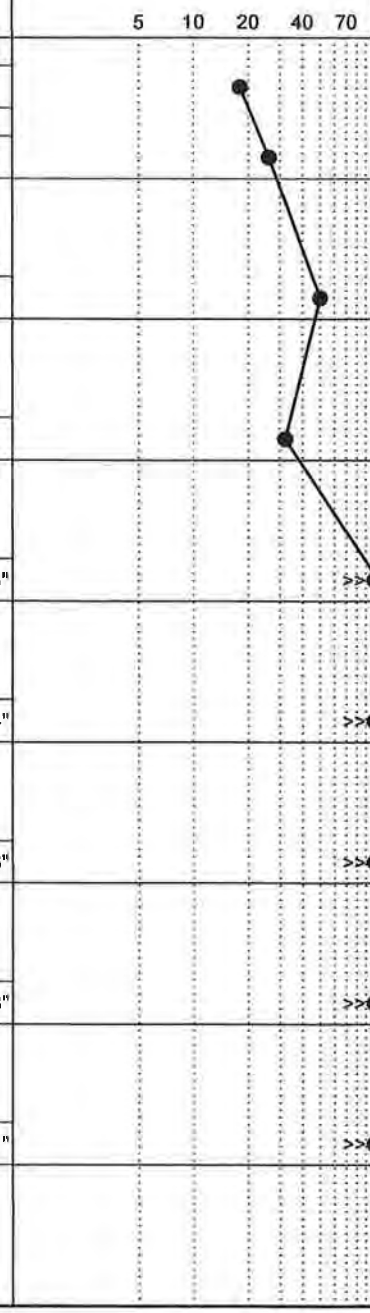
BORING No. SB-6

Boring Location: N 35°32.482'; W 79°08.307'

Date Drilled: 5/13/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: Caved @ 20 ft 24 hrs	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff Reddish Brown, Light Gray, and Yellowish Brown Mottled Silty Clay with Some Sand		1.0	SS-1	5	8	10	18
				3.5	SS-2	6	12	14	26
	8.0	Hard Reddish Brown and Dark Reddish Gray Silty Clay		8.5	SS-3	19	24	26	50
	13.0	Hard Dark Reddish Brown and Light Gray Silty Clay		13.5	SS-4	17	17	15	32
	18.0	Very Hard Dark Reddish Brown and Light Gray Silty Clay		18.5	SS-5	50/3"			50/3"
				23.5	SS-6	50/4"			50/4"
				28.5	SS-7	50/6"			50/6"
	31.0	Very Hard Dark Reddish Brown and Light Gray Silty Clay with Siltstone Layers		33.5	SS-8	50/3"			50/3"
	38.5	Auger Refusal at 38.5 ft		38.5	SS-9	50/1"			50/1"

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

BORING RECORD

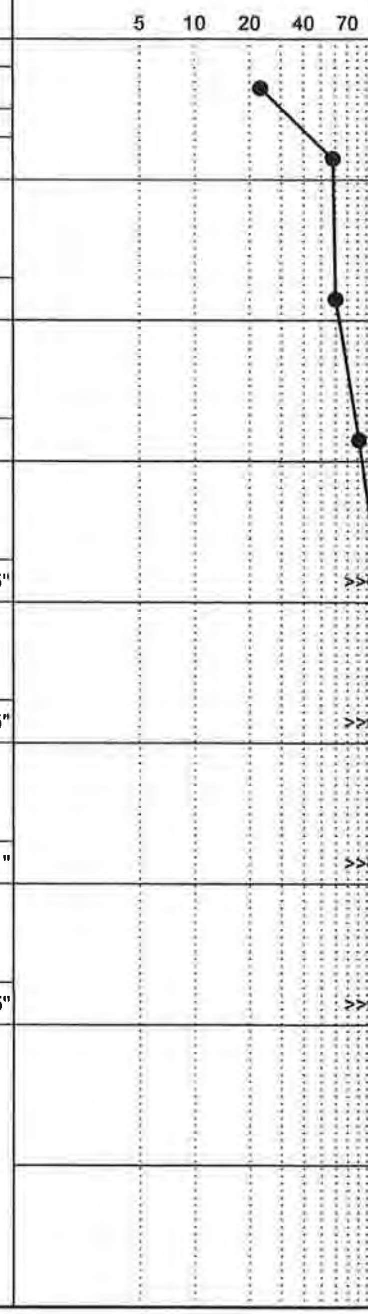
GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation **Sanford, NC** **GeoTrack Project No.: 14-3420-N**	**BORING No. SB-7** Boring Location: N 35°32.457'; W 79°08.665'

Date Drilled: 5/14/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: Caved @ 15 ft 1 hr	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff Yellowish Brown Fine Sandy Clay with Some Silt		1.0	SS-1	8	11	12	23
	3.0	Very Dense Reddish Brown, Gray, and Brown Clayey Fine Sand with Some Silt		3.5	SS-2	14	27	31	58
	7.0	Hard to Very Hard Reddish Brown Silty Clay with Clayey Sand Layers and Siltstone Layers		8.5	SS-3	19	27	33	60
				13.5	SS-4	27	36	45	81
				18.5	SS-5	50/5"			50/5"
				23.5	SS-6	31	50/5"		50/5"
				28.5	SS-7	50/1"			50/1"
				33.5	SS-8	50/5"			50/5"
	38.5	Auger Refusal at 38.5 ft							

STD. PENETRATION TEST DATA (blows/ft)



BORING RECORD 3420 BORING LOGS.GPJ GEOTRACK.GDT 6/30/14

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

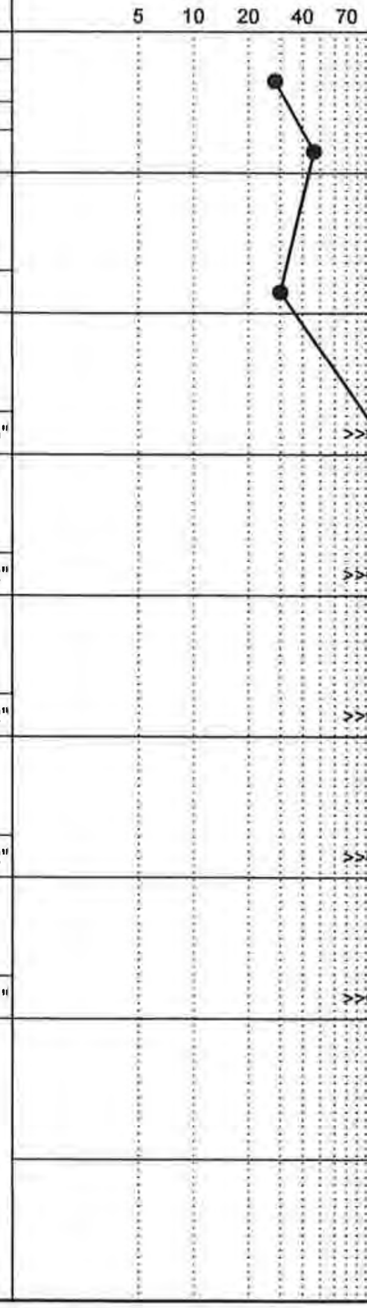
BORING RECORD
GEOTRACK TECHNOLOGIES, INC.

Sanford Mine Reclamation **Sanford, NC** **GeoTrack Project No.: 14-3420-N**	**BORING No. SB-8** Boring Location: N 35°32.561'; W 79°08.839'

Date Drilled: 5/14/14	Ground Elevation:	Notes: Metro Drill - CME 45
Drilling Method: HSA	Hammer Type: Gravity	
Water Level: Caved @ 15 ft 4 hrs	Boring Diameter: 6 in	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6in	2nd 6in	3rd 6in	N Value
	0.0	Very Stiff to Hard Reddish Brown, Light Gray, and Yellowish Brown Mottled Silty Clay with Some Sand		1.0	SS-1	8	13	15	28
				3.5	SS-2	17	22	24	46
	8.0	Hard Reddish Brown and Yellowish Brown Mottled Silty Clay		8.5	SS-3	8	13	17	30
	13.0	Hard Dark Reddish Brown and Light Gray Silty Clay with Siltstone Layers		13.5	SS-4	26	50/5"		50/5"
				18.5	SS-5	50/2"			50/2"
				23.5	SS-6	50/2"			50/2"
				28.5	SS-7	50/2"			50/2"
				33.5	SS-8	50/1"			50/1"
	36.0	Auger Refusal at 36 feet							

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SUMMARY OF SOIL TESTS
SANFORD MINE
SANFORD, NC
GEOTRACK PROJECT NO. 14-3420-N

Boring No.	Sample Depths (ft)	Unified Soil Class.	Natural Moisture Content (%)	Natural Unit Weight (pcf)	Atterberg Limits (%)			% Fines
					LL	PL	PI	
SB-3	3.5-5	CL	16.6					50.0
SB-3	13.5-15	CL	12.2		32	19	13	85.5
SB-3	18.5-20	CL	12.8					91.9
SB-3	23.5-25	CL	8.3		39	24	15	98.2
SB-3	38.5-40	CL	13.6					83.7
SB-7	3.5-5	SC	14.3					42.9
SB-7	8.5-10	CL	12.8		35	24	11	93.2
SB-7	13.5-15	SC	6.4		24	16	8	43.5
SB-7	18.5-20	CL	7.4		40	19	21	98.5
SB-7	23.5-25	CL	8.5					96.3

EXPLORATION AND TESTING PROCEDURES

Soil Test Borings: Soil sampling and penetration testing for this project were performed in accordance with ASTM D 1586. The borings were advanced with hollow-stem, continuous flight augers and, at standard intervals, soil samples were obtained with a standard 1.4-inch I.D., 2 inch O.D., split-tube sampler. The sampler was first seated six (6) inches to penetrate any loose cuttings, then driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "Standard Penetration Resistance" (N-Value). The Standard Penetration Resistance, when properly evaluated, is an index to soil consistency, strength, density, and ability to support foundations.

Representative portions of each soil sample were placed in glass jars and taken to our laboratory. The samples were then visually classified by an engineer to supplement the driller's field classifications. Test Boring Records are attached indicating the soil descriptions and Standard Penetration Resistances.

Moisture Content: This test was conducted in accordance with ASTM Designation D 2216. The test is performed by determining the weight of a moist sample. The sample is then dried under controlled temperatures. The moisture content is the ratio expressed as a percentage, of the weight of water in the soil to the weight of the solid particles. The test results are presented on the attached sheets.

Atterberg Limits Test: A representative sample was selected for Atterberg Limits testing to determine the soil's plasticity characteristics. The Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid and is determined in accordance with ASTM D 423. The Plastic Limit is the moisture content at which the soil begins to lose its plasticity and is determined in accordance with ASTM D 424. The data obtained is presented on the attached sheets.

Percent Fines: In this test, the sample is dried and then washed over a standard No. 200 sieve. The percentage of soil, by weight, passing the sieve is the percentage of fines or portion of the sample in the silt and clay size range. This test was conducted in accordance with ASTM Designation D1140 54.

APPENDIX D
FEMA Flood Zone and Municipal Water Supply Availability

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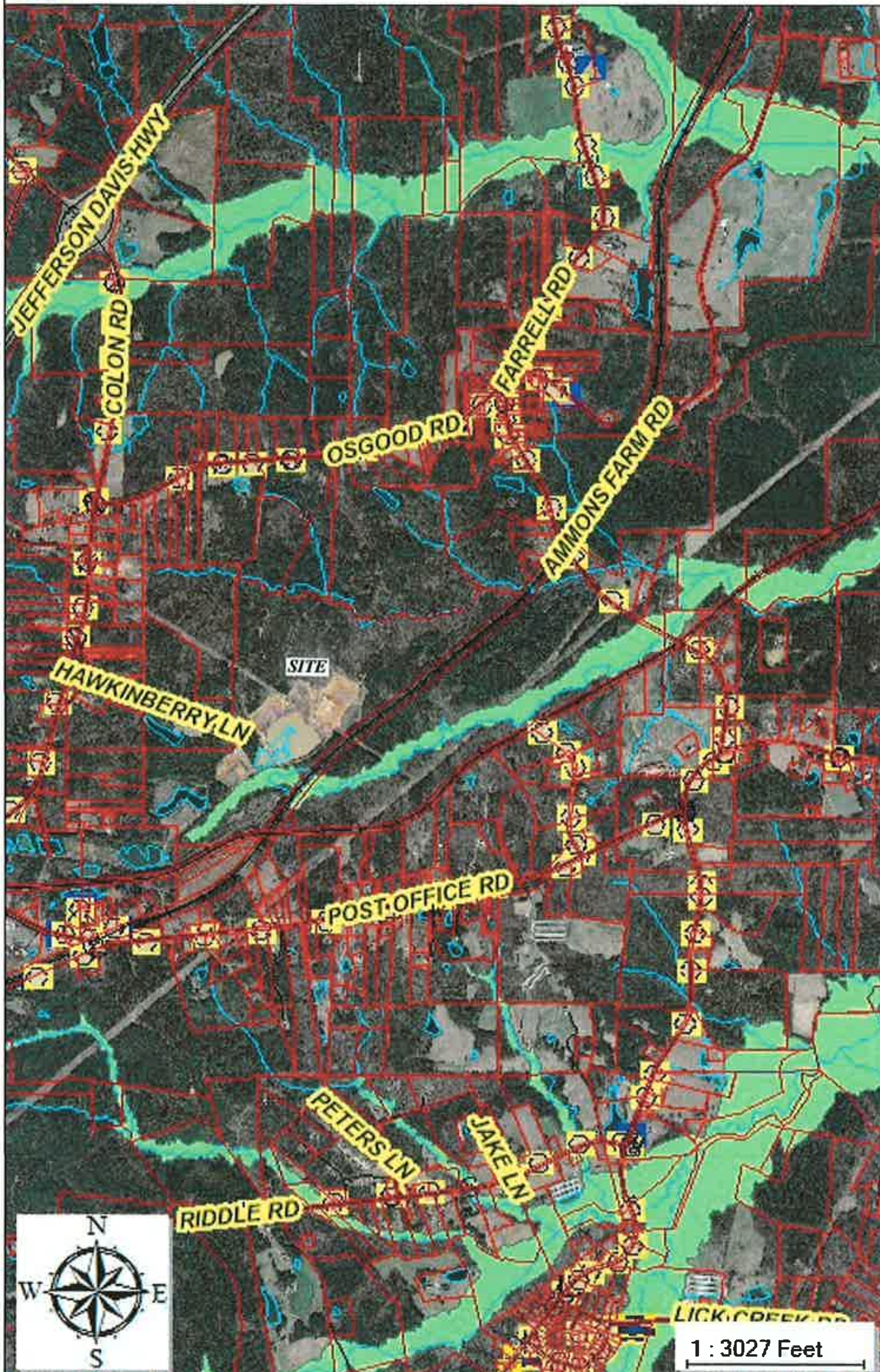
CONNECTGIS WEB HOSTING

Lee2
Printed October 07, 2014
See Below for Disclaimer



Parcels

Streets

Water Main Appurtenances

- ARV
- BOV
- CAP
- GV
- HYD
- HYD-VALVE
- HYDRANT
- METER
- PLUG
- PUMP STA
- REDUCER
- VALVE
- WATER TANK

Railroad

Lee County

Sanford City Limits

Broadway Town Limits

Hydrography

FEMA Firm 2005

- A
- AE
- AEFW
- SHADED X

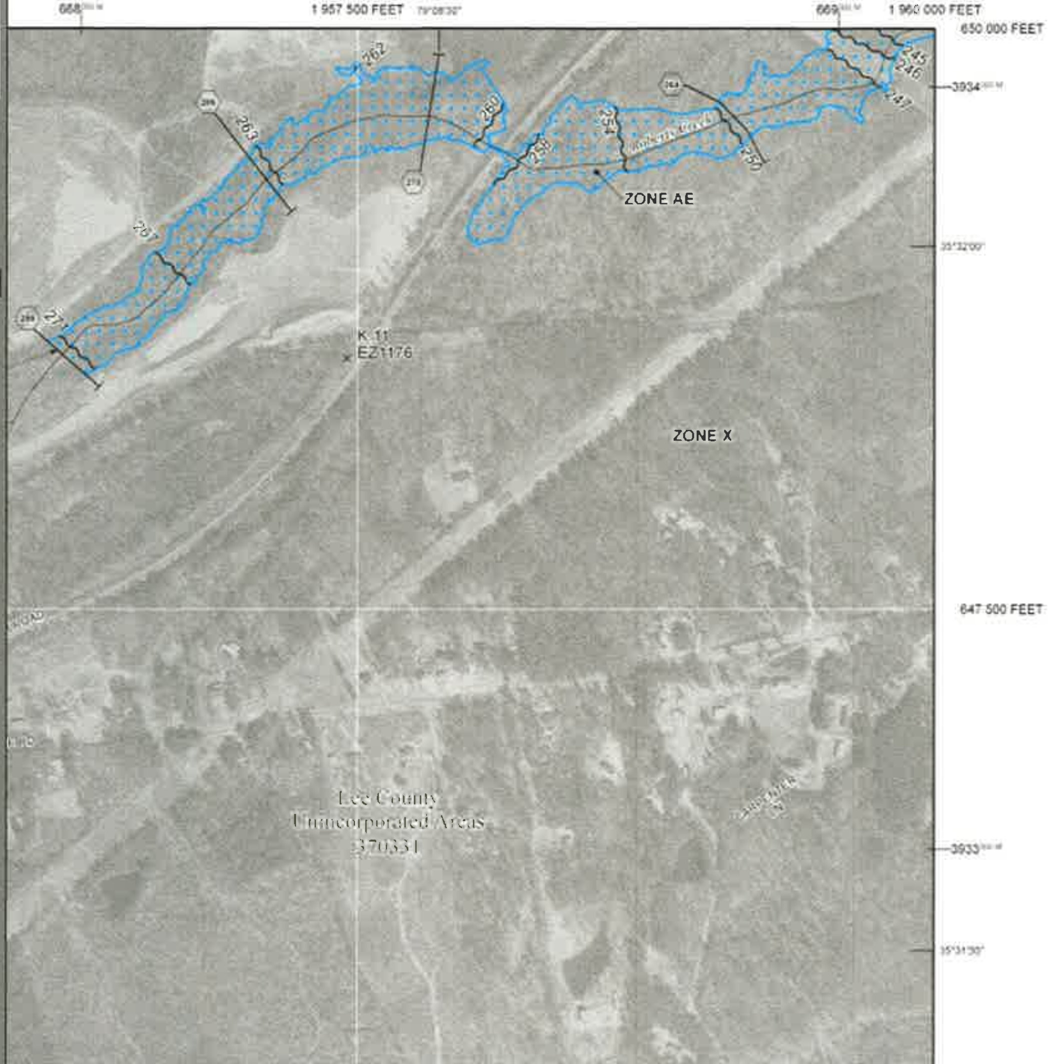
FEMA

Scale: 21 % LOMC: 1

Help

Zoom Win | Pan
Zoom In | Zoom Out
1:1 Zoom In | MAX Zoom Out

Make a FIRMette



LEGEND

SPECIAL FLOOD HAZARD AREAS (S
INUNDATION BY THE 1% ANNUAL CHANCE

The 1% annual chance flood (100-year flood), also known as the has a 1% chance of being equaled or exceeded in any given yea Area is the area subject to flooding by the 1% annual chance fl Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevation determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of pon determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow depths determined. For areas of alluvial f determined.
ZONE AR	Special Flood Hazard Area formerly protected f flood by a flood control system that was subseq indicates that the former flood control system protection from the 1% annual chance or greater
ZONE A99	Areas to be protected from 1% annual chanc protection system under construction; no Base Fl
ZONE VE	Coastal flood zone with velocity hazard (wave a determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodp free of encroachment so that the 1% annual chance flood can b increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1 average depths of less than 1 foot or with drain mile; and areas protected by levees from 1% ann

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chanc
ZONE D	Areas in which flood hazards are undetermined, but pos

COASTAL BARRIER RESOURCES SYSTEM (C

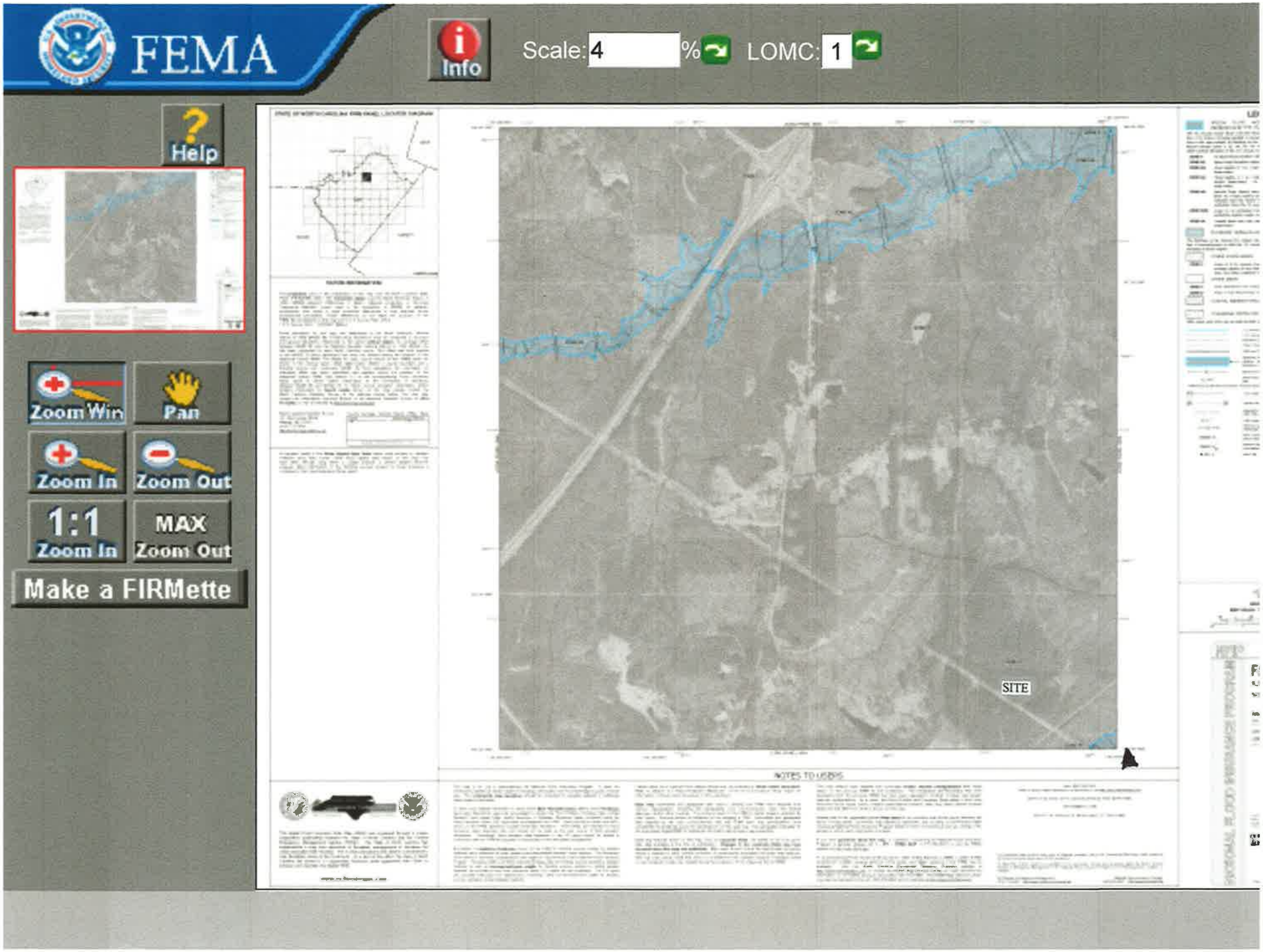
OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to S

1% annual chance floodplain bound
0.2% annual chance floodplain bou
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood H dividing Special Flood Hazard A Elevations, flood depths or flood vel
513 Base Flood Elevation line and value;
(EL 987) Base Flood Elevation value where u feet*

* Referenced to the North American Vertical Datum of 1988

Cross section line
Transect line


FEMA
Info
Scale: 4 %
LOMC: 1
Help
Zoom Win
Pan
Zoom In
Zoom Out
1:1 Zoom In
MAX Zoom Out
Make a FIRMette
SITE
NOTES TO USERS

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APPENDIX E
Health & Safety Plan

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HEALTH & SAFETY PLAN

CHARAH, INC. – SANFORD MINE RECLAMATION STUCTURAL FILL SITE
1303 BRICKYARD ROAD
SANFORD, NORTH CAROLINA

July 15, 2014

Prepared By:

[illegible]

Ross Klingman, P.G.
Buxton Environmental, Inc.

I have read and understand the contents of this Health and Safety Plan:

Name	Date	
Mark Sellia	7/15/14	RED Dog
Chase Pernell	7/15/14	
Robert Cassell	7/21/14	Summit
[illegible]	7/21/14	
[illegible]	7-28-14	GEO Exploration
[illegible]	7-23-14	
Rufus D [illegible]	7-23-14	
[illegible]	8-25-14	EDPS
[illegible]	8-25-14	
[illegible]	8-29-14	

Buxton Environmental, Inc.
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Phone: (704) 344-1450
Fax: (704) 344-1451
E-Mail: buxtonenv@bellsouth.net

SECTION 1

1.0 INTRODUCTION

The Health and Safety Plan presented herein as prepared by Buxton Environmental, Inc. will be implemented and followed by all company site personnel. Buxton Environmental's policy is to conduct all activities in the manner required to protect the health and safety of the project personnel and the public. All work is in general accordance with applicable federal, state, and local regulations, including the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), and requirements of 29 CFR 1910.

The Buxton Environmental Site Manager is responsible for insuring the adherence to safety procedures during the field work. Routine site inspections are conducted to verify conformity. In no case may work be performed in a manner that conflicts with the intent of the safety and environmental concerns expressed in this plan. Personnel violating safety procedures will be disciplined or removed from the job site.

It is the objective of this Health and Safety Plan to provide safe working conditions for personnel at the site. The establishment of the safety organization and procedures, as well as the selection of personnel protection measures, were based on an analysis of the known potential hazards.

This Health and Safety Plan was prepared based upon the projections of the site work. On-site job tasks will consist of geotechnical drilling, sampling and piezometer installation at a former clay mine site. Duration of these activities is expected to be two weeks. If additional phases become necessary, this plan will be amended to include site-specific requirements and/or information.

1.1 Safety Organization

The Health and Safety Program for the investigation at the site was developed primarily for Buxton Environmental, Inc. personnel. Information copies are being provided to subcontractor and other interested parties. The Site Manager is the on-site Health and Safety Officer. Thus, the Site Manager supervises all site operations including health and safety operations and training, and decontamination of workers and equipment.

The on-site Health and Safety Officer conducts, orients, audits, and insures the safety and health requirements of this plan are followed. He also assists in supervising the proper day-to-day execution of the personnel protection program and prohibiting improperly prepared personnel from entering or working in the site areas which require use of protective equipment and clothing.

1.2 Site History

Buxton Environmental, Inc. understands that the subject site consists of approximately 113 acres, and was formerly utilized by General Shale Brick, Inc. for clay mining activities. The mine is understood to have been closed for approximately 6 years.

1.3 Hazard Analysis

The following hazard analysis was conducted to ensure that site activities, personnel protection, and emergency response are consistent with the tasks to be performed and the potential for exposure to specific contaminants expected to be encountered. The hazard analysis forms the foundation for this Health and Safety Plan.

SECTION 2

2.0 PERSONNEL PROTECTION

The personnel protection program for the project includes provision of protective equipment, administrative control for personal hygiene, and training of employees working on the project.

2.1 Personal Protective Equipment (PPE)

The following PPE will be worn by employees conducting soil sampling:

Initial activities will be carried out in Level D protective attire: coveralls, boots, steel toe boots, and gloves.

2.2 Safety Practices

The following safe work practices are followed on-site. These practices establish general precautionary measures for reducing the risks associated with work site operations and minimizing the exposure to contaminants. Heat stress is not anticipated with the minimal protection clothing required.

Personal Hygiene

The following procedure is practiced by all Buxton Environmental personnel entering the work areas of the site:

1. Eating, drinking, chewing gum or tobacco, taking medication and smoking is prohibited.

The Site Manager performs inspections and documents variations.

Violators are to be disciplined or removed from the job site.

Personnel Protection

1. Be familiar with and knowledgeable about standard operating safety procedures.
2. Be familiar with, knowledgeable of and adhere to all instructions in the site safety plan.
3. Be familiar with arrangements for emergency medical assistance. The location and telephone number of the nearest emergency medical facilities are provided in Section 6.
4. Consider fatigue and other environmental factors influencing efficiency of personnel.
5. Wear appropriate or designated, approved protective clothing.

Operations and Communications

1. In the event of emergencies, verbal commands are used to enforce the site safety plan.
2. Buxton Environmental personnel going on-site are to be thoroughly briefed on the anticipated hazards, equipment requirements, safety practices, emergency procedures and

communication methods.

3. Unfamiliar operations are rehearsed prior to implementation.
4. The number of personnel and equipment in the work areas are minimized consistent with site operations.
5. Appropriate decontamination procedures for leaving the site are established and are discussed in Section 3.

2.3 Training

All site personnel have fulfilled the training requirements specified in 29 CFR 1910.120:

- All employees, initial instruction of 40 hours
- All employees, 8 hour annual refresher

The Health and Safety Officer or alternate will review the following with all employees prior to their working on the site:

1. On-site training requirements for employees
2. Site safety and health hazards and appropriate precautions such as:
    - Proper materials handling
    - Preventive maintenance of safety equipment
    - Requirements for, and use of personal protective equipment
    - Methods used for decontamination
    - Areas of the site that have restricted access
    - Required personal hygiene practices
3. Effective response to any emergency
4. Responses to fires and explosions
5. Shutdown of operations
6. General safety precautions

A log of site personnel having completed this review is maintained by the Health and Safety Officer.

Everyone on the site attends a pre-entry briefing prior to the start of site activities to insure their familiarity with this plan. Follow-up meetings will be held if this plan is amended or if on-site activities necessitate this action.

Each Buxton Environmental, Inc. employee working on the site has been provided a copy of this plan prior to their site visit. They are responsible for becoming familiar with and adhering to the requirements and information contained in this plan.

SECTION 3

3.0 CONTINGENCY PLAN

The Health and Safety Plan for these site actions has been established to allow site operations to be conducted without adverse impacts on worker health and safety. In addition, supplementary emergency response procedures have been developed to cover extraordinary conditions that might possibly occur at the site.

3.1 General

All accidents and unusual events are dealt with in a manner to minimize continued health risk of site workers. In the event that an accident or other unusual events occur, the following procedure will be utilized.

- First aid or other appropriate initial action will be administered by those closest to the accident/event. This assistance will be conducted in a manner to assure that those rendering assistance are not placed in a situation of unacceptable risk.
- All accidents/unusual events must be reported to the Site Manager. The Site Manager is responsible for conducting the emergency response in an efficient, rapid, and safe manner. The Site Manager decides if off-site assistance and/or medical treatment is required and arranges assistance.
- All workers on site are responsible for conducting themselves in a mature, calm manner in the event of an accident/unusual event. All personnel must conduct themselves so as to avoid danger to themselves and to surrounding workers.

The following emergency equipment is available at the site:

- First aid kit
- Fire extinguisher

3.2 Work Injury

If an employee working in a contaminated area is physically injured, Red Cross first aid procedures are followed. Depending on the severity of the injury, emergency medical response may be sought. If the employee can be moved, he is taken to the edge of the work area where contaminated chemical resistant coveralls are removed and any emergency first aid administered. Next, transport the worker to a local emergency medical facility.

3.3 Fires

Fire extinguishers are provided with the heavy equipment. If a localized fire breaks out, use chemical fire extinguishers to bring the occurrence under control. If necessary and feasible, place soil or other inert materials on the burning area to extinguish the flames and minimize the potential for spreading. If appropriate, contact the local fire fighting authorities for notification and/or assistance. If an uncontrolled fire develops, the Site Manager or his designated assistant

3.4 Emergency Horn Signal

All personnel are informed of an emergency situation which requires suspension of site operations; egress from the work area; emergency responses; and if necessary, site evacuation via method defined during employee training. The type of horn will be specified during the pre-entry briefing.

3.5 Notification and Documentation

Checklist

The names and phone numbers of all personnel and agencies that could be involved in emergency response are provided in this plan and posted at the site by the site manager.

Procedures

In the event of an on-site emergency requiring notification of off-site personnel, the Site Manager is responsible for immediately notifying the personnel. If for some reason the Site Manager is unavailable, the alternate must perform this function.

Documentation

The Site Manager provides a report of the emergency to the Project Manager describing the following:

- The event (including date and time) that necessitated the notification and the basis for that decision
- Date, time, and names of all person/agencies notified and their response
- Resolution of the incident (including duration) and the method/corrective action involved

This report is submitted within five working days of the resolution of the event.

3.6 Evacuation Plan

Although very unlikely, it is possible that a site emergency could necessitate evacuating all personnel from the site. If such a situation arises, the Site Manager gives the appropriate signal for site evacuation. It is the responsibility of all individuals to evacuate in a calm, controlled manner. All available vehicles located outside of the work zone are used in the evacuation. All personnel exit the site and go to rendezvous points selected by the Site Manger depending on wind direction, severity and type of incident, etc. The Site Manager's log of on-site personnel is used to ensure that all individuals are accounted for. Control of personnel at the rendezvous point is the responsibility of the Site Manager or his designated assistant.

TABLE 1

NOTIFICATION CHECKLIST

The event of fire, uncontrollable chemical spill, explosion, severe earthquake, or any occurrence that might be damaging to personnel or adjacent property requires the immediate notification of the proper emergency service. The proper emergency service is determined by the nature of the emergency.

EMERGENCY OF DISASTER NOTIFICATION PROCEDURE

774-2100

Central Carolina Hospital; 1135 Carthage Street; Sanford, North Carolina; ~~(919) 708-4600~~

27330 Press #3

Fire Department: 911

PROCEDURE FOR REPORTING ACCIDENTS

IMMEDIATELY CALL: (1) Ross Klingman (704) 344-1450 mobile: (704) 906-4994

After notification of the proper emergency service or services, proceed to deal with the emergency at hand.

KEY PERSONNEL

Project Manger	Ross Klingman	(704) 344-1450
Site Manager	Ross Klingman	(704) 344-1450
1st Alternate	Ross Klingman	(704) 344-1450
Safety & Health Coordinator	Ross Klingman	(704) 344-1450

MAP FROM SITE TO HOSPITAL

A copy of the map is attached.

mapquest

Trip to:

1135 Carthage St

Sanford, NC 27330-4162

5.27 miles / 10 minutes

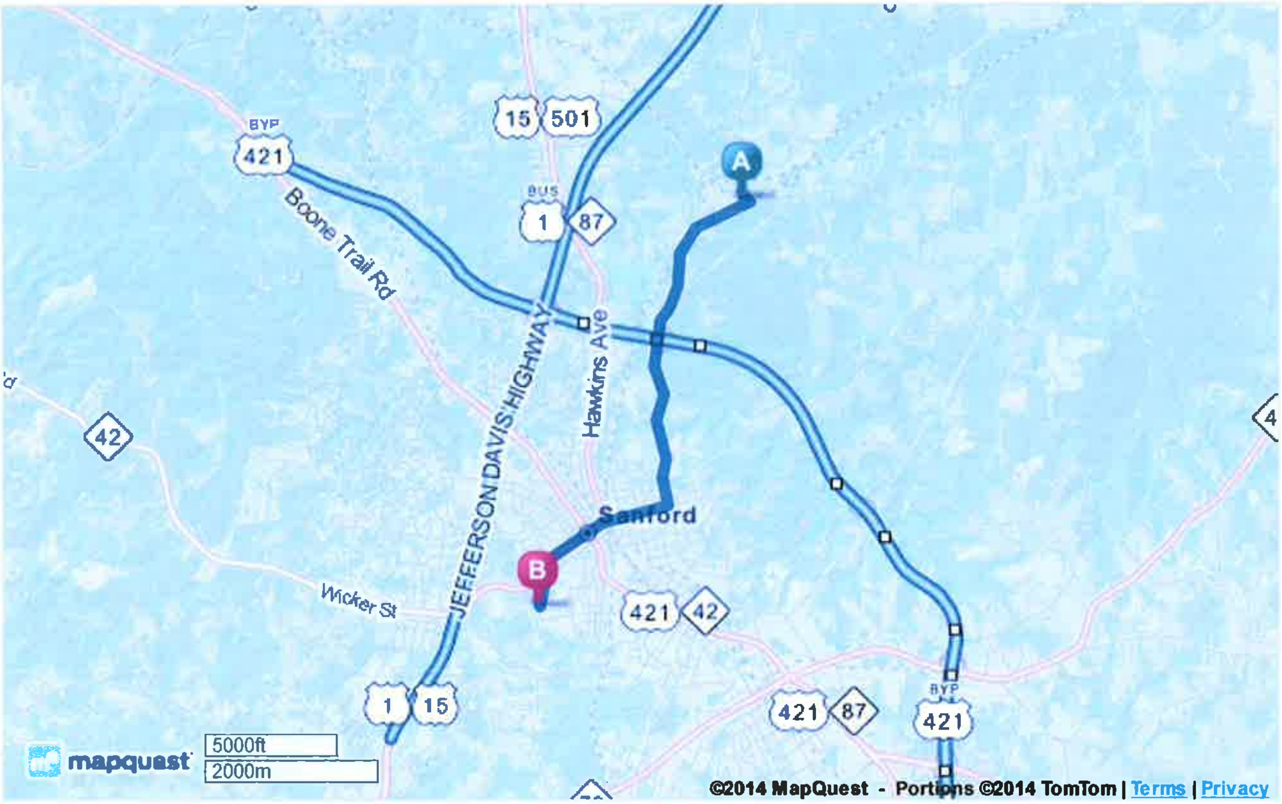
Notes

[440 - 526] Brickyard Rd, Sanford, NC 27330-8804

1. Start out going **east** on **Brickyard Rd** toward **T Tarpey Ln**. Map	**0.04 Mi**	*0.04 Mi Total*
2. Take the 1st **right** to stay on **Brickyard Rd**. Map *If you reach the end of T Tarpey Ln you've gone about 0.1 miles too far*	**0.03 Mi**	*0.07 Mi Total*
3. Turn **right** onto **Post Office Rd**. Map	**0.6 Mi**	*0.6 Mi Total*
4. Turn **slight left** onto **Colon Rd**. Map	**2.6 Mi**	*3.2 Mi Total*
5. **Colon Rd** becomes **N 7th St**. Map	**0.3 Mi**	*3.5 Mi Total*
6. Turn **right** onto **Charlotte Ave**. Map *Charlotte Ave is just past Midland Ave* *If you are on S 7th St and reach McIver St you've gone a little too far*	**0.7 Mi**	*4.2 Mi Total*
7. **Charlotte Ave** becomes **Carthage St**. Map	**1.1 Mi**	*5.3 Mi Total*
8. **1135 CARTHAGE ST** is on the **left**. Map *Your destination is just past Doctors Dr* *If you reach Fields Dr you've gone about 0.1 miles too far*		

1135 Carthage St, Sanford, NC 27330-4162

Total Travel Estimate: **5.27 miles - about 10 minutes**



APPENDIX F
ASTM Standard Protocol Information

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GENERAL NOTES

TERMINOLOGY

Unless otherwise noted, all terms utilized herein refer to the Standard Definitions presented in ASTM D 653.

PARTICLE SIZES

Boulders		-	Greater than 12 inches (305mm)
Cobbles		-	3 inches (76.2mm) to 12 inches (305mm)
Gravel -	Coarse	-	3/4 inches (19.05mm) to 3 inches (76.2mm)
	Fine	-	No. 4 - 3/16 inches (4.75mm) to 3/4 inches (19.05mm)
Sand	Coarse	-	No. 10 (2.00mm) to No. 4 (4.75mm)
	Medium	-	No. 40 (0.425mm) to No. 10 (2.00mm)
	Fine	-	No. 200 (0.074mm) to No. 40 (0.425mm)
Silt		-	0.005mm to 0.074mm
Clay		-	Less than 0.005mm

COHESIONLESS SOILS

Classification

The major soil constituent is the principal noun, i.e. sand, silt, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	Minor Constituents (percent by weight)
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35% (clayey, silty, etc.)	Little - 12 to 23%
And - Over 35%	Some - 23 to 33%

Density Classification	Relative Density %	Approximate Range of (N)
Very Loose	0-15	0-4
Loose	16-35	5-10
Medium Compact	36-65	11-30
Compact	66-85	31-50
Very Compact	86-100	Over 50

Relative Density of Cohesionless Soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier; i.e., silty clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohensionless soils; i.e., silty clay, trace of sand, little gravel.

Consistency	Unconfined Compressive Strength (psf)	Appromixate Range of (N)
Very Soft	Below 500	0-2
Soft	500-1000	3-4
Medium	1000-2000	5-8
Stiff	2000-4000	9-15
Very Stiff	4000-8000	16-30
Hard	8000-16000	31-50
Very Hard	Over 16C00	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

SAMPLE DESIGNATIONS

AS - Auger Sample - Directly from auger flight.
BS - Miscellaneous Samples - Bottle or Bag.
S - Split Spoon Sample with Liner Insert - ASTM D 1586
LS - Liner Sample S with liner insert 3 inches in length.
ST - Shelby Tube Sample - 3 inch diameter unless otherwise noted.
PS - Piston Sample - 3 inch diameter unless otherwise noted.
RC - Rock Core - NX core unless otherwise noted.

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0" outside-diameter, 1-3/8" inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

bottom of the borehole must be clean and the formation to be sampled must be fresh and undisturbed. It is, therefore, easy to see why: 1) the difficulties of a heaving formation must be overcome prior to sampling and 2) a good sampling program can only be conducted in a stabilized borehole.

A split-spoon sampler, as shown in Figure 40, is of standard dimensions and is driven by a 140-pound weight dropped through a 30-inch interval. The procedure for collecting split-spoon samples and the standard dimensions for samplers are described in ASTM D1586 (American Society for Testing and Materials, 1984). The number of blows required to drive the split-spoon sampler provides an indication of the compaction/density of the soils being sampled. Because only 18-inch intervals are sampled out of every 5 feet penetrated, drilling characteristics (i.e. rate of penetration, vibrations, stability, etc.) of the formation being penetrated are also used to infer characteristics of unsampled material. "Continuous" samples can also be taken with the split-spoon method by augering or drilling to the bottom of the previously-sampled interval and continuously repeating the operation. In order to obtain more accurate "N" values, a better approach is to attempt to collect two samples every five feet. This minimizes collection of samples in the disturbed zone in front of the bit. Continuous sampling is more time consuming, but is often the best way to obtain good stratigraphic data in unconsolidated sediments.

Table 20 shows the penetration characteristics of a variety of unconsolidated materials. The samples collected by split-spoon sampler are considered to be "disturbed" samples. They are, therefore, unsuitable for running certain laboratory tests, such as permeability.

TABLE 20. STANDARD PENETRATION TEST CORRELATION CHART (AFTER ACKER, 1974)

Soil Type	Designation	Blows/Foot*
Sand and Silt	Loose	0-10
	Medium	11-30
	Dense	31-50
	Very Dense	>50
Clay	Very Soft	<2
	Soft	3-5
	Medium	6-15
	Stiff	16-25
	Hard	>25

*Assumes: a) 2-inch outside diameter by 1⅜-inch inside diameter sampler
b) 140-pound hammer falling through 30 inches

Thin-Wall Samplers

Work performed by Hvorslev (1949) and others have shown that if relatively undisturbed samples are to be obtained, it is imperative that

Designation: D 1587 – 00

Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes[1]

This standard is issued under the fixed designation D 1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This practice covers a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of engineering properties, such as strength, compressibility, permeability, and density. Thin-walled tubes used in piston, plug, or rotary-type samplers should comply with Section 6.3 of this practice which describes the thin-walled tubes.

NOTE 1—This practice does not apply to liners used within the samplers.

1.2 This Practice is limited to soils that can be penetrated by the thin-walled tube. This sampling method is not recommended for sampling soils containing gravel or larger size soil particles cemented or very hard soils. Other soil samplers may be used for sampling these soil types. Such samplers include driven split barrel samplers and soil coring devices (D 1586, D 3550, and D 6151). For information on appropriate use of other soil samplers refer to D 6169.

1.3 This practice is often used in conjunction with fluid rotary drilling (D 1452D 5783) or hollow-stem augers (D 6151). Subsurface geotechnical explorations should be reported in accordance with practice (D 5434). This practice discusses some aspects of sample preservation after the sampling event. For information on preservation and transportation process of soil samples, consult Practice D 4220. This practice does not address environmental sampling; consult D 6169 and D 6232for information on sampling for environmental investigations.

1.4 The values stated in inch-pound units are to be regarded as the standard. The SI values given in parentheses are provided for information purposes only. The tubing tolerances presented in Table 2 are from sources available in North America. Use of metric equivalent is acceptable as long as thickness and proportions are similar to those required in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Standard Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]

D 1586 Penetration Resistance and Split Barrel Sampling of Soils[2]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 3550 Practice for Ring-Lined Barrel Sampling of Soils[2]

D 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction[2]

D 4220 Practices for Preserving and Transporting Soil Samples[2]

D 5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock[3]

D 5783 Guide for Use of Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices[3]

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved August 10, 2000. Published December 2000. Originally published as D 1587–58T. Last previous edition D 1587–83.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 04.09.

*A Summary of Changes section appears at the end of this standard.

TABLE 1 Suitable Thin-Walled Steel Sample Tubes[A]

Outside diameter (D_o):			
in.	2	3	5
mm	50.8	76.2	127
Wall thickness:			
Bwg	18	16	11
in.	0.049	0.065	0.120
mm	1.24	1.65	3.05
Tube length:			
in.	36	36	54
m	0.91	0.91	1.45
Inside clearance ratio, %	<1	<1	<1

[A] The three diameters recommended in Table 1 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

TABLE 2 Dimensional Tolerances for Thin-Walled Tubes

Nominal Tube Diameters from Table 1[A] Tolerances						
Size Outside Diameter	2 in.	50.8 mm	3 in.	76.2 mm	5 in.	127 mm
Outside diameter, D_o	+0.007 -0.000	+0.179 -0.000	+0.010 -0.000	+0.254 -0.000	+0.015 -0.000	0.381 -0.000
Inside diameter, D_i	+0.000 -0.007	+0.000 -0.179	+0.000 -0.010	+0.000 -0.254	+0.000 -0.015	+0.000 -0.381
Wall thickness	±0.007	±0.179	±0.010	±0.254	±0.015	±0.381
Ovality	0.015	0.381	0.020	0.508	0.030	0.762
Straightness	0.030/ft	2.50/m	0.030/ft	2.50/m	0.030/ft	2.50/m

[A] Intermediate or larger diameters should be proportional. Specify only two of the first three tolerances; that is, D_o and D_i, or D_o and Wall thickness, or D_i and Wall thickness.

D 6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling[3]

D 6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations[3]

D 6232 Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities[4]

3. Terminology

3.1 *Definitions:*

3.1.1 For common definitions of terms in this standard, refer to Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *inside clearance ratio, %*—the ratio of the difference in the inside diameter of the tube, D_i, minus the inside diameter of the cutting edge, D_e, to the inside diameter of the tube, D_i expressed as a percentage (see Fig. 1).

3.2.2 *ovality*—the cross section of the tube that deviates from a perfect circle.

4. Summary of Practice

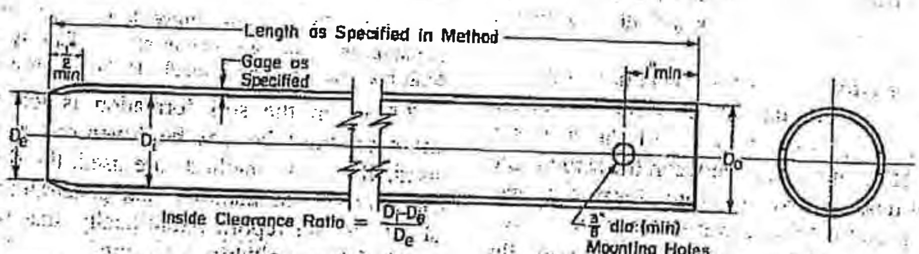
4.1 A relatively undisturbed sample is obtained by pressing a thin-walled metal tube into the in-situ soil at the bottom of a boring, removing the soil-filled tube, and applying seals to the soil surfaces to prevent soil movement and moisture gain or loss.

5. Significance and Use

5.1 This practice, or Practice D 3550 with thin wall shoe, is used when it is necessary to obtain a relatively undisturbed specimen suitable for laboratory tests of engineering properties or other tests that might be influenced by soil disturbance.

NOTE 2—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the

[4] *Annual Book of ASTM Standards*, Vol 11.04.



NOTE 1—Minimum of two mounting holes on opposite sides for D_o smaller than 4 in. (101.6 mm).
NOTE 2—Minimum of four mounting holes equally spaced for D_o 4 in. (101.6 mm) and larger.
NOTE 3—Tube held with hardened screws or other suitable means.
NOTE 4—2-in. (50.8 mm) outside-diameter tubes are specified with an 18-gage wall thickness to comply with area ratio criteria accepted for "undisturbed samples." Users are advised that such tubing is difficult to locate and can be extremely expensive in small quantities. Sixteen-gage tubes are generally readily available.

Metric Equivalent Conversions

in.	mm
3/8	9.53
1/2	12.7
1	25.4
2	50.8
3	76.2
4	101.6
5	127

FIG. 1 Thin-Walled Tube for Sampling

suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective sampling. Users of this practice are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D 5740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Drilling Equipment*—When sampling in a boring, any drilling equipment may be used that provides a reasonably clean hole; that minimizes disturbance of the soil to be sampled; and that does not hinder the penetration of the thin-walled sampler. Open borehole diameter and the inside diameter of driven casing or hollow stem auger shall not exceed 3.5 times the outside diameter of the thin-walled tube.

6.2 *Sampler Insertion Equipment*, shall be adequate to provide a relatively rapid continuous penetration force. For hard formations it may be necessary, although not recommended, to drive the thin-walled tube sampler.

6.3 *Thin-Walled Tubes*, should be manufactured to the dimensions as shown in Fig. 1. They should have an outside diameter of 2 to 5 in. (50 to 130 mm) and be made of metal having adequate strength for the type of soil to be sampled. Tubes shall be clean and free of all surface irregularities including projecting weld seams. Other diameters may be used but the tube dimensions should be proportional to the tube designs presented here.

6.3.1 *Length of Tubes*—See Table 1 and 7.4.1.

6.3.2 *Tolerances*, shall be within the limits shown in Table 2.

6.3.3 *Inside Clearance Ratio*, should be not greater than 1 % unless specified otherwise for the type of soil to be sampled. Generally, the inside clearance ratio used should increase with the increase in plasticity of the soil being sampled, except for sensitive soils or where local experience indicates otherwise. See 3.2.1 and Fig. 1 for definition of inside clearance ratio.

6.3.4 *Corrosion Protection*—Corrosion, whether from galvanic or chemical reaction, can damage or destroy both the thin-walled tube and the sample. Severity of damage is a function of time as well as interaction between the sample and the tube. Thin-walled tubes should have some form of protective coating, unless the soil is to be extruded less than 3 days. The type of coating to be used may vary depending upon the material to be sampled. Plating of the tubes or alternate base metals may be specified. Galvanized tubes are often used when long term storage is required. Coatings may include a light coat of lubricating oil, lacquer, epoxy, Teflon, zinc oxide, and others.

NOTE 3—Most coating materials are not resistant to scratching by soils that contain sands. Consideration should be given for prompt testing of the sample because chemical reactions between the metal and the soil sample can occur with time.

6.4 *Sampler Head*, serves to couple the thin-walled tube to the insertion equipment and, together with the thin-walled tube, comprises the thin-walled tube sampler. The sampler head shall contain a venting area and suitable check valve with the venting area to the outside equal to or greater than the area through the check valve. In some special cases, a check valve may not be required but venting is required to avoid sample compression. Attachment of the head to the tube shall be concentric and coaxial to assure uniform application of force to the tube by the sampler insertion equipment.

7. Procedure

7.1 Remove loose material from the center of a casing or hollow stem auger as carefully as possible to avoid disturbance of the material to be sampled. If groundwater is encountered, maintain the liquid level in the borehole at or above ground water level during the drilling and sampling operation.

7.2 Bottom discharge bits are not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted.

NOTE 4—Roller bits are available in downward-jetting and diffused-jet configurations. Downward-jetting configuration rock bits are not acceptable. Diffuse-jet configurations are generally acceptable.

7.3 Lower the sampling apparatus so that the sample tube's bottom rests on the bottom of the hole and record depth to the bottom of the sample tube to the nearest 0.1-ft (.03 m).

7.3.1 Keep the sampling apparatus plumb during lowering, thereby preventing the cutting edge of the tube from scraping the wall of the borehole.

7.4 Advance the sampler without rotation by a continuous relatively rapid downward motion and record length of advancement to the nearest 1 in. (25 mm).

7.4.1 Determine the length of advance by the resistance and condition of the soil formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays. In no case shall a length of advance be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3-in. (75 mm) for sludge and end cuttings.

NOTE 5—The mass of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those shown in Table 1.

7.5 When the soil formation is too hard for push-type insertion, the tube may be driven or Practice D 3550 may be used. If driving methods are used, the data regarding weight and fall of the hammer and penetration achieved must be shown in the report. Additionally, that tube must be prominently labeled a "driven sample."

7.6 Withdraw the sampler from the soil formation as carefully as possible in order to minimize disturbance of the sample. The tube can be slowly rotated to shear the material at the end of the tube, and to relieve water and/or suction pressures and improve recovery. Where the soil formation is soft, a delay before withdraw of the sampler (typically 5 to 30 minutes) may improve sample recovery.

8. Sample Measurement, Sealing and Labeling

8.1 Upon removal of the tube, remove the drill cuttings in the upper end of the tube and measure the length of the soil sample recovered to the nearest 0.25 in. (5 mm) in the tube. Seal the upper end of the tube. Remove at least 1 in. (25 mm) of material from the lower end of the tube. Use this material for soil description in accordance with Practice D 2488. Measure the overall sample length. Seal the lower end of the tube. Alternatively, after measurement, the tube may be sealed without removal of soil from the ends of the tube.

8.1.1 Tubes sealed over the ends, as opposed to those sealed with expanding packers, should be provided with spacers or appropriate packing materials, or both prior to sealing the tube ends to provide proper confinement. Packing materials must be nonabsorbent and must maintain their properties to provide the same degree of sample support with time.

8.1.2 Depending on the requirements of the investigation, field extrusion and packaging of extruded soil samples can be performed. This allows for physical examination and classification of the sample. Samples are extruded in special hydraulic jacks equipped with properly sized platens to extrude the core in a continuous smooth speed. In some cases, further extrusion may cause sample disturbance reducing suitability for testing of engineering properties. In other cases, if damage is not significant, cores can be extruded and preserved for testing (D 4220). Bent or damaged tubes should be cut off before extruding.

8.2 Prepare and immediately affix labels or apply markings as necessary to identify the sample (see Section 9). Assure that the markings or labels are adequate to survive transportation and storage.

NOTE 6—Top end of the tube should be labeled "top".

9. Field Log

9.1 Record the information that may be required for preparing field logs in general accordance to ASTM D 5434 "Guide for Field Logging of Subsurface Explorations of Soil and Rock". This guide is used for logging explorations by drilling and sampling. Some examples of the information required include;

9.1.1 Name and location of the project,

9.1.2 Boring number,

9.1.3 Log of the soil conditions,

9.1.4 Surface elevation or reference to a datum to the nearest foot (0.5 m) or better,

9.1.5 Location of the boring,

9.1.6 Method of making the borehole,

9.1.7 Name of the drilling foreman and company, and

9.1.8 Name of the drilling inspector(s).

9.1.9 Date and time of boring-start and finish,

9.1.10 Depth to groundwater level: date and time measured,

9.2 Recording the appropriate sampling information is required as follows:

9.2.1 Depth to top of sample to the nearest 0.1 ft. (.03 m) and number of sample,

9.2.2 Description of thin-walled tube sampler: size, type of metal, type of coating,

9.2.3 Method of sampler insertion: push or drive,

9.2.4 Method of drilling, size of hole, casing, and drilling fluid used,

9.2.5 Soil description in accordance with Practice D 2488,

9.2.6 Length of sampler advance (push), and

9.2.7 Recovery: length of sample obtained.

10. Keywords

10.1 geologic investigations; sampling; soil exploration; soil investigations; subsurface investigations; undisturbed

SUMMARY OF CHANGES

In accordance with committee D18 policy, this section identifies the location of changes to this standard since the last edition, 1994, which may impact the use of this standard.

(1) Editorial corrections to various sections based on comments received from Committee Balloting

(2) Added D 6232 to Section 2.

(3) Changed Note 7 to Section 8.1.2.

(4) Renumbered Note 8.

Designation: D 2487 – 00

Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)[1]

This standard is issued under the fixed designation D 2487; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This practice describes a system for classifying mineral and organo-mineral soils for engineering purposes based on laboratory determination of particle-size characteristics, liquid limit, and plasticity index and shall be used when precise classification is required.

NOTE 1—Use of this standard will result in a single classification group symbol and group name except when a soil contains 5 to 12 % fines or when the plot of the liquid limit and plasticity index values falls into the crosshatched area of the plasticity chart. In these two cases, a dual symbol is used, for example, GP-GM, CL-ML. When the laboratory test results indicate that the soil is close to another soil classification group, the borderline condition can be indicated with two symbols separated by a slash. The first symbol should be the one based on this standard, for example, CL/CH, GM/SM, SC/CL. Borderline symbols are particularly useful when the liquid limit value of clayey soils is close to 50. These soils can have expansive characteristics and the use of a borderline symbol (CL/CH, CH/CL) will alert the user of the assigned classifications of expansive potential.

1.2 The group symbol portion of this system is based on laboratory tests performed on the portion of a soil sample passing the 3-in. (75-mm) sieve (see Specification E 11).

1.3 As a classification system, this standard is limited to naturally occurring soils.

NOTE 2—The group names and symbols used in this test method may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. See Appendix X2.

1.4 This standard is for qualitative application only.

NOTE 3—When quantitative information is required for detailed designs of important structures, this test method must be supplemented by laboratory tests or other quantitative data to determine performance characteristics under expected field conditions.

1.5 This standard is the ASTM version of the Unified Soil Classification System. The basis for the classification scheme is the Airfield Classification System developed by A. Casagrande in the early 1940's.[2] It became known as the Unified Soil Classification System when several U.S. Government Agencies adopted a modified version of the Airfield System in 1952.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 117 Test Method for Materials Finer Than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing[3]

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates[3]

C 702 Practice for Reducing Field Samples of Aggregate to Testing Size[3]

D 420 Guide to Site Characterization for Engineering, Design and Construction Purposes

D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[4]

D 422 Test Method for Particle-Size Analysis of Soils[4]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[4]

[1] This standard is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved March 10, 2000. Published May 2000. Originally published as D 2487 – 66 T. Last previous edition D 2487 – 98.

[2] Casagrande, A., "Classification and Identification of Soils," *Transactions*, ASCE, 1948, p. 901.

[3] *Annual Book of ASTM Standards*, Vol 04.02.

[4] *Annual Book of ASTM Standards*, Vol 04.08.

*A Summary of Changes section appears at the end of this standard.

- D 1140 Test Method for Amount of Material in Soils Finer than the No. 200 (75-μm) Sieve[4]
- D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock[4]
- D 2217 Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[4]
- D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[4]
- D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction[5]
- D 4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)[4]
- D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils[4]
- D 4427 Classification of Peat Samples by Laboratory Testing[4]
- E 11 Specification for Wire-Cloth Sieves for Testing Purposes[6]

3. Terminology

3.1 *Definitions*—Except as listed below, all definitions are in accordance with Terminology D 653.

NOTE 4—For particles retained on a 3-in. (75-mm) U.S. standard sieve, the following definitions are suggested:

Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) U.S. standard sieve, and

Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.1 *clay*—soil passing a No. 200 (75-μm) U.S. standard sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents and that exhibits considerable strength when air dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line.

3.1.2 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) U.S. standard sieve with the following subdivisions:

Coarse—passes 3-in. (75-mm) sieve and retained on ¾-in. (19-mm) sieve, and

Fine—passes ¾-in. (19-mm) sieve and retained on No. 4 (4.75-mm) sieve.

3.1.3 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.4 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.5 *peat*—a soil composed of vegetable tissue in various stages of decomposition usually with an organic odor, a dark-brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.6 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75-μm) U.S. standard sieve with the following subdivisions:

Coarse—passes No. 4 (4.75-mm) sieve and retained on No. 10 (2.00-mm) sieve,

Medium—passes No. 10 (2.00-mm) sieve and retained on No. 40 (425-μm) sieve, and

Fine—passes No. 40 (425-μm) sieve and retained on No. 200 (75-μm) sieve.

3.1.7 *silt*—soil passing a No. 200 (75-μm) U.S. standard sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4 or if the plot of plasticity index versus liquid limit falls below the "A" line.

3.2 *Definitions of Terms Specific to This Standard.*

3.2.1 *coefficient of curvature, Cc*—the ratio $(D_{30})^2/(D_{10} \times D_{60})$, where D_{60}, D_{30}, and D_{10} are the particle sizes corresponding to 60, 30, and 10 % finer on the cumulative particle-size distribution curve, respectively.

3.2.2 *coefficient of uniformity, Cu*—the ratio D_{60}/D_{10}, where D_{60} and D_{10} are the particle diameters corresponding to 60 and 10 % finer on the cumulative particle-size distribution curve, respectively.

4. Summary

4.1 As illustrated in Table 1, this classification system identifies three major soil divisions: coarse-grained soils, fine-grained soils, and highly organic soils. These three divisions are further subdivided into a total of 15 basic soil groups

[4] *Annual Book of ASTM Standards*, Vol 04.09.
[6] *Annual Book of ASTM Standards*, Vol 14.02.

TABLE 1 Soil Classification Chart

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
COARSE-GRAINED SOILS	Gravels	Clean Gravels	Cu ≥ 4 and 1 ≤ Cc ≤ 3[C]	GW	Well-graded gravel[D]
More than 50 % retained on No. 200 sieve	More than 50 % of coarse fraction retained on No. 4 sieve	Less than 5 % fines[E]	Cu < 4 and/or 1 > Cc > 3[C]	GP	Poorly graded gravel[D]
		Gravels with Fines	Fines classify as ML or MH	GM	Silty gravel[D,F,G]

TABLE 1 *Continued*

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
		More than 12 % fines[E]	Fines classify as CL or CH	,urule,1>GC	Clayey gravel[D,F,G]
	Sands	Clean Sands	Cu ≥ 6 and 1 ≤ Cc ≤ 3[C]	SW	Well-graded sand[H]
	50 % or more of coarse	Less than 5 % fines[I]	Cu < 6 and/or 1 > Cc > 3[C]	SP	Poorly graded sand[H]
	fraction passes No. 4 sieve	Sands with Fines	Fines classify as ML or MH	SM	Silty sand[F,G,H]
		More than 12 % fines[I]	Fines classify as CL or CH	SC	Clayey sand[F,G,H]
FINE-GRAINED SOILS	Silts and Clays	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
50 % or more passes the No.	Liquid limit less than 50		PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
200 seive		organic	Liquid limit – oven dried> < 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit – not dried	OL	Organic silt[K,L,M,O]
	Silts and Clays	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
	Liquid limit 50 or more		PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	Liquid limit – oven dried < 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit – not dried		Organic silt[K,L,M,Q]
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2 / D_{10} \times D_{60}$
[D] If soil contains ≥15 % sand, add "with sand" to group name.
[E] Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
[F] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[G] If fines are organic, add "with organic fines" to group name.
[H] If soil contains ≥15 % gravel, add "with gravel" to group name.
[I] Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥30 % plus No. 200, predominantly sand, add "sandy" to group name.
[M] If soil contains ≥30 % plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

4.2 Based on the results of visual observations and prescribed laboratory tests, a soil is catalogued according to the basic soil groups, assigned a group symbol(s) and name, and thereby classified. The flow charts, Fig. 1 for fine-grained soils, and Fig. 3 for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name.

5. Significance and Use

5.1 This standard classifies soils from any geographic location into categories representing the results of prescribed laboratory tests to determine the particle-size characteristics, the liquid limit, and the plasticity index.

5.2 The assigning of a group name and symbol(s) along with the descriptive information required in Practice D 2488 can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.3 The various groupings of this classification system have been devised to correlate in a general way with the engineering behavior of soils. This standard provides a useful first step in any field or laboratory investigation for geotechnical engineering purposes.

5.4 This standard may also be used as an aid in training personnel in the use of Practice D 2488.

5.5 This standard may be used in combination with Practice D 4083 when working with frozen soils.

NOTE 5—Notwithstanding the statements on precision and bias contained in this standard: The precision of this test method is dependent on the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective testing. Users of this test method are cautioned that compliance with Practice D 3740 does not in itself assure reliable testing. Reliable testing depends on several factors; Practice D 3740 provides a means for evaluating some of those factors.

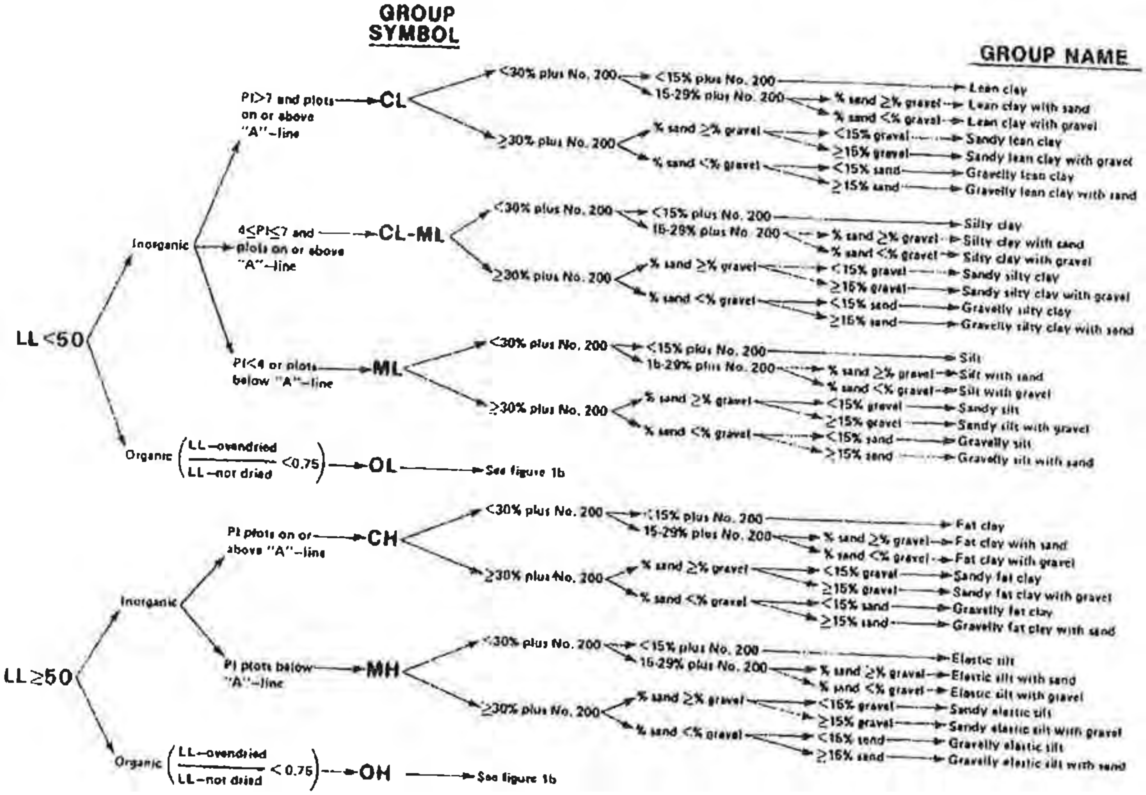


FIG. 1 Flow Chart for Classifying Fine-Grained Soil (50 % or More Passes No. 200 Sieve)

6. Apparatus

6.1 In addition to the apparatus that may be required for obtaining and preparing the samples and conducting the prescribed laboratory tests, a plasticity chart, similar to Fig. 4, and a cumulative particle-size distribution curve, similar to Fig. 5, are required.

NOTE 6—The "U" line shown on Fig. 4 has been empirically determined to be the approximate "upper limit" for natural soils. It is a good check against erroneous data, and any test results that plot above or to the left of it should be verified.

7. Sampling

7.1 Samples shall be obtained and identified in accordance with a method or methods, recommended in Guide D 420 or by other accepted procedures.

7.2 For accurate identification, the minimum amount of test sample required for this test method will depend on which of the laboratory tests need to be performed. Where only the particle-size analysis of the sample is required, specimens having the following minimum dry weights are required:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (⅜ in.)	200 g (0.5 lb)
19.0 mm (¾ in.)	1.0 kg (2.2 lb)
38.1 mm (1½ in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

Whenever possible, the field samples should have weights two to four times larger than shown.

7.3 When the liquid and plastic limit tests must also be performed, additional material will be required sufficient to provide 150 g to 200 g of soil finer than the No. 40 (425-μm) sieve.

7.4 If the field sample or test specimen is smaller than the minimum recommended amount, the report shall include an appropriate remark.

8. Classification of Peat

8.1 A sample composed primarily of vegetable tissue in various stages of decomposition and has a fibrous to amorphous texture, a dark-brown to black color, and an organic odor should be designated as a highly organic soil and shall be classified as peat, PT, and not subjected to the classification procedures described hereafter.

8.2 If desired, classification of type of peat can be performed in accordance with Classification D 4427.

9. Preparation for Classification

9.1 Before a soil can be classified according to this standard, generally the particle-size distribution of the minus 3-in. (75-mm) material and the plasticity characteristics of the minus No. 40 (425-μm) sieve material must be determined. See 9.8 for the specific required tests.

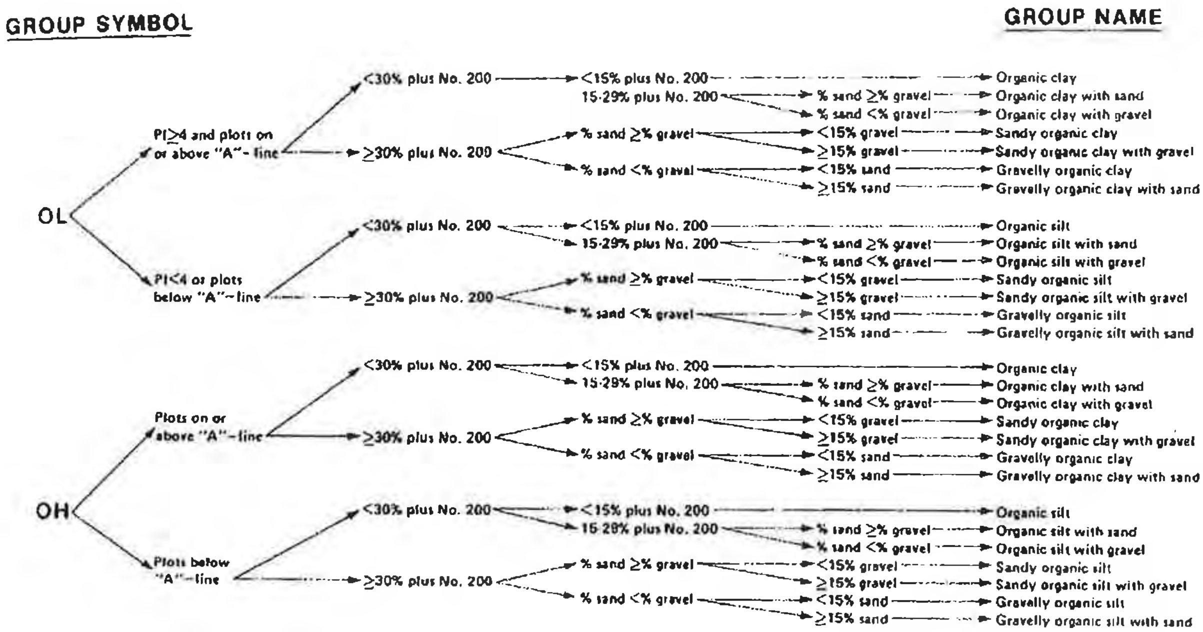


FIG. 2 Flow Chart for Classifying Organic Fine-Grained Soil (50 % or More Passes No. 200 Sieve)

9.2 The preparation of the soil specimen(s) and the testing for particle-size distribution and liquid limit and plasticity index shall be in accordance with accepted standard procedures. Two procedures for preparation of the soil specimens for testing for soil classification purposes are given in Appendixes X3 and X4. Appendix X3 describes the wet preparation method and is the preferred method for cohesive soils that have never dried out and for organic soils.

9.3 When reporting soil classifications determined by this standard, the preparation and test procedures used shall be reported or referenced.

9.4 Although the test procedure used in determining the particle-size distribution or other considerations may require a hydrometer analysis of the material, a hydrometer analysis is not necessary for soil classification.

9.5 The percentage (by dry weight) of any plus 3-in. (75-mm) material must be determined and reported as auxiliary information.

9.6 The maximum particle size shall be determined (measured or estimated) and reported as auxiliary information.

9.7 When the cumulative particle-size distribution is required, a set of sieves shall be used which include the following sizes (with the largest size commensurate with the maximum particle size) with other sieve sizes as needed or required to define the particle-size distribution:

3-in. (75-mm)
¾-in. (19.0-mm)
No. 4 (4.75-mm)
No. 10 (2.00-mm)
No. 40 (425-μm)
No. 200 (75-μm)

9.8 The tests required to be performed in preparation for classification are as follows:

9.8.1 For soils estimated to contain less than 5 % fines, a plot of the cumulative particle-size distribution curve of the fraction coarser than the No. 200 (75-μm) sieve is required. A semi-log plot of percent passing versus partical-size or sieve size/sieve number is plotted as shown in Fig. 5.

9.8.2 For soils estimated to contain 5 to 15 % fines, a cumulative particle-size distribution curve, as described in 9.8.1, is required, and the liquid limit and plasticity index are required.

9.8.2.1 If sufficient material is not available to determine the liquid limit and plasticity index, the fines should be estimated to be either silty or clayey using the procedures described in Practice D 2488 and so noted in the report.

9.8.3 For soils estimated to contain 15 % or more fines, a determination of the percent fines, percent sand, and percent gravel is required, and the liquid limit and plasticity index are required. For soils estimated to contain 90 % fines or more, the percent fines, percent sand, and percent gravel may be estimated using the procedures described in Practice D 2488 and so noted in the report.

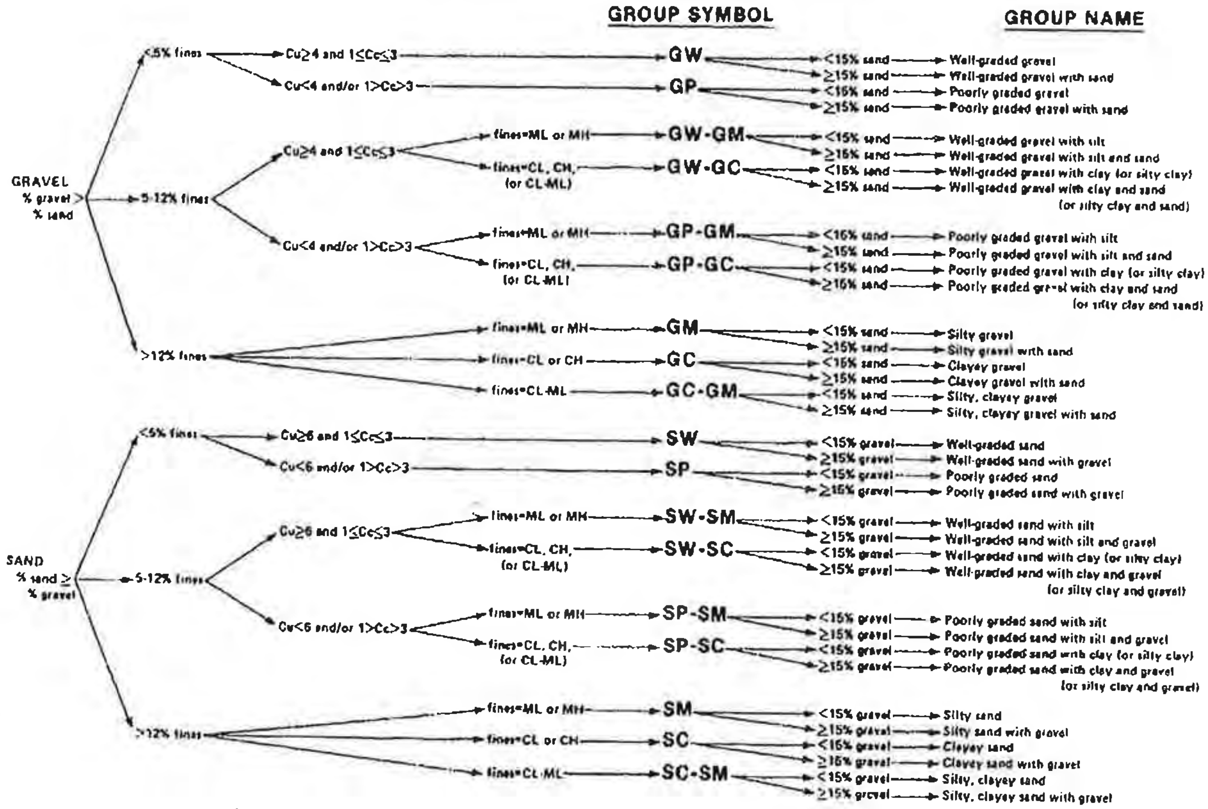


FIG. 3 Flow Chart for Classifying Coarse-Grained Soils (More Than 50 % Retained on No. 200 Sieve)

10. Preliminary Classification Procedure

10.1 Class the soil as fine-grained if 50 % or more by dry weight of the test specimen passes the No. 200 (75-μm) sieve and follow Section 3.1.2.

10.2 Class the soil as coarse-grained if more than 50 % by dry weight of the test specimen is retained on the No. 200 (75-μm) sieve and follow Section 12.

11. Procedure for Classification of Fine-Grained Soils (50 % or more by dry weight passing the No. 200 (75-μm) sieve)

11.1 The soil is an inorganic clay if the position of the plasticity index versus liquid limit plot, Fig. 4, falls on or above the "A" line, the plasticity index is greater than 4, and the presence of organic matter does not influence the liquid limit as determined in 11.3.2.

NOTE 7 The plasticity index and liquid limit are determined on the minus No. 40 (425 μm) sieve material.

11.1.1 Classify the soil as a *lean clay,* CL, if the liquid limit is less than 50. See area identified as CL on Fig. 4.

11.1.2 Classify the soil as a *fat clay,* CH, if the liquid limit is 50 or greater. See area identified as CH on Fig. 4.

NOTE 8 In cases where the liquid limit exceeds 110 or the plasticity index exceeds 60, the plasticity chart may be expanded by maintaining the same scale on both axes and extending the "A" line at the indicated slope.

11.1.3 Classify the soil as a *silty clay,* CL-ML, if the position of the plasticity index versus liquid limit plot falls on or above the "A" line and the plasticity index is in the range of 4 to 7. See area identified as CL-ML on Fig. 4.

11.2 The soil is an inorganic silt if the position of the plasticity index versus liquid limit plot, Fig. 4, falls below the "A" line or the plasticity index is less than 4, and presence of organic matter does not influence the liquid limit as determined in 11.3.2.

11.2.1 Classify the soil as a *silt,* ML, if the liquid limit is less than 50. See area identified as ML on Fig. 4.

11.2.2 Classify the soil as an *elastic silt,* MH, if the liquid limit is 50 or greater. See area identified as MH on Fig. 4.

11.3 The soil is an organic silt or clay if organic matter is present in sufficient amounts to influence the liquid limit as determined in 11.3.2.

11.3.1 If the soil has a dark color and an organic odor when moist and warm, a second liquid limit test shall be performed on a test specimen which has been oven dried at 110 ± 5°C to a constant weight, typically over night.

11.3.2 The soil is an organic silt or organic clay if the liquid limit after oven drying is less than 75 % of the liquid limit of the original specimen determined before oven drying (see Procedure B of Practice D 2217).

11.3.3 Classify the soil as an *organic silt* or *organic clay,* OL, if the liquid limit (not oven dried) is less than 50 %

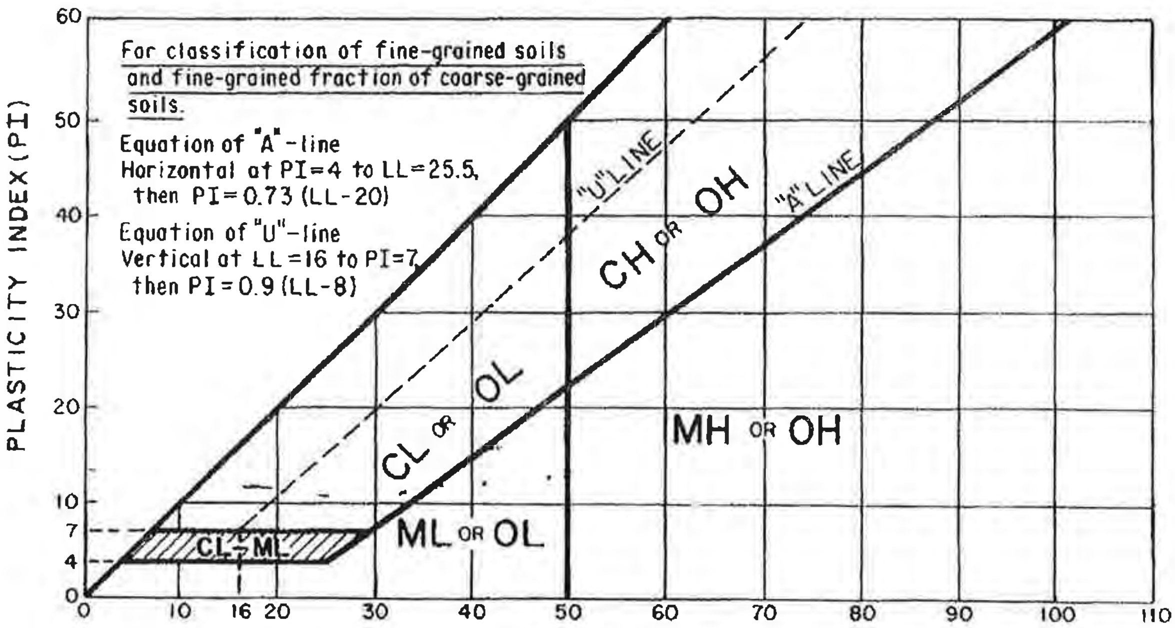
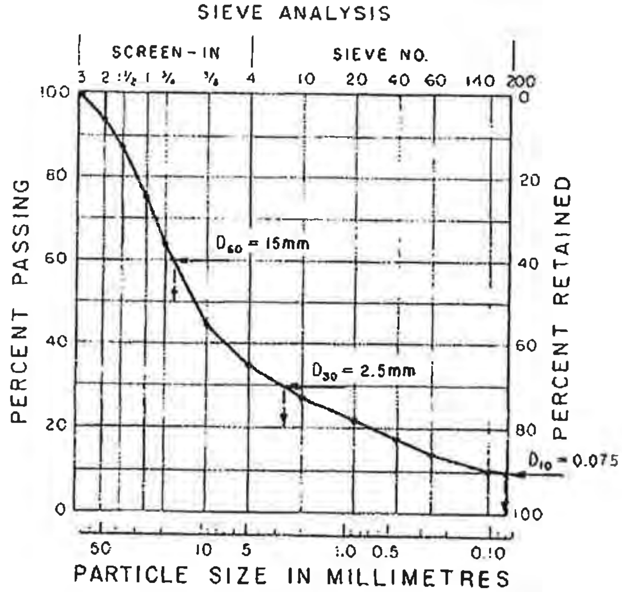


FIG. 4 Plasticity Chart



$$Cu = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200 \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{(2.5)^2}{0.075 \times 15} = 5.6$$

FIG. 5 Cumulative Particle-Size Plot

Classify the soil as an *organic silt*, OL, if the plasticity index is less than 4, or the position of the plasticity index versus liquid limit plot falls below the "A" line. Classify the soil as an *organic clay*, OL, if the plasticity index is 4 or greater and the position of the plasticity index versus liquid limit plot falls on or above the "A" line. See area identified as OL (or CL-ML) on Fig. 4.

11.3.4 Classify the soil as an *organic clay* or *organic silt*, OH, if the liquid limit (not oven dried) is 50 or greater. Classify the soil as an *organic silt*, OH, if the position of the plasticity index versus liquid limit plot falls below the "A" line. Classify the soil as an *organic clay*, OH, if the position of the plasticity index versus liquid-limit plot falls on or above the "A" line. See area identified as OH on Fig. 4.

11.4 If less than 30 % but 15 % or more of the test specimen is retained on the No. 200 (75-µm) sieve, the words "with sand" or "with gravel" (whichever is predominant) shall be added to the group name. For example, lean clay with sand, CL; silt with gravel, ML. If the percent of sand is equal to the percent of gravel, use "with sand."

11.5 If 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve and the coarse-grained portion is predominantly sand. Add the word "gravelly" if 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve and the coarse-grained portion is predominantly gravel. For example, sandy lean clay, CL; gravelly fat clay, CH; sandy silt, ML. If the percent of sand is equal to the percent of gravel, use "sandy."

12. Procedure for Classification of Coarse-Grained Soils (more than 50 % retained on the No. 200 (75-µm) sieve)

12.1 Class the soil as gravel if more than 50 % of the coarse fraction [plus No. 200 (75-µm) sieve] is retained on the No. 4 (4.75-mm) sieve.

12.2 Class the soil as sand if 50 % or more of the coarse fraction [plus No. 200 (75-µm) sieve] passes the No. 4 (4.75-mm) sieve.

12.3 If 12 % or less of the test specimen passes the No. 200 (75-µm) sieve, plot the cumulative particle-size distribution, Fig. 5, and compute the coefficient of uniformity, *Cu*, and coefficient of curvature, *Cc*, as given in Eqs 1 and 2.

$$Cu = D_{60}/D_{10} \quad (1)$$

$$Cc = (D_{30})^2/(D_{10} \times D_{60}) \quad (2)$$

where:

D_{10}, D_{30}, and D_{60} = the particle-size diameters corresponding to 10, 30, and 60 %, respectively, passing on the cumulative particle-size distribution curve, Fig. 5.

NOTE 9—It may be necessary to extrapolate the curve to obtain the D_{10} diameter.

12.3.1 If less than 5 % of the test specimen passes the No. 200 (75-µm) sieve, classify the soil as a *well-graded gravel*, GW, or *well-graded sand*, SW, if Cu is greater than or equal to 4.0 for gravel or greater than 6.0 for sand, and Cc is at least 1.0 but not more than 3.0.

12.3.2 If less than 5 % of the test specimen passes the No. 200 (75-µm) sieve, classify the soil as *poorly graded gravel*, GP, or *poorly graded sand*, SP, if either the *Cu* or the *Cc* criteria for well-graded soils are not satisfied.

12.4 If more than 12 % of the test specimen passes the No. 200 (75-µm) sieve, the soil shall be considered a coarse-grained soil with fines. The fines are determined to be either clayey or silty based on the plasticity index versus liquid limit plot on Fig. 4. (See 9.8.2.1 if insufficient material available for testing) (see Note 7).

12.4.1 Classify the soil as a *clayey gravel*, GC, or *clayey sand*, SC, if the fines are clayey, that is, the position of the plasticity index versus liquid limit plot, Fig. 4, falls on or above the "A" line and the plasticity index is greater than 7.

12.4.2 Classify the soil as a *silty gravel*, GM, or *silty sand*, SM, if the fines are silty, that is, the position of the plasticity index versus liquid limit plot, Fig. 4, falls below the "A" line or the plasticity index is less than 4.

12.4.3 If the fines plot as a silty clay, CL-ML, classify the soil as a *silty, clayey gravel*, GC-GM, if it is a gravel or a *silty, clayey sand*, SC-SM, if it is a sand.

12.5 If 5 to 12 % of the test specimen passes the No. 200 (75-µm) sieve, give the soil a dual classification using two group symbols.

12.5.1 The first group symbol shall correspond to that for a gravel or sand having less than 5 % fines (GW, GP, SW, SP), and the second symbol shall correspond to a gravel or sand having more than 12 % fines (GC, GM, SC, SM).

12.5.2 The group name shall correspond to the first group symbol plus "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example, well-graded gravel with clay, GW-GC; poorly graded sand with silt, SP-SM (See 9.8.2.1 if insufficient material available for testing).

NOTE 10—If the fines plot as a *silty clay*, CL-ML, the second group symbol should be either GC or SC. For example, a poorly graded sand with 10 % fines, a liquid limit of 20, and a plasticity index of 6 would be classified as a poorly graded sand with silty clay, SP-SC.

12.6 If the specimen is predominantly sand or gravel but contains 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example, poorly graded gravel with sand, clayey sand with gravel.

12.7 If the field sample contained any cobbles or boulders or both, the words "with cobbles," or "with cobbles and boulders" shall be added to the group name. For example, silty gravel with cobbles, GM.

13. Report

13.1 The report should include the group name, group symbol, and the results of the laboratory tests. The particle-size distribution shall be given in terms of percent of gravel, sand, and fines. The plot of the cumulative particle-size distribution curve shall be reported if used in classifying the soil. Report appropriate descriptive information according to the procedures in Practice D 2488. A local or commercial name or geologic interpretation for the material may be added at the end of the descriptive information if identified as such. The test procedures used shall be referenced.

NOTE 11—*Example: Clayey Gravel with Sand and Cobbles* (GC)—46 % fine to coarse, hard, subrounded gravel; 30 % fine to coarse, hard, subrounded sand; 24 % clayey fines, LL = 38, PI = 19; weak reaction with HCl; original field sample had 4 % hard, subrounded cobbles; maximum dimension 150 mm.

In-Place Conditions—firm, homogeneous, dry, brown,
Geologic Interpretation—alluvial fan.

NOTE 12—Other examples of soil descriptions are given in Appendix X1.

14. Precision and Bias

14.1 Criteria for acceptability depends on the precision and bias of Test Methods D 422, D 1140 and D 4318.

15. Keywords

15.1 Atterberg limits; classification; clay; gradation; gravel; laboratory classification; organic soils; sand; silt; soil classification; soil tests

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF DESCRIPTIONS USING SOIL CLASSIFICATION

X1.1 The following examples show how the information required in 13.1 can be reported. The appropriate descriptive information from Practice D 2488 is included for illustrative purposes. The additional descriptive terms that would accompany the soil classification should be based on the intended use of the classification and the individual circumstances.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—73 % fine to coarse, hard, subangular gravel; 23 % fine to coarse, hard, subangular sand; 4 % fines; Cc = 2.7, Cu = 12.4.

X1.1.2 *Silty Sand with Gravel (SM)*—61 % predominantly fine sand; 23 % silty fines, LL = 33, PI = 6; 16 % fine, hard, subrounded gravel; no reaction with HCl; (field sample smaller than recommended). *In-Place Conditions*—Firm, stratified and contains lenses of silt 1 to 2 in. thick, moist, brown to gray; in-place density = 106 lb/ft^3 and in-place moisture = 9 %.

X1.1.3 *Organic Clay (OL)*—100 % fines, LL (not dried) = 32, LL (oven dried) = 21, PI (not dried) = 10; wet, dark brown, organic odor, weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—74 % fine to coarse, hard, subangular reddish sand; 26 % organic and silty dark-brown fines, LL (not dried) = 37, LL (oven dried) = 26, PI (not dried) = 6, wet, weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—78 % fine to coarse, hard, subrounded to subangular gravel; 16 % fine to coarse, hard, subrounded to subangular sand; 6 % silty (estimated) fines; moist, brown; no reaction with HCl; original field sample had 7 % hard, subrounded cobbles and 2 % hard, subrounded boulders with a maximum dimension of 18 in.

X2. USING SOIL CLASSIFICATION AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, ETC.

X2.1 The group names and symbols used in this standard may be used as a descriptive system applied to materials that exist in situ as shale, claystone, sandstone, siltstone, mudstone, etc., but convert to soils after field or laboratory processing (crushing, slaking, etc.).

X2.2 Materials such as shells, crushed rock, slag, etc., should be identified as such. However, the procedures used in this standard for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, a classification in accordance with this standard may be assigned to aid in describing the material.

X2.3 If a classification is used, the group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how soil classifications could be incorporated into a description system for materials that are not naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2- to 4-in. pieces of shale from power auger hole, dry, brown, no reaction with HCl. After laboratory processing by slaking in water for 24 h, material classified as "Sandy Lean Clay (CL)"—61 % clayey fines, LL = 37, PI = 16; 33 % fine to medium sand; 6 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"—91 % fine to medium sand; 9 % silty (estimated) fines; dry, reddish-brown, strong reaction with HCl.

X2.4.3 *Broken Shells*—62 % gravel-size broken shells; 31 % sand and sand-size shell pieces; 7 % fines; would be classified as "Poorly Graded Gravel with Sand (GP)".

X2.4.4 *Crushed Rock*—Processed gravel and cobbles from Pit No. 7; "Poorly Graded Gravel (GP)"—89 % fine, hard, angular gravel-size particles; 11 % coarse, hard, angular sand-size particles, dry, tan; no reaction with HCl; Cc = 2.4, Cu = 0.9.

X3. PREPARATION AND TESTING FOR CLASSIFICATION PURPOSES BY THE WET METHOD

X3.1 This appendix describes the steps in preparing a soil sample for testing for purposes of soil classification using a wet-preparation procedure.

X3.2 Samples prepared in accordance with this procedure should contain as much of their natural water content as possible and every effort should be made during obtaining, preparing, and transportating the samples to maintain the natural moisture.

X3.3 The procedures to be followed in this standard assume that the field sample contains fines, sand, gravel, and plus 3-in. (75-mm) particles and the cumulative particle-size distribution plus the liquid limit and plasticity index values are required (see 9.8). Some of the following steps may be omitted when they are not applicable to the soil being tested.

X3.4 If the soil contains plus No. 200 (75-μm) particles that would degrade during dry sieving, use a test procedure for determining the particle-size characteristics that prevents this degradation.

X3.5 Since this classification system is limited to the portion of a sample passing the 3-in. (75-mm) sieve, the plus 3-in. (75-mm) material shall be removed prior to the determination of the particle-size characteristics and the liquid limit and plasticity index.

X3.6 The portion of the field sample finer than the 3-in. (75-mm) sieve shall be obtained as follows:

X3.6.1 Separate the field sample into two fractions on a 3-in. (75-mm) sieve, being careful to maintain the natural water content in the minus 3-in. (75-mm) fraction. Any particles adhering to the plus 3-in. (75-mm) particles shall be brushed or wiped off and placed in the fraction passing the 3-in. (75-mm) sieve.

X3.6.2 Determine the air-dry or oven-dry weight of the fraction retained on the 3-in. (75-mm) sieve. Determine the total (wet) weight of the fraction passing the 3-in. (75-mm) sieve.

X3.6.3 Thoroughly mix the fraction passing the 3-in. (75-mm) sieve. Determine the water content, in accordance with Test Method D 2216, of a representative specimen with a minimum dry weight as required in 7.2. Save the water-content specimen for determination of the particle-size analysis in accordance with X3.8.

X3.6.4 Compute the dry weight of the fraction passing the 3-in. (75-mm) sieve based on the water content and total (wet) weight. Compute the total dry weight of the sample and calculate the percentage of material retained on the 3-in. (75-mm) sieve.

X3.7 Determine the liquid limit and plasticity index as follows:

X3.7.1 If the soil disaggregates readily, mix on a clean, hard surface and select a representative sample by quartering in accordance with Practice C 702.

X3.7.1.1 If the soil contains coarse-grained particles coated with and bound together by tough clayey material, take extreme care in obtaining a representative portion of the No. 40 (425-μm) fraction. Typically, a larger portion than normal has to be selected, such as the minimum weights required in 7.2.

X3.7.1.2 To obtain a representative specimen of a basically cohesive soil, it may be advantageous to pass the soil through a ¾-in. (19-mm) sieve or other convenient size so the material can be more easily mixed and then quartered or split to obtain the representative specimen.

X3.7.2 Process the representative specimen in accordance with Procedure B of Practice D 2217.

X3.7.3 Perform the liquid-limit test in accordance with Test Method D 4318, except the soil shall not be air dried prior to the test.

X3.7.4 Perform the plastic-limit test in accordance with Test Method D 4318, except the soil shall not be air dried prior to the test, and calculate the plasticity index.

X3.8 Determine the particle-size distribution as follows:

X3.8.1 If the water content of the fraction passing the 3-in. (75-mm) sieve was required (X3.6.3), use the water-content specimen for determining the particle-size distribution. Otherwise, select a representative specimen in accordance with Practice C 702 with a minimum dry weight as required in 7.2.

X3.8.2 If the cumulative particle-size distribution including a hydrometer analysis is required, determine the particle-size distribution in accordance with Test Method D 422. See 9.7 for the set of required sieves.

X3.8.3 If the cumulative particle-size distribution without a hydrometer analysis is required, determine the particle-size distribution in accordance with Method C 136. See 9.7 for the set of required sieves. The specimen should be soaked until all clayey aggregations have softened and then washed in accordance with Test Method C 117 prior to performing the particle-size distribution.

X3.8.4 If the cumulative particle-size distribution is not required, determine the percent fines, percent sand, and percent gravel in the specimen in accordance with Test Method C 117, being sure to soak the specimen long enough to soften all clayey aggregations, followed by Test Method C 136 using a nest of sieves which shall include a No. 4 (4.75-mm) sieve and a No. 200 (75-μm) sieve.

X3.8.5 Calculate the percent fines, percent sand, and percent gravel in the minus 3-in. (75-mm) fraction for classification purposes.

X4. AIR-DRIED METHOD OF PREPARATION OF SOILS FOR TESTING FOR CLASSIFICATION PURPOSES

X4.1 This appendix describes the steps in preparing a soil sample for testing for purposes of soil classification when air-drying the soil before testing is specified or desired or when the natural moisture content is near that of an air-dried state.

X4.2 If the soil contains organic matter or mineral colloids that are irreversibly affected by air drying, the wet-preparation method as described in Appendix X3 should be used.

X4.3 Since this classification system is limited to the portion of a sample passing the 3-in. (75-mm) sieve, the plus 3-in. (75-mm) material shall be removed prior to the determination of the particle-size characteristics and the liquid limit and plasticity index.

X4.4 The portion of the field sample finer than the 3-in. (75-mm) sieve shall be obtained as follows:

X4.4.1 Air dry and weigh the field sample.

X4.4.2 Separate the field sample into two fractions on a 3-in. (75-mm) sieve.

X4.4.3 Weigh the two fractions and compute the percentage of the plus 3-in. (75-mm) material in the field sample.

X4.5 Determine the particle-size distribution and liquid limit and plasticity index as follows (see 9.8 for when these tests are required):

X4.5.1 Thoroughly mix the fraction passing the 3-in. (75-mm) sieve.

X4.5.2 If the cumulative particle-size distribution including a hydrometer analysis is required, determine the particle-size distribution in accordance with Test Method D 422. See 9.7 for the set of sieves that is required.

X4.5.3 If the cumulative particle-size distribution without a hydrometer analysis is required, determine the particle-size distribution in accordance with Test Method D 1140 followed by Method C 136. See 9.7 for the set of sieves that is required.

X4.5.4 If the cumulative particle-size distribution is not required, determine the percent fines, percent sand, and percent gravel in the specimen in accordance with Test Method D 1140 followed by Method C 136 using a nest of sieves which shall include a No. 4 (4.75-mm) sieve and a No. 200 (75-μm) sieve.

X4.5.5 If required, determine the liquid limit and the plasticity index of the test specimen in accordance with Test Method D 4318.

X5. ABBREVIATED SOIL CLASSIFICATION SYMBOLS

X5.1 In some cases, because of lack of space, an abbreviated system may be useful to indicate the soil classification symbol and name. Examples of such cases would be graphical logs, databases, tables, etc.

X5.2 This abbreviated system is not a substitute for the full name and descriptive information but can be used in supplementary presentations when the complete description is referenced.

X5.3 The abbreviated system should consist of the soil classification symbol based on this standard with appropriate lower case letter prefixes and suffixes as:

Prefix	Suffix
s = sandy	s = with sand
g = gravelly	g = with gravel
	c = cobbles
	b = boulders

X5.4 The soil classification symbol is to be enclosed in parentheses. Some examples would be:

Group Symbol and Full Name	Abbreviated
CL, Sandy lean clay	s(CL)
SP-SM, Poorly graded sand with silt and gravel	(SP-SM)g
GP, poorly graded gravel with sand, cobbles, and boulders	(GP)scb
ML, gravelly silt with sand and cobbles	g(ML)sc

SUMMARY OF CHANGES

In accordance with Committee D18 policy, this section identifies the location of changes to this standard since the last edition (1998) that may impact the use of this standard.

(1) Added Practice D 3740 to Section 2.

(2) Added Note 5 under 5.5 and renumbered subsequent notes.

Rock Quality Designation

From Wikipedia, the free encyclopedia

You have new messages (diff).

Rock Quality Designation (RQD) was developed in 1964 by D. U. Deere. It is based on measuring core recovery percentage which incorporates only pieces that are 100 mm or greater in length. In this respect pieces of core that are not hard and sound should not be counted though they are 100 mm in length. The optimal core diameter is 47.5 mm. RQD has considerable value in estimating support of rock tunnels. This quantitative index has been used as a red flag to identify low-quality rock zones. Today is RQD used as a standard parameter in drill core logging and forms a basic element value of the major mass classification systems: Rock Mass Rating system (RMR) and Q-system

Definition

RQD is defined as the quotient:

$$RQD = \frac{Suml}{ltot} \text{*100\%}$$

$Suml$=Sum of length of core sticks longer than 10 cm

$ltot$=Total length of core run

Classification table

From obtained RQD index we can classify rock mass:

RQD	Rock mass quality
<25%	very poor
25-50%	poor
50-75%	fair
75-90%	good
90-100%	excellent

Category: Rock mass classifications

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APPENDIX G
Boring Logs and Well Construction Records

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Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-1

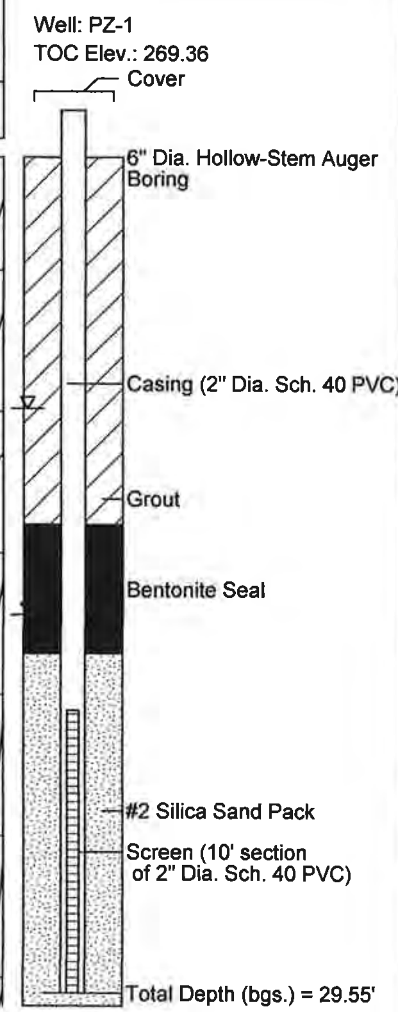
Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/15/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/15/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	269.36'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	266.78'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	Fill (road bed)

Water Levels
▼ 1 Hour = 16.17' bgs
▽ 24 Hours = 8.89' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	266.78	4 32 35	SS	14	dry; very hard; red (2.5YR 4/6) with brown mottles; fine to coarse sandy silty clay with brick gravel fragments; cohesive; medium plasticity; Fill
5	261.78	5 7 9	SS	16	moist; very stiff; reddish brown (2.5 YR 4/3) with orange and yellow mottles and black vertical stringers; quartz gravelly silty clay; high plasticity; cohesive; Fill
10	256.78	7 5 8	SS	18	moist; stiff; reddish yellow (5YR 6/6) with white and rust mottles and stringers; silty clay; medium plasticity; cohesive; Fill
15	251.78	17 50/4"	SS	10	moist; very hard; yellowish red (5YR 4/6) with black stringers; horizontal fissile; very fine mica sandy silty clay with large quartz gravel; low plasticity; cohesive; Partially Weathered Rock
20	246.78	7 50/4"	SS,BAG	8	dry; very compact; red (2.5YR 4/6); clayey silty medium sand; no plasticity or cohesion; Partially Weathered Rock; (Lab Results: PZ-1 Bag (19-20'); USCS=SC; Gravel=12.1%; Sand=58.9%; Silt=22.7%; Clay=6.3%; Effective Porosity=26%; Atterberg Limits: PL=17, LL=29, PI=12)
25	241.78	41 50/1"	SS, BAG	10	dry; very compact; weak red (2.5YR 4/6) with white mottles and specks; horizontal fissile; quartz gravelly clayey silt; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-1 Bag (24-25'); USCS=CL; Sand=38.9%; Silt=47.1%; Clay=14.0%; Effective Porosity=15%; Atterberg Limits: PL=17, LL=30, PI=13)
30	236.78	50/.5"	SS	4	wet; weak red (10R 4/4); weathered mudstone with quartz and phyllite gravel; Partially Weathered Rock
					Auger Refusal @ 30'
35	231.78				
40	226.78				
45					



NON RESIDENTIAL WELL CONSTRUCTION RECORD

COPY

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2789A

1. WELL CONTRACTOR:

MARK E.SEILER, SR.
Well Contractor (Individual) Name

RED DOG DRILLING
Well Contractor Company Name

216 PINEWOOD LANE
Street Address

MIDLAND NC 28107
City or Town State Zip Code

(704) 888-5422
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) PZ-1

3. WELL USE (Check One Box) Monitoring ☒ Municipal/Public ☐ Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐ Irrigation ☐ Other ☑ (list use) Piezometer

DATE DRILLED 7/15/14

4. WELL LOCATION:

1303 Brickyard Rd. 27330
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY Lee

TOPOGRAPHIC / LAND SETTING: (check appropriate box)

☐Slope ☐Valley ☐Flat ☐Ridge ☐Other

LATITUDE 36 ° 32 ' 13.0000 " DMS OR 3X.XXXXXXXXX DD

LONGITUDE 79 ° 8 ' 28.0000 " DMS OR 7X.XXXXXXXXX DD

Latitude/longitude source: ☐GPS ☐Topographic map

(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Sanford Clay Mine
Facility Name Facility ID# (if applicable)

1303 Brickyard Rd.
Street Address

Sanford NC 27330
City or Town State Zip Code

Ross Klingman/Buxton Environmental
Contact Name

1101 South Blvd. Suite 101
Mailing Address

Charlotte NC 28203
City or Town State Zip Code

(704) 344-1450
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 30'

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒

c. WATER LEVEL Below Top of Casing: N/A FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth): ☐

Top	Bottom	Top	Bottom
N/A	N/A		

7. CASING:

	Depth Top	Bottom	Diameter	Thickness/ Weight	Material
	0	20 Ft.	2"	40	PVC
		Ft.			
		Ft.			

8. GROUT:

Depth Top	Bottom	Material	Method
0	13 Ft.	Bent Grout	Dump
	Ft.		
	Ft.		

9. SCREEN:

Depth Top	Bottom	Diameter	Slot Size	Material
20	30 Ft.	2 in.	.010 in.	PVC
	Ft.	in.	in.	
	Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth Top	Bottom	Size	Material
18	30 Ft.	#2	Silica
	Ft.		
	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	30	Triassic

12. REMARKS: Bent Chips 13-18

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Mark E. Seiler Sr 8/8/14
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Mark E Seiler
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-2s and 2

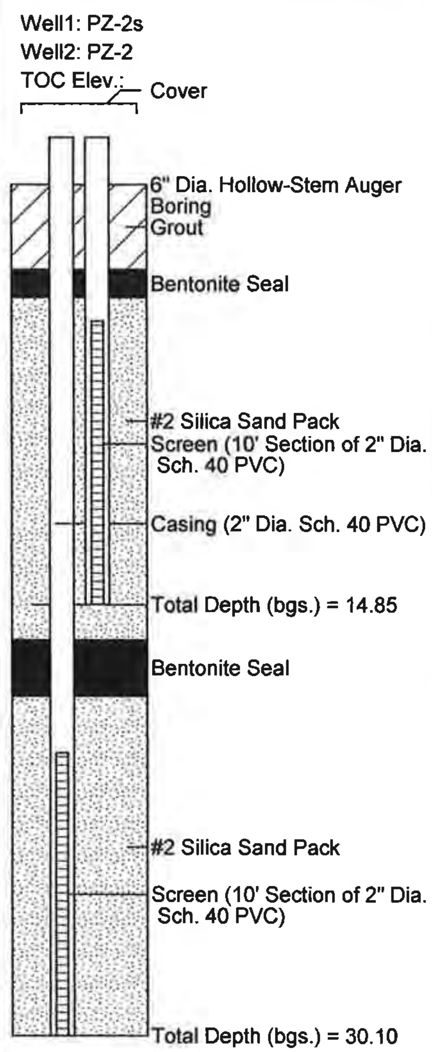
Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	: 7/15/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/16/14	Drilling Method:	: HSA; CME-45C
Drilling Company:	: Red Dog Drilling	Top-of-Casing Elev.:	: 276.93'/276.84'
Drillers Name:	: Mark Seiler	Ground Surface Elev.:	: 274.31'
NC Driller Certification:	: 2789A	Natural, Cut, Fill Grade:	: Fill (road bed)

Water Levels
- 1 Hour = dry/16.10' bgs
- 24 Hours = dry/11.84' bgs

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	274.31	17 18 24	SS	21	dry; compact; reddish yellow (7.5YR 6/8); horizontal fissile; clayey silt with gravel and brick fragments; no plasticity or cohesion; Fill
5	269.31	14 8 18	SS	20	moist; very stiff; brown (10YR 5/3) with gray and white mottles; quartz gravelly fine sandy clayey silt with roots and organic odor; low plasticity; cohesive; Fill
10	264.31	4 4 6	SS,ST	20,24	moist; stiff; brownish yellow (10YR 6/6) with light gray and light orange mottles; coarse quartz sandy clayey silt; low plasticity; cohesive; Flood Plain; (Lab Results: PZ-2 UD (9-11'); USCS=CH; Gravel=2.1%; Sand=15.3%; Silt= 40.2%; Clay=42.4%; Specific Gravity=2.66' Hydraulic Conductivity= 6.23 x 10-5 cm/sec; Total Porosity=40.7%; Effective Porosity=2%; Atterberg Limits: PL=25, LL=50; PI=25)
15	259.31	30 50/4"	SS	12	dry; very hard; yellowish red (5YR 4/6) with black manganese horizontal planes between fissile layers; clayey silt; low plasticity; cohesive; Partially Weathered Rock
20	254.31	12 12 20	SS	16	moist; hard; red (2.5YR 5/6) with yellow stringers; silty clay; low plasticity; cohesive; Residuum
25	249.31	26 20 30	SS	18	moist; hard; reddish brown (2.5YR 5/4) with light green gray and black stringers; horizontal fissile; fine sandy clayey silt; low plasticity; cohesive; Residuum
30	244.31	17 22 50/2"	SS,BAG	14	wet; very hard; red (2.5YR 4/8); silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-2 Bag (29-30.5'); USCS=CL; Sand=2.2%; Silt=70.7%; Clay=27.1%; Effective Porosity=4; Atterberg Limits= PL=22, LL=43, PI=21)
					Auger Refusal @ 30.5'
35	239.31				
40	234.31				
45					



NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

COPY

WELL CONTRACTOR CERTIFICATION # 2789A

1. WELL CONTRACTOR:

MARK E.SEILER, SR.
Well Contractor (Individual) Name

RED DOG DRILLING
Well Contractor Company Name

216 PINEWOOD LANE
Street Address

MIDLAND NC 28107
City or Town State Zip Code

(704) 888-5422
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) PZ-2

3. WELL USE (Check One Box) Monitoring ☐ Municipal/Public ☐ Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐ Irrigation☐ Other ☑ (list use) Piezometer

DATE DRILLED 7/16/14

4. WELL LOCATION:

1303 Brickyard Rd. 27330
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY Lee

TOPOGRAPHIC / LAND SETTING: (check appropriate box)

☐Slope ☐Valley ☐Flat ☐Ridge ☐Other

LATITUDE 36 ° 32 ' 13.0000 " DMS OR 3x.xxxxxxxxx DD

LONGITUDE 79 ° 8 ' 28.0000 " DMS OR 7x.xxxxxxxxx DD

Latitude/longitude source: ☐GPS ☐Topographic map

(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Sanford Clay Mine
Facility Name Facility ID# (if applicable)

1303 Brickyard Rd.
Street Address

Sanford NC 27330
City or Town State Zip Code

Ross Klingman/Buxton Environmental
Contact Name

1101 South Blvd. Suite 101
Mailing Address

Charlotte NC 28203
City or Town State Zip Code

(704) 344-1450
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 30

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒

c. WATER LEVEL Below Top of Casing: 28' FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth): ☐

Top N/A Bottom N/A Top Bottom
Top Bottom 25 Top Bottom
Top Bottom Top Bottom

7. CASING:

Depth Top	Bottom	Diameter	Thickness/ Weight	Material
0	20 Ft.	2	40	PVC
0	5 Ft.	2	40	PVC
	Ft.			

8. GROUT:

Depth Top	Bottom	Material	Method
0	3 Ft.	Bent-Grout	Dump
	Ft.		
	Ft.		

9. SCREEN:

Depth Top	Bottom	Diameter	Slot Size	Material
20	30 Ft.	2 in.	.010 in.	PVC
5	15 Ft.	2 in.	.010 in.	PVC
	Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth Top	Bottom	Size	Material
18	30 Ft.	#2	Silica
4	16 Ft.	"	"
	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	30	Triassic
		Rocky @ 27'

12. REMARKS: Bent Chips 16-18
Bent Chips 3-4

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Mark E Seiler Sr. 8/8/14
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Mark E Seiler Sr
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-1617, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-3s and 3

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	: 7/16/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/16/14	Drilling Method:	: HSA; CME-45C
Drilling Company:	: Red Dog Drilling	Top-of-Casing Elev.:	: 299.12'/299.29'
Drillers Name:	: Mark Seiler	Ground Surface Elev.:	: 296.20'
NC Driller Certification:	: 2789A	Natural, Cut, Fill Grade:	: slight cut

Water Levels

▼ 1 Hour = dry/36.11'bgs

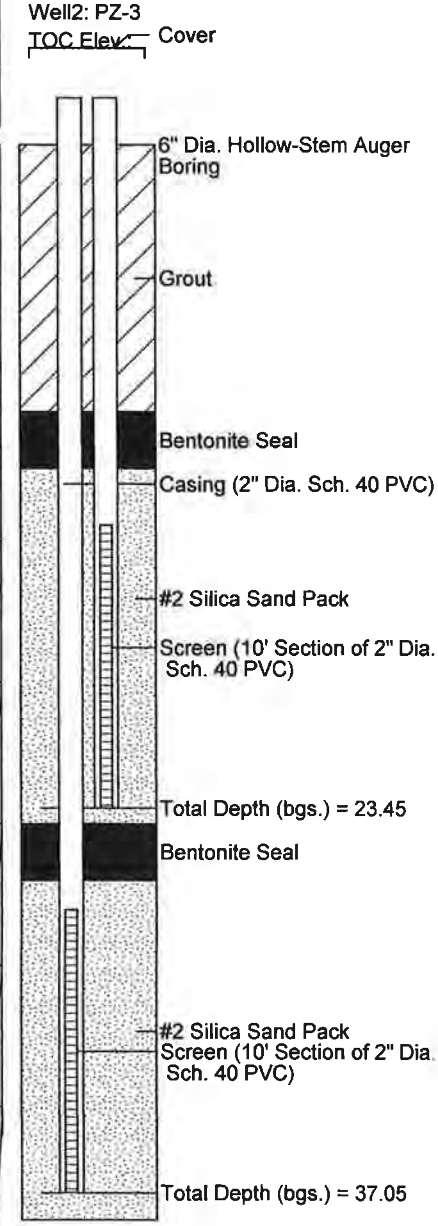
▽ 24 Hours = dry/30.91' bgs

Sample Type

SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	296.2	4 6 8	SS,ST	16,24	moist; stiff; yellowish red (5YR 5/6) with light gray and orange yellow mottled; fine to coarse sandy gravelly clayey silt; low plasticity; cohesive; Soil Horizon; (Lab Results: PZ-3 UD (0-2'); USCS=CL; Sand=6.7%; Silt=52.8%; Clay=40.5%; Specific Gravity=2.67; Hydraulic Conductivity=2.42 x 10-6 cm/sec; Total Porosity=39.3%; Effectuve Porosity=2%; Atterberg Limits: PL=27, LL=48, PI=21)
5	291.2	7 8 11	SS	14	
					moist; very stiff; red (2.5YR 4/6) with white and brown specks; clayey fine to coarse sandy and gravelly silt; no plasticity; cohesive; Residuum
10	286.2	7 16 16	SS	14	dry; hard; reddish brown (2.5YR 5/4) with light orange and maroon mottles; clayey silt; no plasticity; cohesive; Residuum
15	281.2	15 44 50/3"	SS	16	moist; very hard; red (10R 5/6) with maroon mottles and vertical manganese fracture planes; clayey silt; no plasticity; cohesive; Partially Weathered Rock
20	276.2	50/6"	SS	7	dry; very hard; reddish brown (2.5YR 5/4) with olive green and white specks; fine to medium sandy silt with rock fragments; no plasticity; cohesive; Partially Weathered Rock
25	271.2	50/5"	SS	9	dry; very compact; reddish brown (2.5YR 5/4) with white and green specks; medium horizontal fissile; silty fine to coarse sand with gravel; no plasticity or cohesion; Partially Weathered Rock
30	266.2	50/2"	SS	5	dry; very hard; weak red (10R 5/3); highly horizontal fissile; fine mica sandy silt; no plasticity; cohesive; Partially Weathered Rock
35	261.2	50/5"	SS,BAG	6	moist; weak red (10R 4/3) with green, yellow and black specks and mottles; slightly clayey silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock; (Lab Results: PZ-3 Bag (34-34.5'); USCS=SM; Gravel=12.8%; Sand=59.7%; Silt and Clay=27.5%; Effective Porosity=30%)
40	256.2				Auger Refusal @ 38'
45					

Well1: PZ-3s
Well2: PZ-3
TOC Elev.:



NON RESIDENTIAL WELL CONSTRUCTION RECORD

COPY

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2789A

1. WELL CONTRACTOR:

MARK E.SEILER, SR.
Well Contractor (Individual) Name

RED DOG DRILLING
Well Contractor Company Name

216 PINEWOOD LANE
Street Address

MIDLAND NC 28107
City or Town State Zip Code

(704) 888-5422
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) PZ-3

3. WELL USE (Check One Box) Monitoring ☐ Municipal/Public ☐ Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐ Irrigation☐ Other ☑ (list use) Piezometer

DATE DRILLED 8/16/14

4. WELL LOCATION:

1303 Brickyard Rd. 27330
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY Lee

TOPOGRAPHIC / LAND SETTING: (check appropriate box)

☐Slope ☐Valley ☐Flat ☐Ridge ☐Other

LATITUDE 36 ° 32 ' 13.0000 " DMS OR 3x.xxxxxxxxx DD

LONGITUDE 79 ° 8 ' 28.0000 " DMS OR 7x.xxxxxxxxx DD

Latitude/longitude source: ☐GPS ☐Topographic map

(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Sanford Clay Mine
Facility Name Facility ID# (if applicable)

1303 Brickyard Rd.
Street Address

Sanford NC 27330
City or Town State Zip Code

Ross Klingman/Buxton Environmental
Contact Name

1101 South Blvd. Suite 101
Mailing Address

Charlotte NC 28203
City or Town State Zip Code

(704.) 344-1450
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 38

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑

c. WATER LEVEL Below Top of Casing: 26.8 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth): ☐

Top N/A Bottom N/A Top Bottom
Top Bottom Top Bottom
Top Bottom Top Bottom

7. CASING:

Depth Top	Bottom	Diameter	Thickness/Weight	Material
0	26 Ft.	2	40	PVC
0	14 Ft.	2	40	PVC
	Ft.			

8. GROUT:

Depth Top	Bottom	Material	Method
0	10 Ft.	Bent-Grout	Dump
	Ft.		
	Ft.		

9. SCREEN:

Depth Top	Bottom	Diameter	Slot Size	Material
28	38 Ft.	2 in.	010 in.	PVC
14	24 Ft.	2 in.	010 in.	PVC
	Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth Top	Bottom	Size	Material
27	38 Ft.	#2	Silica
12	25 Ft.	#2	Silica
	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	38	Tracck

12. REMARKS: Bent Chips 25-27
10-12

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Mark E Seiler Sr. 8/8/14

SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Mark E Seiler SR.

PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing,
1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-4

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

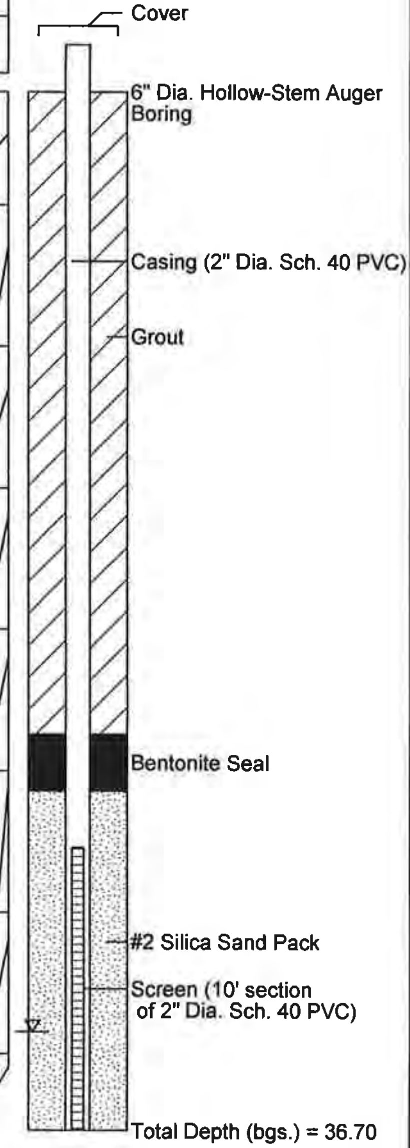
Date Started:	7/16/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/16/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	299.50'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	296.82'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = 33.22' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	296.82	4 5 5	SS	14	moist; stiff; brownish yellow (10YR 6/8); fine to coarse sandy clayey silt with gravel; low plasticity; cohesive; Soil Horizon
5	291.82	4 5 6	SS,BAG	16	moist; stiff; brownish yellow (10YR 6/8) with rust mottles; silty clay; low plasticity; cohesive; Soil Horizon; (Lab Results: PZ-4 Bag (4-5.5'); USCS=CH; Sand=3.0%; Silt=50.9%; Clay=46.1%; Effective Porosity=2%; Atterberg Limits: PL=27, LL=60, PI=33)
10	286.82	9 9 12	SS	18	moist; very stiff; red (2.5YR 4/8) with olive green, rust, light gray and light purple mottled; gravelly clayey silt; no plasticity; cohesive; Residuum
15	281.82	27 50/5"	SS	12	dry; very hard; weak red (2.5YR 5/2) with light green specks; medium horizontal fissile; silt; no plasticity; cohesive; Partially Weathered Rock
20	276.82	29 50/3"	SS	12	dry; very hard; weak red (2.5YR 5/2) with white stringers and vertical black manganese fracture planes; silt; no plasticity; cohesive; Partially Weathered Rock
25	271.82	47 50/4"	SS, BAG	15	moist; very hard; red (2.5YR 4/6); highly horizontal fissile; very slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-4 Bag (24-24.5'); USCS=CL; Sand=21.0%; Silt=61.6%; Clay=17.4%; Effective Porosity=11%; Atterberg Limits: PL=16, LL=31, PI=15)
30	266.82	34 50/2"	SS	20	moist; very hard; weak red (10R 4/2) with white, black and yellow specks and stringers; medium horizontal fissile; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
35	261.82	50/0"	SS	0	No Recovery
					Auger Refusal @ 36.7'
40	256.82				
45					

Well: PZ-4
TOC Elev.: 299.50



NON RESIDENTIAL WELL CONSTRUCTION RECORD

COPY

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2789A

1. WELL CONTRACTOR:

MARK E.SEILER, SR.
Well Contractor (Individual) Name

RED DOG DRILLING
Well Contractor Company Name

216 PINEWOOD LANE
Street Address

MIDLAND NC 28107
City or Town State Zip Code

(704) 888-5422
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#____

OTHER ASSOCIATED PERMIT#(if applicable)____

SITE WELL ID #(if applicable) PZ-4

3. WELL USE (Check One Box) Monitoring ☐ Municipal/Public ☐ Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐ Irrigation☐ Other ☑ (list use) Piezometer

DATE DRILLED 8/16/14

4. WELL LOCATION:

1303 Brickyard Rd. 27330
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY Lee

TOPOGRAPHIC / LAND SETTING: (check appropriate box)

☐Slope ☐Valley ☐Flat ☐Ridge ☐Other____

LATITUDE 36 ° 32 ' 13.0000 " DMS OR 3x.xxxxxxxxx DD

LONGITUDE 79 ° 8 ' 28.0000 " DMS OR 7x.xxxxxxxxx DD

Latitude/longitude source: ☐GPS ☐Topographic map

(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Sanford Clay Mine
Facility Name Facility ID# (if applicable)

1303 Brickyard Rd.
Street Address

Sanford NC 27330
City or Town State Zip Code

Ross Klingman/Buxton Environmental
Contact Name

1101 South Blvd. Suite 101
Mailing Address

Charlotte NC 28203
City or Town State Zip Code

(704) 344-1450
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 365

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☐

c. WATER LEVEL Below Top of Casing: 32.1 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST____

f. DISINFECTION: Type____ Amount____

g. WATER ZONES (depth): ☐

Top N/A	Bottom N/A	Top	Bottom
Top	Bottom	Top	Bottom
Top	Bottom	Top	Bottom

7. CASING:

Depth		Diameter	Thickness/ Weight	Material
Top 0	Bottom 265 Ft.	2	40	PVC
Top	Bottom Ft.			
Top	Bottom Ft.			

8. GROUT:

Depth		Material	Method
Top 0	Bottom 225 Ft.	Bent. Grout	Tremie
Top	Bottom Ft.		
Top	Bottom Ft.		

9. SCREEN:

Depth		Diameter	Slot Size	Material
Top 265	Bottom 365 Ft.	2 in.	0.10 in.	PVC
Top	Bottom Ft.	in.	in.	
Top	Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth		Size	Material
Top 245	Bottom 365 Ft.	#2	Silica
Top	Bottom Ft.		
Top	Bottom Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	365	Triassic

12. REMARKS: Bent. Chips 225-245

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Mark E. Seiler Sr. 8/18/14
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Mark E. Seiler SR.
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing,
1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-4D

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

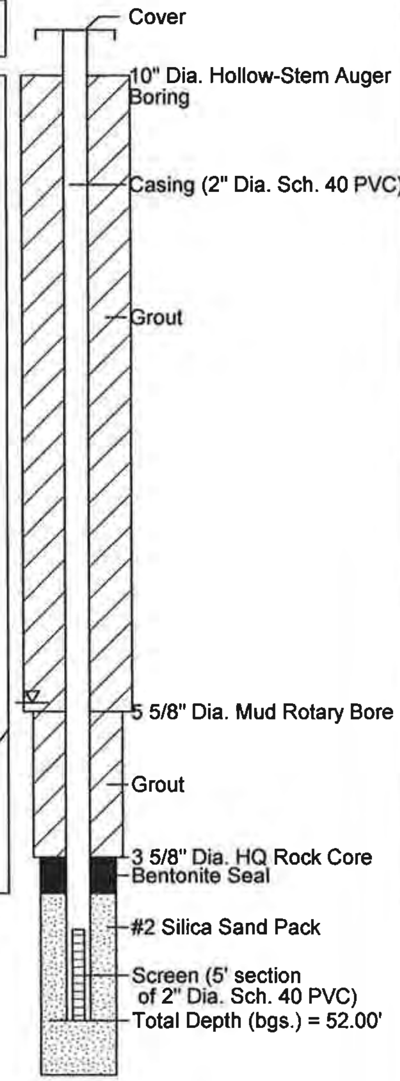
Date Started:	: 7/16/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/16/14	Drilling Method:	: HSA; Geoprobe 8040DT
Drilling Company:	: Geologic Exploration	Top-of-Casing Elev.:	: 299.76'(Lawrence Survey)
Drillers Name:	: Johnny Burr	Ground Surface Elev.:	: 297.25'(Lawrence Survey)
NC Driller Certification:	: 3098A	Natural, Cut, Fill Grade:	: slight cut

Water Levels
- 1 Hour = dry
- 24 Hours = 35.00' bgs

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	297.25				Advance 10" diameter Hollow-Stem Augers from 0-35' See Boring Log PZ-4 for lithologic information from 0-36.5'
5	292.25				
10	287.25				
15	282.25				
20	277.25				
25	272.25				
30	267.25				
35	262.25				Auger Refusal @ 35' Advance 5 5/8" diameter mud-rotary drilling from 35-45', (layered rock and soil from 35-42'; moderately competent rock from 42-45')
40	257.25				
45	252.25				Advance HQ rock core (3 5/8" outer diameter) from 45-55' *1st Run from 45-50' (23.5" Recovery; RQD=39.2%; Rock Mass Quaility=Poor) Upper 9" core (blocky mudstone with healed 80 degree fracture; grading downward to muddy coarse sandstone) Lower 14.5" core (muddy sandy conglomerate; consiting of horizontally oriented rounded phyllite discs and rounded quartz gravel)
50	247.25				*2nd Run (50-55') (45" Recovery; RQD=23.3%; Rock Mass Quality=Very Poor) Broken conglomerate as above (4" total length); grading downward into blocky mudstone with horizontal fractures every 1.5 to 5" (37.5" total length); grading downward into muddy coarse sandstone (3.5" length total)
55	242.25				
60	237.25				
65	232.25				
70					

Well: PZ-4D
TOC Elev.: 299.76



WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

For Internal Use ONLY:

1. Well Contractor Information:

JOHNNY BURR

Well Contractor Name

A - 3098

NC Well Contractor Certification Number

GEOLOGIC EXPLORATION, INC

Company Name

2. Well Construction Permit #: ____________________

List all applicable well construction permits (i.e. County, State, Variance, etc.)

3. Well Use (check well use):

Water Supply Well:

☐Agricultural ☐Municipal/Public
☐Geothermal (Heating/Cooling Supply) ☐Residential Water Supply (single)
☐Industrial/Commercial ☐Residential Water Supply (shared)
☐Irrigation

Non-Water Supply Well:

☑Monitoring ☐Recovery

Injection Well:

☐Aquifer Recharge ☐Groundwater Remediation
☐Aquifer Storage and Recovery ☐Salinity Barrier
☐Aquifer Test ☐Stormwater Drainage
☐Experimental Technology ☐Subsidence Control
☐Geothermal (Closed Loop) ☐Tracer
☐Geothermal (Heating/Cooling Return) ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 07/23/14 **Well ID#** PZ-4D

5a. Well Location:

SANFORD MINE

Facility/Owner Name

Facility ID# (if applicable) ____________________

1303 BRICKYARD ROAD SANFORD 27330

Physical Address, City, and Zip

LEE

County

Parcel Identification No. (PIN) ____________________

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

35° 32' 03.96" N 79° 08' 54.71" W

6. Is (are) the well(s): ☑**Permanent** or ☐**Temporary**

7. Is this a repair to an existing well: ☐**Yes** or ☑**No**

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 52.0 **(ft.)**

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 20.0 **(ft.)**

If water level is above casing, use "+"

11. Borehole diameter: 10.0/5.875/3.78 **(in.)**

12. Well construction method: AUGER/MUD ROTARY/HQ ROCK CORE

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ________ **Method of test:** ________

13b. Disinfection type: ________ **Amount:** ________

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
0.0 ft.	47.0 ft.	2.0 in.	SCH 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
47.0 ft.	52.0 ft.	2.0 in.	.010	SCH 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
0.0 ft.	41.0 ft.	PORTLAND BENTONITE	SLURRY
ft.	ft.		
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
45.0 ft.	52.0 ft.	20-40	FINE SILICA SAND
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.0 ft.	RED SILTY CLAY
3.0 ft.	8.0 ft.	RED ROCKY CLAY
8.0 ft.	10.0 ft.	YELLOW/ORANGE ROCKY CLAY
10.0 ft.	45.0 ft.	RED/TAN MUDSTONE
45.0 ft.	52.0 ft.	HARD RED/TAN MUDSTONE
ft.	ft.	
ft.	ft.	

21. REMARKS

BENTONITE SEAL FROM 41.0 TO 45.0 FEET

22. Certification:

Johnny Burr 08/04/14

Signature of Certified Well Contractor Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Quality, Information Processing Unit,
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Quality, Underground Injection Control Program,
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

View of rock core PZ-4D from 45 feet to 55 feet below grade. 1st Run (left) and 2nd Run (right).

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-5

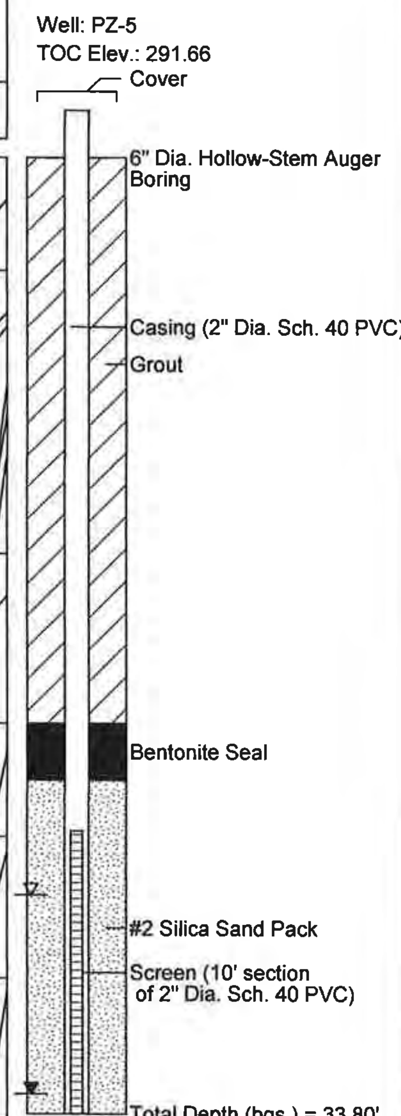
Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	: 7/17/14	Logged By:	: Ross Klingman, P.G
Date Completed:	: 7/17/14	Drilling Method:	: HSA; CME-45C
Drilling Company:	: Red Dog Drilling	Top-of-Casing Elev.:	: 291.66'(Lawrence Survey)
Drillers Name:	: Mark Seiler	Ground Surface Elev.:	: 289.11'(Lawrence Survey)
NC Driller Certification:	: 2789A	Natural, Cut, Fill Grade:	: slight cut

Water Levels
- ▼ 1 Hour = 33.10' bgs
- ▽ 24 Hours = 26.06' bgs

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	289.11	3 5 6	SS	16	moist; stiff; yellow (10YR 7/8) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon
5	284.11	3 4 5	SS	19	wet; stiff; red (2.5YR 5/6) with yellow and light gray mottles; silty clay; low plasticity; cohesive; Soil Horizon
			ST	24	moist; red (2.5YR 4/6); clayey silt and silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-5 UD (6-8'); USCS=CL; Sand=2.2%; Silt=62.1%; Clay=35.7%; Specific Gravity=2.69; Hydraulic Conductivity=2.43 x 10-7 cm/sec; Total Porosity=30.6%; Effective Porosity=2%; Atterberg Limits: PL=26, LL=48, PI=22)
10	279.11	10 22 37	SS	15	moist; very hard; red (2.5YR 4/6); medium horizontal fissile; clayey silt; low plasticity; cohesive; Residuum
15	274.11	12 31 32	SS	18	moist; very hard; red (2.5YR 4/6); medium horizontal fissile; clayey silt; low plasticity; cohesive; Residuum
20	269.11	33 50/5"	SS	14	moist; very hard; weak red (10R 4/3) with dark gray mottles; blocky horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
25	264.11	50/6"	SS	14	moist; very hard; red (10R 4/6); highly horizontal fissile; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
30	259.11	50/2"	SS	5	moist; very hard; red (10R 4/6) with gray pods; highly horizontal fissile; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
35	254.11	50/6"	SS,BAG	8	wet; very hard; red (10R 4/6) with gray pods; highly horizontal fissile; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-5 Bag (34-34.5'); USCS=CL; Sand 13.7%; Silt=73.6; Clay=12.7%; Effective Porosity=8; Atterberg Limits: PL=20, LL=32, PI=12)
40	249.11				
45					



NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2789A

COPY

1. WELL CONTRACTOR:
MARK E.SEILER. SR.
Well Contractor (Individual) Name
RED DOG DRILLING
Well Contractor Company Name
216 PINEWOOD LANE
Street Address
MIDLAND NC 28107
City or Town State Zip Code
(704) 888-5422
Area code Phone number

2. WELL INFORMATION:
WELL CONSTRUCTION PERMIT#
OTHER ASSOCIATED PERMIT#(if applicable)
SITE WELL ID #(if applicable) PZ-5

3. WELL USE (Check One Box) Monitoring ☐ Municipal/Public ☐ Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐ Irrigation☐ Other ☑ (list use) Piezometer
DATE DRILLED 7/17/14

4. WELL LOCATION:
1303 Brickyard Rd. 27330
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)
CITY: Sanford COUNTY Lee
TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐Slope ☐Valley ☐Flat ☐Ridge ☐Other
LATITUDE 36 ° 32 ' 13.0000 " DMS OR 3x.xxxxxxxxx DD
LONGITUDE 79 ° 8 ' 28.0000 " DMS OR 7x.xxxxxxxxx DD
Latitude/longitude source: ☐GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)
Sanford Clay Mine
Facility Name Facility ID# (if applicable)
1303 Brickyard Rd.
Street Address
Sanford NC 27330
City or Town State Zip Code
Ross Klingman/Buxton Environmental
Contact Name
1101 South Blvd. Suite 101
Mailing Address
Charlotte NC 28203
City or Town State Zip Code
(704) 344-1450
Area code Phone number

6. WELL DETAILS:
a. TOTAL DEPTH: 34
b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
c. WATER LEVEL Below Top of Casing: 30.2 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth): ☐

Top N/A	Bottom N/A	Top	Bottom
Top	Bottom	Top	Bottom
Top	Bottom	Top	Bottom

7. CASING:

Depth		Diameter	Thickness/ Weight	Material
Top 0	Bottom 24 Ft.	2	40	PVC
Top	Bottom Ft.			
Top	Bottom Ft.			

8. GROUT:

Depth		Material	Method
Top 0	Bottom 20 Ft.	Bent Grout	Pump
Top	Bottom Ft.		
Top	Bottom Ft.		

9. SCREEN:

Depth		Diameter	Slot Size	Material
Top 24	Bottom 34 Ft.	2 in.	.010 in.	PVC
Top	Bottom Ft.	in.	in.	
Top	Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth		Size	Material
Top 22	Bottom 34 Ft.	#2	Silica
Top	Bottom Ft.		
Top	Bottom Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	34	Triassic

12. REMARKS: Bent. Chips 20-22

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE 8/8/14

Mark E. Seiler Sr.
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-6

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/17/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/17/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	286.13'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	283.48'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	slight cut

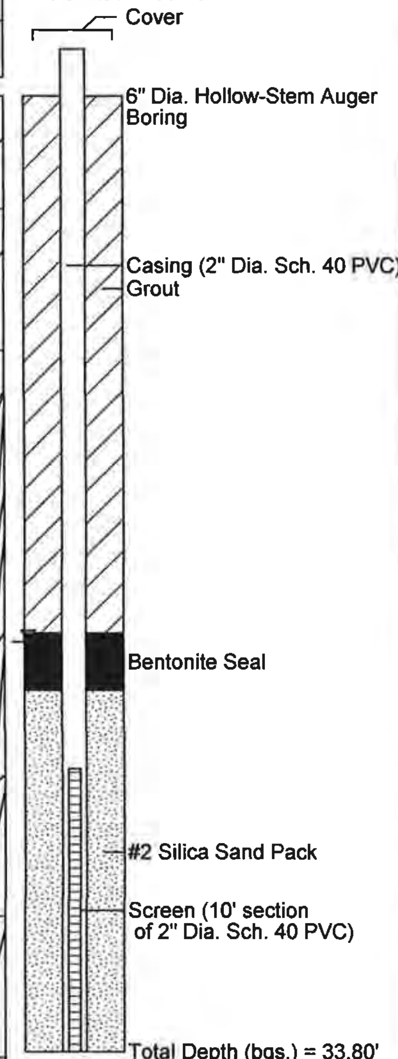
Water Levels
1 Hour = dry
24 Hours = 19.30' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	283.48	3 5 8	SS	10	moist; medium compact; yellow (10YR 7/6); horizontal fissile; silt; no plasticity or cohesion; Soil Horizon
5	278.48	4 3 5	SS	13	moist; medium; pale yellow (2.5 Y 7/4) with light rust mottles; silty clay with roots; low plasticity; cohesive; Soil Horizon
10	273.48	7 11 15	SS	20	moist; very stiff; dark reddish gray (2.5YR 4/1) with white and yellow mottles; silty clay; low plasticity; cohesive; Residuum
			ST	7	moist; weak red (10R 4/4); clayey silt; no plasticity; cohesive; Residuum; (Lab Results: PZ-6 UD (10.5-11'); USCS=CL; Sand=11.3%, Silt=72.5%, Clay=16.2%; Specific Gravity=2.68; Hydraulic Conductivity=6.01 x 10-6 cm/sec; Total Porosity=30.7%; Effective Porosity=8%; Atterberg Limits: PL=23, LL=37, PI=14)
15	268.48	9 21 50/5"	SS	24	moist; very hard; red (2.5YR 4/6); fine to coarse sandy clayey silt with gravel and rock fragments; no plasticity; cohesive; Partially Weathered Rock
20	263.48	50/4"	SS,BAG	6	dry; very hard; dark reddish brown (2.5YR 4/1); silty medium to coarse sand with rounded phyllite gravel; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-6 Bag (19-19.5'); USCS=SC; Sand=59.9%; Silt=27.1%; Clay=13.0%; Effective Porosity=16%; Atterberg Limits: PL=18, LL=33, PI=15)
25	258.48	50/1"	SS	1	moist; very hard; reddish brown (2.5YR 4/4); horizontal fissile; weathered mudstone; Partially Weathered Rock
30	253.48	50/.5"	SS	1	dry; very hard; weak red (2.5YR 5/2); horizontal fissile; sandy mudstone; Partially Weathered Rock
35	248.48	50/.5"	SS	1	dry; very hard; weak red (2.5YR 5/2); weathered silty conglomerate; Partially Weathered Rock
40	243.48				
45					

Auger Refusal @ 35'

Well: PZ-6
TOC Elev.: 286.13'



NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

COPY

WELL CONTRACTOR CERTIFICATION # 2789A

1. WELL CONTRACTOR:

MARK E SEILER, SR.
Well Contractor (Individual) Name

RED DOG DRILLING
Well Contractor Company Name

216 PINEWOOD LANE
Street Address

MIDLAND NC 28107
City or Town State Zip Code

(704) 888-5422
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) PZ-6

3. WELL USE (Check One Box) Monitoring ☐ Municipal/Public ☐ Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐ Irrigation ☐ Other ☑ (list use) Piezometer

DATE DRILLED 7/17/14

4. WELL LOCATION:

1303 Brickyard Rd. 27330
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY Lee

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐Slope ☐Valley ☐Flat ☐Ridge ☐Other

LATITUDE 36 ° 32 ' 13.0000 " DMS OR 3x.xxxxxxxxx DD

LONGITUDE 79 ° 8 ' 28.0000 " DMS OR 7x.xxxxxxxxx DD

Latitude/longitude source: ☐GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Sanford Clay Mine
Facility Name Facility ID# (if applicable)

1303 Brickyard Rd.
Street Address

Sanford NC 27330
City or Town State Zip Code

Ross Klingman/Buxton Environmental
Contact Name

1101 South Blvd. Suite 101
Mailing Address

Charlotte NC 28203
City or Town State Zip Code

(704) 344-1450
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 34

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑

c. WATER LEVEL Below Top of Casing: 31.5 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth): ☐

Top	Bottom	Top	Bottom
N/A	N/A		

7. CASING:

Depth Top	Depth Bottom	Diameter	Thickness/ Weight	Material
0	24 Ft.	2	40	PVC
	Ft.			
	Ft.			

8. GROUT:

Depth Top	Depth Bottom	Material	Method
0	20 Ft.	Bent-Grout	Dump
	Ft.		
	Ft.		

9. SCREEN:

Depth Top	Depth Bottom	Diameter	Slot Size	Material
24	34 Ft.	2 in.	.010 in.	PVC
	Ft.	in.	in.	
	Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth Top	Depth Bottom	Size	Material
22	34 Ft.	#2	Silica
	Ft.		
	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	34	Triassic

12. REMARKS: Bent Chips 20-22

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Mark E. Seiler Sr. 8/8/14
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Mark E Seiler SR.
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-7

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/17/14
Date Completed: : 7/17/14
Drilling Company: : Red Dog Drilling
Drillers Name: : Mark Seiler
NC Driller Certification: : 2789A

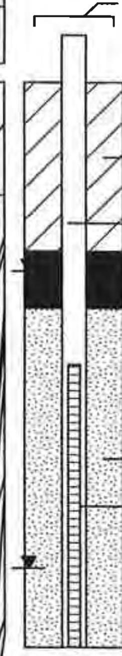
Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA
Top-of-Casing Elev.: : 290.57'(Lawrence Survey)
Ground Surface Elev.: : 287.92'(Lawrence Survey)
Natural, Cut, Fill Grade: : slight cut

Water Levels
▼ 1 Hour = 17.20' bgs
▽ 24 Hours = 6.69' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	287.92	3 3 5	SS	16	moist; medium; light yellowish brown (2.5Y 6/3); fine to coarse sandy clayey silt with roots; no plasticity; cohesive; Soil Horizon
5	282.92	5 8 12	SS	12	moist; very stiff; reddish brown (%YR 5/4) with light gray mottles; blocky; fine to coarse sandy silty clay; low plasticity; cohesive; Residuum
			ST	24	moist; reddish brown (5YR 5/4) with light gray mottles; blocky; fine to coarse sandy silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-7 UD (6-8'); USCS=CL; Sand=3.2%; Silt=67.5%; Clay=29.3%; Specific Gravity=2.74; Hydraulic Conductivity=1.76 x 10-6 cm/sec; Total Porosity=30.1; Effective Porosity=3; Atterberg Limits: PL=24, LL=40, PI=16)
10	277.92	11 13 15	SS	20	
		50/6"	SS,BAG	15	moist/wet; very stiff; reddish brown (5YR 5/4) with vertical black manganese planes; silty clay; low plasticity; cohesive; Residuum
15	272.92				moist/wet; very hard; red (2.5YR 5/8); highly horizontal fissile; clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-7 Bag (14-14.5); USCS=CL; Sand=0.4%; Silt=76.8%; Clay=22.8%; Effective Porosity=4%; Atterberg Limits: PL=22, LL=41, PI=19)
		50/1"	SS	3	
20	267.92				wet; very hard; reddish brown (5YR 5/4); highly horizontal fissile; weathered sandy mud stone; Partially Weathered Rock
25	262.92				
30	257.92				
35	252.92				
40	247.92				
45					

Well: PZ-7
TOC Elev.: 290.57



NON RESIDENTIAL WELL CONSTRUCTION RECORD

COPY

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2789A

1. WELL CONTRACTOR:

MARK E.SEILER, SR.
Well Contractor (Individual) Name

RED DOG DRILLING
Well Contractor Company Name

216 PINEWOOD LANE
Street Address

MIDLAND NC 28107
City or Town State Zip Code

(704) 888-5422
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT#

OTHER ASSOCIATED PERMIT#(if applicable)

SITE WELL ID #(if applicable) PZ-7

3. WELL USE (Check One Box) Monitoring ☐ Municipal/Public ☐ Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐ Irrigation☐ Other ☑ (list use) Piezometer

DATE DRILLED 7/17/14

4. WELL LOCATION:

1303 Brickyard Rd. 27330
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY Lee

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐Slope ☐Valley ☐Flat ☐Ridge ☐Other

LATITUDE 36 ° 32 ' 13.0000 " DMS OR 3X.XXXXXXXXX DD

LONGITUDE 79 ° 8 ' 28.0000 " DMS OR 7X.XXXXXXXXX DD

Latitude/longitude source: ☐GPS ☐Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Sanford Clay Mine
Facility Name Facility ID# (if applicable)

1303 Brickyard Rd.
Street Address

Sanford NC 27330
City or Town State Zip Code

Ross Klingman/Buxton Environmental
Contact Name

1101 South Blvd. Suite 101
Mailing Address

Charlotte NC 28203
City or Town State Zip Code

(704) 344-1450
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 20

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒

c. WATER LEVEL Below Top of Casing: 16.5 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth): ☐

Top N/A	Bottom N/A	Top	Bottom
Top	Bottom	Top	Bottom
Top	Bottom	Top	Bottom

7. CASING:

Depth		Diameter	Thickness/ Weight	Material
Top 0	Bottom 10 Ft.	2	40	PVC
Top	Bottom Ft.			
Top	Bottom Ft.			

8. GROUT:

Depth		Material	Method
Top 0	Bottom 6 Ft.	Bent.Grout	Dump
Top	Bottom Ft.		
Top	Bottom Ft.		

9. SCREEN:

Depth		Diameter	Slot Size	Material
Top 10	Bottom 20 Ft.	2 in.	010 in.	PVC
Top	Bottom Ft.	in.	in.	
Top	Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth		Size	Material
Top 8	Bottom 20 Ft.	#2	Silica
Top	Bottom Ft.		
Top	Bottom Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
0	20	Triassic

12. REMARKS: Bent Chips 6-8

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS. AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

[signature] 7/17/14
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Mark E Seiler SR.
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-8

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/21/14
Date Completed:	7/21/14
Drilling Company:	Summit Engineering
Drillers Name:	Robert Cassell
NC Driller Certification:	4143A
Logged By:	Ross Klingman, P.G.
Drilling Method:	HSA; CME-550x
Top-of-Casing Elev.:	304.85'(Lawrence Survey)
Ground Surface Elev.:	302.56'(Lawrence Survey)
Natural, Cut, Fill Grade:	slight cut

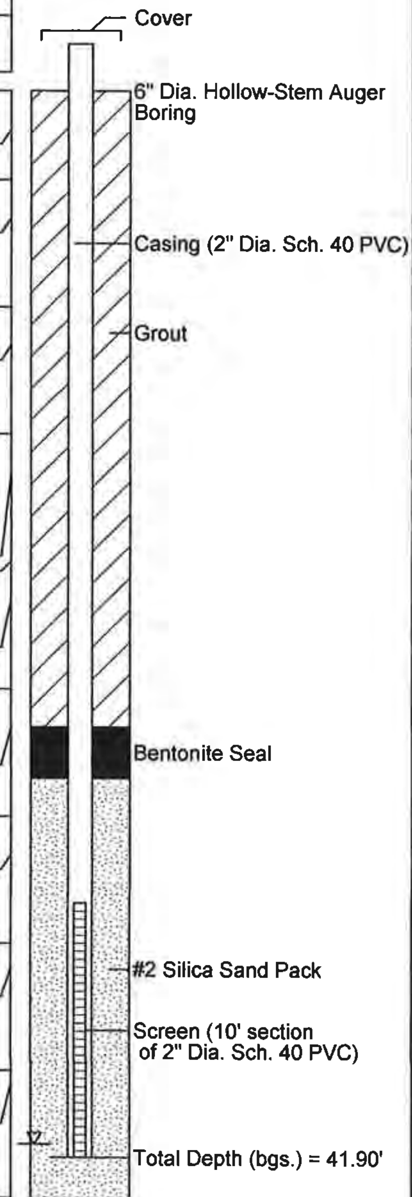
Water Levels
1 Hour = dry
24 Hours = 41.38' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	302.56	4 5 8	SS	18	moist; stiff; strong brown (7.5Y 5/8) with white specks; silty clay; medium plasticity; cohesive; Residuum
5	297.56	3 4 6	SS	14	moist; stiff; red (2.5YR 4/6) with light orange mottles; silty clay; low plasticity; cohesive; Residuum
10	292.56	4 6 9	SS	15	moist; stiff; red (2.5YR 4/6); silty clay; low plasticity; cohesive; Residuum
15	287.56	10 13 13	SS,BAG	16	moist; very stiff; red (2.5YR 4/6) with orange mottles and black stringers; silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-8 Bag (13.5-15'); USCS=CL; Sand=3.1%; Silt=68.1%; Clay=28.8%; Effective Porosity=3%; Atterberg Limits: PL=23, LL=39, PI=16)
20	282.56	9 13 17	SS	14	moist; very stiff; red (10R 4/8) with light gray and yellow mottles; clayey quartz and phyllite gravelly silt; no plasticity; cohesive; Residuum
25	277.56	8 13 15	SS	20	moist; very stiff; red (10R 4/6) with light gray and yellow mottles; clayey quartz and phyllite gravelly silt; no plasticity; cohesive; Residuum
30	272.56	9 27 50/5"	SS	20	moist; very hard; red (10R 4/8) with maroon mottles; silty clay; low plasticity; cohesive; Residuum
35	267.56	34 50/5"	SS	15	moist; very hard; red (10R 4/8) with maroon mottles; silty clay; low plasticity; cohesive; Residuum
40	262.56	50/5"	SS	12	dry; very compact; weak red (10R 4/4); clayey silty fine to coarse sand; no plasticity or cohesion; Partially Weathered Rock
45	257.56	50/5"	SS	10	moist; very hard; red (10R 4/8); highly horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
50					

Auger Refusal @ 35'

Well: PZ-8
TOC Elev.: 304.85



WELL CONSTRUCTION RECORD
This form can be used for single or multiple wells

For Internal Use ONLY:

1. Well Contractor Information:

Robert M CASSELL JR.

Well Contractor Name

NC WC 4143-A

NC Well Contractor Certification Number

SUMMIT

Company Name

2. Well Construction Permit #: ______

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐Agricultural
- ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply)
- ☐Residential Water Supply (single)
- ☐Industrial/Commercial
- ☐Residential Water Supply (shared)
- ☐Irrigation

Non-Water Supply Well:
- ☒Monitoring
- ☐Recovery

Injection Well:
- ☐Aquifer Recharge
- ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery
- ☐Salinity Barrier
- ☐Aquifer Test
- ☐Stormwater Drainage
- ☐Experimental Technology
- ☐Subsidence Control
- ☐Geothermal (Closed Loop)
- ☐Tracer
- ☐Geothermal (Heating/Cooling Return)
- ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-21-14 **Well ID#** PZ-8

5a. Well Location:

Facility/Owner Name ______ Facility ID# (if applicable) ______

1303 BRICKYARD RD SANFORD NC

Physical Address, City, and Zip

LEE

County ______ Parcel Identification No. (PIN) ______

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

______ N ______ W

6. Is (are) the well(s): ☒Permanent or ☐Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 42' (ft.)

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ______ (ft.)

If water level is above casing, use "+"

11. Borehole diameter: 6" (in.)

12. Well construction method: HSA

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ______ **Method of test:** ______

13b. Disinfection type: ______ **Amount:** ______

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	32 ft.	2 in.	SCH 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
32 ft.	42 ft.	2 in.	.010	SCH 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
0 ft.	28 ft.	Port.	Tremie
28 ft.	30 ft.	Bent.	SEAL
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
30 ft.	42 ft.	well sand	Tremie Down
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.2 ft.	yell. orng. Cl Si
3.2 ft.	ft.	Reddish Fi TRI Si.
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	45.0 ft.	
ft.	ft.	

21. REMARKS

22. Certification:

Signature of Certified Well Contractor ______ Date 7-29-14

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:
You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells:
Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-9s and 9

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/21/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/21/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	288.11'/288.11'
Drillers Name:	Robert Cassell	Ground Surface Elev.:	285.74'
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	slight cut

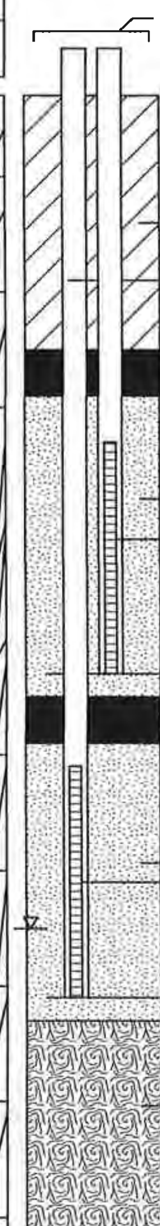
Water Levels
1 Hour = dry/dry
24 Hours = dry/36.03' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	285.74	3 4 6	SS	16	moist; stiff; yellowish red (5YR 5/6) with rust mottles; silty clay; low plasticity; cohesive; Soil Horizon
5	280.74	3 4 8	SS	16	moist; stiff; light yellow brown (2.5 Y 6/3) with light orange mottles; silty clay; low plasticity; cohesive; Soil Horizon
10	275.74	3 4 7	SS	16	moist; stiff; light yellowish brown (2.5Y 6/3) with rust and maroon mottles; silty clay; low plasticity; cohesive; Soil Horizon
15	270.74	12 15 32	SS,BAG	22	dry; compact; weak red (10R 4/3) with white and gray specks; silty fine to coarse sand with phyllite gravel; no plasticity or plasticity; Residuum; (Lab Results: PZ-9 Bag (13.5-15'); USCS=SC; Gravel=0.4%; Sand=52.2; Silt=35.9; Clay=11.5%; Effective Porosity=17; Atterberg Limits: PL=20, LL=34, PI=14)
20	265.74	50/5"	SS	8	dry; very hard; weak red (10R 4/3); highly horizontal fissile; fine sandy silt; no plasticity; cohesive; Partially Weathered Rock
25	260.74	34 50/4"	SS	8	dry; very compact; weak red (10R 4/3) with white and gray specks; silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
30	255.74	50/5"	SS	6	dry; very compact; weak red (10R 4/3) with white and gray specks; silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
35	250.74	50/5"	SS	4	dry; very compact; weak red (10R 4/3) with white and gray specks; medium horizontal fissile; silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
40	245.74	50/5"	SS	8	dry; very hard; reddish brown (2.5YR 4/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
45	240.74	50/3"	SS	10	dry; very hard; reddish brown (2.5YR 4/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
50	235.74	50/ 5"	SS	3	dry; very hard; reddish brown (2.5YR 4/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
55					

Auger Refusal @ 49'

Well1: PZ-9s
Well2: PZ-9
TOC Elev. 288.11':



WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

1. Well Contractor Information:

Robert M Gassell Jr

Well Contractor Name

NCWC - 4143 -A

NC Well Contractor Certification Number

Summit

Company Name

2. Well Construction Permit #: P2-95 P2-9

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well: P2-95 P2-9

- ☐Agricultural
- ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply)
- ☐Residential Water Supply (single)
- ☐Industrial/Commercial
- ☐Residential Water Supply (shared)
- ☐Irrigation

Non-Water Supply Well:

- ☒Monitoring
- ☐Recovery

Injection Well: P2-95 P2-9

- ☐Aquifer Recharge
- ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery
- ☐Salinity Barrier
- ☐Aquifer Test
- ☐Stormwater Drainage
- ☐Experimental Technology
- ☐Subsidence Control
- ☐Geothermal (Closed Loop)
- ☐Tracer
- ☐Geothermal (Heating/Cooling Return)
- ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-21-14 **Well ID#** P2-95 P2-9

5a. Well Location:

Facility/Owner Name

Facility ID# (if applicable)

1303 Brickyard Rd. Sanford NC

Physical Address, City, and Zip

Lee

County

Parcel Identification No. (PIN)

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

N W

6. Is (are) the well(s): ☒Permanent or ☐Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 2

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: P2-95 25 / P2-9, 39 (ft.)

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: (ft.)

If water level is above casing, use "+"

11. Borehole diameter: 10" (in.)

12. Well construction method: HSA

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ______ **Method of test:** ______

13b. Disinfection type: ______ **Amount:** ______

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	15 ft.	2 in.	Sch 40	PVC
+2 ft.	29 ft.	2 in.	Sch 40	PVC

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
15 ft.	25 ft.	2 in.	.010	Sch 40	PVC
29 ft.	39 ft.	2 in.	.010	Sch 40	PVC

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
0 ft.	11 ft.	Port	Trimmie
11 ft.	13 ft.	Bent.	
26 ft.	28 ft.	Bent.	

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
13 ft.	25 ft.	Well Sand	Trickle Down
27 ft.	39 ft.	Well Sand	Trickle Down

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.0 ft.	Yellow & org Cl Si
3.0 ft.	ft.	Reddish Si (TRI)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	40.0 ft.	

21. REMARKS

* 2 wells constructed in one Bore Hole.

22. Certification:

7-29-14

Signature of Certified Well Contractor | Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-10

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

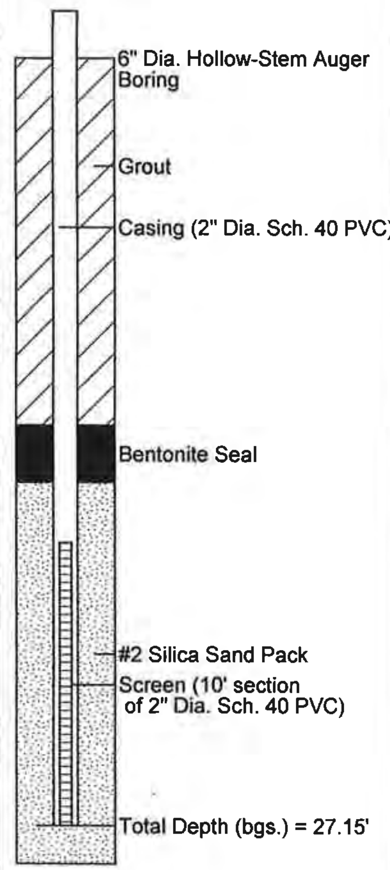
Date Started:	7/21/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/21/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	266.51'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	263.48'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	slight cut

Water Levels
- 1 Hour = dry
- 24 Hours = dry

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Well: PZ-10
TOC Elev.: 266.51

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	263.48	3, 5, 6	SS	24	moist; stiff; reddish yellow (7.5YR 6/6) with light gray and rust mottles; silty clay; no plasticity; cohesive; Soil Horizon
5	258.48	11, 13, 14	SS	14	dry; very stiff; red (2.5YR 4/8) with maroon and light gray mottles; clayey fine sandy silt; no plasticity; cohesive; Residuum
10	253.48	13, 50/4"	SS	12	dry; very hard; red (2.5YR 4/6) with black vertical planes; blocky; silty clay; no plasticity; cohesive; Partially Weathered Rock
15	248.48	50/3"	SS	3	dry; very hard; red (2.5YR 4/6) with black vertical planes; highly horizontal fissile; mica sandy silty clay; low plasticity; cohesive; Partially Weathered Rock
20	243.48	50/1"	SS	2	dry; very compact; weak red (10R 5/3); silty fine to coarse sand with quartz and phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
25	238.48	50/6"	SS	12	dry; very hard; red (10R 4/6); highly horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	233.48	29, 10, 16	SS,BAG	18	moist; very hard; red (10R 4/6) with light orange mottles; highly horizontal fissile; silty clay; no plasticity; cohesive; Residuum; (Lab Results: PZ-10 Bag (28.5-30'); USCS=CL; Sand=5.7%; Silt=74.0%; Clay=20.3%; Effective Porosity=5%; Atterberg Limits: PL=18, LL=36; PI=18)
35	228.48				
40	223.48				
45					



WELL CONSTRUCTION RECORD
This form can be used for single or multiple wells

1. Well Contractor Information:
Robert M CASSELL JR.
Well Contractor Name

NCWC 4143-A
NC Well Contractor Certification Number

SUMMIT
Company Name

2. Well Construction Permit #: ______
List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐Agricultural
- ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply)
- ☐Residential Water Supply (single)
- ☐Industrial/Commercial
- ☐Residential Water Supply (shared)
- ☐Irrigation

Non-Water Supply Well:
- ☒Monitoring
- ☐Recovery

Injection Well:
- ☐Aquifer Recharge
- ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery
- ☐Salinity Barrier
- ☐Aquifer Test
- ☐Stormwater Drainage
- ☐Experimental Technology
- ☐Subsidence Control
- ☐Geothermal (Closed Loop)
- ☐Tracer
- ☐Geothermal (Heating/Cooling Return)
- ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-21-14 **Well ID#** PZ-10

5a. Well Location:

______
Facility/Owner Name

Facility ID# (if applicable)

1303 BRICKYARD RD. SANFORD NC
Physical Address, City, and Zip

LEE
County

Parcel Identification No. (PIN)

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

______ N ______ W

6. Is (are) the well(s): ☐Permanent or ☒Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1
For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 27' (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ______ (ft.)
If water level is above casing, use "+"

11. Borehole diameter: 6" (in.)

12. Well construction method: HSA
(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ______ **Method of test:** ______

13b. Disinfection type: ______ **Amount:** ______

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	17 ft.	2 in.	SCH 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
17 ft.	27 ft.	2 in.	.010	SCH 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
15 ft.	13 ft.	Bent	Seal
13 ft.	0 ft.	Port	Tremie
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
27 ft.	15 ft.	Well SAND	Trickle Down
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	2.7 ft.	or yell cl si
2.7 ft.	ft.	Reddish si (TRI)
ft.	ft.	
ft.	ft.	
ft.	27.6 ft.	
ft.	ft.	
ft.	ft.	

21. REMARKS

22. Certification:

______ 7-29-14
Signature of Certified Well Contractor — Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:
You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

**Division of Water Resources, Information Processing Unit,
1617 Mail Service Center, Raleigh, NC 27699-1617**

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

**Division of Water Resources, Underground Injection Control Program,
1636 Mail Service Center, Raleigh, NC 27699-1636**

24c. For Water Supply & Injection Wells:
Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-11

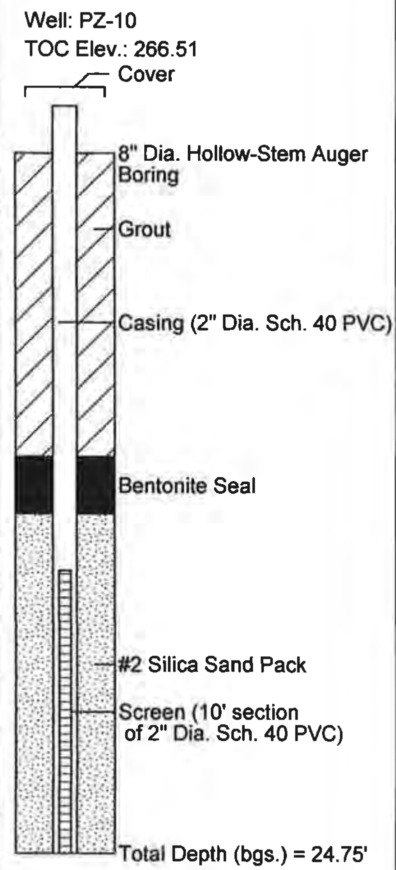
Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	: 7/22/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/22/14	Drilling Method:	: HSA; CME-550x
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 262.30'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 259.56'(Lawrence Survey)
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade:	: natural (drainage bottom)

Water Levels
- ▼ 1 Hour = dry
- ▽ 24 Hours = 19.59' bgs

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	263.48	3 7 9	SS	20	moist; very stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; quartz gravelly fine to coarse sandy clayey silt; no plasticity; cohesive; Soil Horizon
		3 7 5	SS	17	moist; stiff; yellowish red (5YR 4/6) with light gray mottles; fine mica sandy clayey silt; no plasticity; cohesive; Soil Horizon
5	258.48		ST	6	dry; red (2.5YR 4/6), mica and quartz sandy silt; low plasticity; cohesive; Residuum; (Lab Results: PZ-11 UD (6-6.5'); USCS=SM; Gravel=4.8%; Sand=65.5%; Silt=22.6%; Clay=7.1%; Specific Gravity=2.71; Hydraulic Conductivity=3.86 x 10-6 cm/sec; Total Porosity=19.7%; Effective Porosity=25%)
		39 50/3"	SS	12	
10	253.48				dry; very hard; weak red (10R 4/3); silty fine to coarse sand with gravel; no plasticity; cohesive; Partially Weathered Rock
15	248.48	16 36 50/6"	SS	15	moist; very hard; red (2.5YR 4/6) with black and purple mottles; medium horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
20	243.48	15 36 50/4"	SS	20	moist; very hard; red (2.5YR 4/6) with black and purple mottles; highly horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
25	238.48	20 10 8	SS,BAG	16	wet; very stiff; red (2.5YR 4/6) with black and purple mottles; highly horizonatl fissile; silty clay with rock and gravel layers; no plasticity; cohesive; Residuum
30	233.48				
35	228.48				
40	223.48				
45					



WELL CONSTRUCTION RECORD
This form can be used for single or multiple wells

1. Well Contractor Information:
Robert M CASSELL JR.
Well Contractor Name

NCWC 4143-A
NC Well Contractor Certification Number

SUMMIT
Company Name

2. Well Construction Permit #: ______
List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐Agricultural ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply) ☐Residential Water Supply (single)
- ☐Industrial/Commercial ☐Residential Water Supply (shared)
- ☐Irrigation

Non-Water Supply Well:
- ☒Monitoring ☐Recovery

Injection Well:
- ☐Aquifer Recharge ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery ☐Salinity Barrier
- ☐Aquifer Test ☐Stormwater Drainage
- ☐Experimental Technology ☐Subsidence Control
- ☐Geothermal (Closed Loop) ☐Tracer
- ☐Geothermal (Heating/Cooling Return) ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-22-14 **Well ID#** PZ-11

5a. Well Location:

______ Facility/Owner Name ______ Facility ID# (if applicable)

1303 BRICKYARD RD. SANFORD NC
Physical Address, City, and Zip

LEE
County ______ Parcel Identification No. (PIN)

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

______ N ______ W

6. Is (are) the well(s): ☒Permanent or ☐Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1
For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 24.5' (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ______ (ft.)
If water level is above casing, use "+"

11. Borehole diameter: 10" (in.)

12. Well construction method: HSA
(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ______ **Method of test:** ______

13b. Disinfection type: ______ **Amount:** ______

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	14.5 ft.	2 in.	Sch. 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
14.5 ft.	24.5 ft.	2 in.	.010	SC 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
12.5 ft.	10.5 ft.	Bent.	SLAB
10.5 ft.	0.0 ft.	Port.	Tremie
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
12.5 ft.	24.5 ft.	well sand	tremie pour
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.2 ft.	or yel cl si.
3.2 ft.	ft.	Reddish si (TRI)
ft.	ft.	
ft.	ft.	
ft.	25.0 ft.	
ft.	ft.	
ft.	ft.	

21. REMARKS

22. Certification:

______ 7-29-14
Signature of Certified Well Contractor Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:
You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

**Division of Water Resources, Information Processing Unit,
1617 Mail Service Center, Raleigh, NC 27699-1617**

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

**Division of Water Resources, Underground Injection Control Program,
1636 Mail Service Center, Raleigh, NC 27699-1636**

24c. For Water Supply & Injection Wells:
Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-12

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

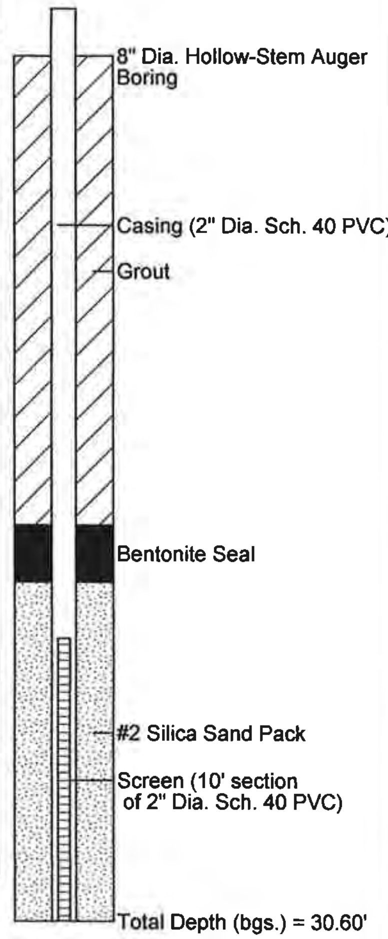
Date Started:	: 7/22/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/22/14	Drilling Method:	: HSA; CME-550x
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 287.15'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 284.32'(Lawrence Survey)
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade:	: natural

Water Levels
1 Hour = dry
24 Hours = dry

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Well: PZ-12
TOC Elev.: 287.15

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	284.32	2 3 3 4	SS	16	moist; medium; yellowish red (5YR 5/8) with brown mottles; clayey, quartz gravelly silt and silty clay; low plasticity; cohesive; Soil Horizon
5	279.32	4 5 8	SS	14	moist; stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; silty clay; medium plasticity; cohesive; Soil Horizon
10	274.32	3 4 7	SS	13	moist; stiff; red (2.5YR 4/6) with green and black specks; fine to medium sandy clayey silt; low plasticity; cohesive; Residuum
15	269.32	5 26 50/4"	SS	15	moist; very hard; red (2.5YR 4/6) with green and black specks; medium horizontal fissile; mica sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock
20	264.32	12 12 16	SS,BAG	21	moist; very stiff; red (2.5YR 4/6) with purple mottles; blocky; silty clay; no plasticity; cohesive; Residuum; (Lab Results: PZ-12 Bag (18.5-20'); USCS=CL; Sand=0.7%; Silt=66.5%; Clay=32.8%; Effective Porosity=2%; Atterberg Limits: PL=20, LL=42, PI=22)
25	259.32	50/3"	SS	8	dry; very hard; red (2.5YR 5/6); horizontal fissile; weathered fine sandy mudstone; Partially Weathered Rock
30	254.32	50/3"	SS	10	dry; very hard; red (2.5YR 5/6); horizontal fissile; weathered fine sandy mudstone; Partially Weathered Rock
35	249.32				
40	244.32				
45					



WELL CONSTRUCTION RECORD
This form can be used for single or multiple wells

1. Well Contractor Information:

Robert M Cassell Jr.

Well Contractor Name

NCWC 4143-A

NC Well Contractor Certification Number

Summit

Company Name

2. Well Construction Permit #: ____________________
List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:	
☐Agricultural	☐Municipal/Public
☐Geothermal (Heating/Cooling Supply)	☐Residential Water Supply (single)
☐Industrial/Commercial	☐Residential Water Supply (shared)
☐Irrigation	
Non-Water Supply Well:	
☒Monitoring	☐Recovery
Injection Well:	
☐Aquifer Recharge	☐Groundwater Remediation
☐Aquifer Storage and Recovery	☐Salinity Barrier
☐Aquifer Test	☐Stormwater Drainage
☐Experimental Technology	☐Subsidence Control
☐Geothermal (Closed Loop)	☐Tracer
☐Geothermal (Heating/Cooling Return)	☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-22-14 **Well ID#** P2-1R

5a. Well Location:

Facility/Owner Name ____________________ Facility ID# (if applicable) ____________________

1303 BRICKYARD RD, SANFORD NC

Physical Address, City, and Zip

LEE

County ____________________ Parcel Identification No. (PIN) ____________________

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

____________________ N ____________________ W

6. Is (are) the well(s): ☐**Permanent** or ☒**Temporary**

7. Is this a repair to an existing well: ☐**Yes** or ☐**No**
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1
For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 30.5' **(ft.)**
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ____________________ **(ft.)**
If water level is above casing, use "+"

11. Borehole diameter: 10 **(in.)**

12. Well construction method: HSA
(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ____________ **Method of test:** ____________

13b. Disinfection type: ____________ **Amount:** ____________

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	20.5 ft.	2 in.	Sc 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
20.5 ft.	30.5 ft.	2 in.	.010	Sc 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
18.5 ft.	16.5 ft.	Bent.	Seal
0.0 ft.	16.5 ft.	Port.	Tremie
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
18.5 ft.	30.5 ft.	well sand	Trickle Down
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.5 ft.	Yell org cl si
3.5 ft.	ft.	Reddish si (TR)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	32.0 ft.	
ft.	ft.	

21. REMARKS

22. Certification:

Signature of Certified Well Contractor 7-29-14 Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:
You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells:
Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-13

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	: 7/22/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/22/14	Drilling Method:	: HSA; CME-550x
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 296.59'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 293.48'(Lawrence Survey)
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade:	: natural

Water Levels
- 1 Hour = dry
- 24 Hours = dry

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Well: PZ-12
TOC Elev.: 296.59

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	293.48	3 8 5	SS,BAG	10	moist; medium compact; brownish yellow (10YR 6/6) with white specks; clayey silty quartz sandy gravel; no plasticity or cohesion; Soil Horizon; (Lab Results: PZ-13 Bag (0-1.5'); USCS=SC-SM; Gravel=36.1%; Sand=37.2%; Silt=19.4%; Clay=7.3%; Effective Porosity=25%; Atterberg Limits: PL=17, LL=21, PI=4)
5	288.48	4 6 6	SS	21	moist; stiff; red (2.5YR 4/6); fine to medium sandy silt and silty clay layers; low plasticity; cohesive; Residuum
10	283.48	17 50/5"	SS	6	moist; very hard; red (2.5YR 4/6); silty clay with large quartz gravel; no plasticity; cohesive; Residuum
15	278.48	11 17 50/6"	SS	24	moist; very hard; weak red (10R 5/3) with light green mottles; medium horizontal fissile; silty clay; no plasticity; cohesive; Residuum
20	273.48	11 15 22	SS	20	moist; hard; pinkish gray (7.5YR 6/2) with black vertical and 45 degree planes; medium horizontal fissile; silty clay; no plasticity; cohesive; Residuum
25	268.48	11 50/6"	SS	18	moist; very hard; gray (7.5YR 5/1); medium horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	263.48	11 15 50/5"	SS	22	moist; very hard; gray (7.5YR 5/1); medium horizontal fissile; silty clay; no plasticity; cohesive; Residuum
35	258.48	50/1"	SS	3	dry; very hard; dark blueish gray (Gley 2 4/1); weathered mudstone; Partially Weathered Rock
40	253.48				
45					

Auger Refusal @ 35'

WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

1. Well Contractor Information:

Robert M CASSELL JR

Well Contractor Name

NCWC 4H3-A

NC Well Contractor Certification Number

SUMMIT

Company Name

2. Well Construction Permit #: ______________________

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:

- ☐Agricultural
- ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply)
- ☐Residential Water Supply (single)
- ☐Industrial/Commercial
- ☐Residential Water Supply (shared)
- ☐Irrigation

Non-Water Supply Well:

- ☒Monitoring
- ☐Recovery

Injection Well:

- ☐Aquifer Recharge
- ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery
- ☐Salinity Barrier
- ☐Aquifer Test
- ☐Stormwater Drainage
- ☐Experimental Technology
- ☐Subsidence Control
- ☐Geothermal (Closed Loop)
- ☐Tracer
- ☐Geothermal (Heating/Cooling Return)
- ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-22-14 **Well ID#** PZ-13

5a. Well Location:

______________________ Facility/Owner Name

______________________ Facility ID# (if applicable)

1303 BRICKYARD RD. SANFORD NC

Physical Address, City, and Zip

LEE

County

______________________ Parcel Identification No. (PIN)

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

______________________ N ______________________ W

6. Is (are) the well(s): ☐**Permanent** or ☒**Temporary**

7. Is this a repair to an existing well: ☐**Yes** or ☒**No**

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 33.5' **(ft.)**

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ______________________ **(ft.)**

If water level is above casing, use "+"

11. Borehole diameter: 10 **(in.)**

12. Well construction method: HSA

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ____________ **Method of test:** ____________

13b. Disinfection type: ____________ **Amount:** ____________

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
0.0 ft.	23.5 ft.	2 in.	Sch 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
23.5 ft.	33.5 ft.	2 in.	.010	Sch 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
~~[illegible]~~	~~[illegible]~~ ft.		
19.5 ft.	21.5 ft.	Bent	Seal
0.0 ft.	19.5 ft.	Port	Tremmie

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
21.5 ft.	33.5 ft.	well sand	[illegible]
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	7.0 ft.	Yell OR Cl Si
3.0 ft.	ft.	Reddish Si (TRI)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	35.0 ft.	
ft.	ft.	

21. REMARKS

22. Certification:

Signature of Certified Well Contractor — Date 7-27-14

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells:
Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-14

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	322.15'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	319.44'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

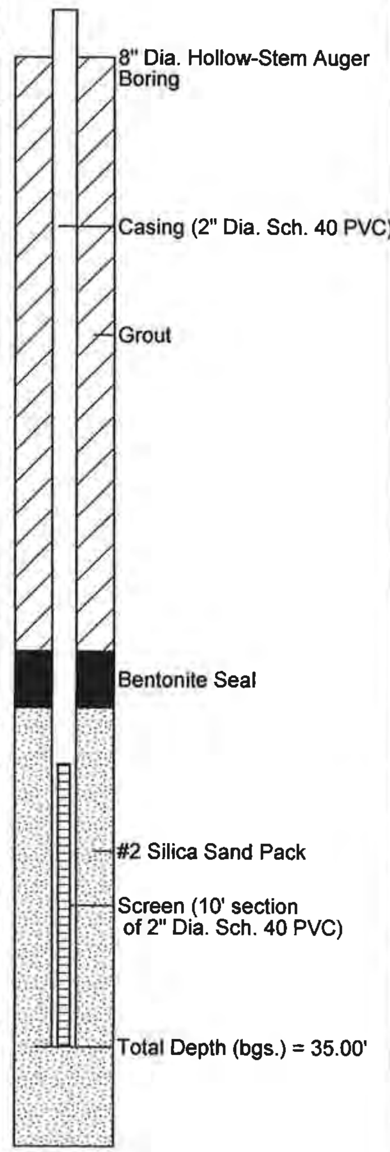
Water Levels
- 1 Hour = dry
- 24 Hours = dry

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	319.44	3 6 7	SS	16	moist; stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; gravelly silty clay; low plasticity; cohesive; Soil Horizon
5	314.44	4 5 6	SS	18	moist; stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; gravelly silty clay; low plasticity; cohesive; Soil Horizon
			ST	12	moist; reddish yellow (7.5YR 6/8) with rust and light gray mottles; large quartz gravelly silty clay; low plasticity; cohesive; Soil Horizon; (Lab Results: PZ-14 UD (6-7'); USCS=CH; Gravel=1.8%; Sand=18.4%; Silt=37.7; Clay=42.1%; Specific Gravity=2.67; Hydraulic Conductivity=1.35 x 10-7 cm/sec; Total Porosity=38.6%; Effective Porosity=2%; Atterburg Limits: PI=28, LL=55, PI=27)
10	309.44	5 6 8	SS	15	moist; stiff; red (10R 4/6) with white specks; clayey quartz gravelly fine to coarse sandy silt; no plasticity, cohesive; Residuum
15	304.44	6 8 10	SS	18	moist; very stiff; red (10R 4/6) with white specks; clayey quartz gravelly fine to coarse sandy silt; no plasticity; cohesive; Residuum
20	299.44	6 7 11	SS	20	moist; very stiff; red (10R 4/8); silty clay; low plasticity; cohesive; Residuum
25	294.44	18 21 43	SS	18	moist; very hard; weak red (10R 5/3) with white and gray specks; fine to medium sandy silty clay; low plasticity; cohesive; Residuum
30	289.44	50/5"	SS	10	dry; very hard; red (10R 4/6); medium horizontal fissile; clayey fine to medium sandy silt; no plasticity; cohesive; Partially Weathered Rock
35	284.44	50/1"	SS	6	moist; very hard; weak red (10R 4/6); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
40	279.44	50/0"	SS	1	moist; very hard; weak red (10R 4/3); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
45					

Auger Refusal @ 39'

Well: PZ-14
TOC Elev.: 322.15



WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

For Internal Use ONLY:

1. Well Contractor Information:

Robert M CASSIELL JR

Well Contractor Name

NCWC 4143-A

NC Well Contractor Certification Number

Summ IT

Company Name

2. Well Construction Permit #: ______

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:

☐Agricultural ☐Municipal/Public
☐Geothermal (Heating/Cooling Supply) ☐Residential Water Supply (single)
☐Industrial/Commercial ☐Residential Water Supply (shared)
☐Irrigation

Non-Water Supply Well:

☒Monitoring ☐Recovery

Injection Well:

☐Aquifer Recharge ☐Groundwater Remediation
☐Aquifer Storage and Recovery ☐Salinity Barrier
☐Aquifer Test ☐Stormwater Drainage
☐Experimental Technology ☐Subsidence Control
☐Geothermal (Closed Loop) ☐Tracer
☐Geothermal (Heating/Cooling Return) ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-23-14 **Well ID#** PZ-14

5a. Well Location:

______ ______

Facility/Owner Name Facility ID# (if applicable)

1303 BACKYARD RD, SANFORD NC

Physical Address, City, and Zip

LEE

County Parcel Identification No. (PIN)

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

______ N ______ W

6. Is (are) the well(s): ☐Permanent or ☒Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 35' **(ft.)**

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ______ **(ft.)**

If water level is above casing, use "+"

11. Borehole diameter: 10" **(in.)**

12. Well construction method: HSA

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ______ **Method of test:** ______

13b. Disinfection type: ______ **Amount:** ______

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
0.0 ft.	25 ft.	2 in.	sec 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
25 ft.	35 ft.	2 in.	.010	sec 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
21 ft.	23 ft.	Bent	Seal
0.0 ft.	21 ft.	Port	Tremmie
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
23 ft.	35 ft.	well sand	Tickle Down
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.1 ft.	or yellow si
3.1 ft.	ft.	Reddish si (TRI)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	35 ft.	
ft.	ft.	

21. REMARKS

22. Certification:

______ 7-27-14

Signature of Certified Well Contractor Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells:

Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-15s and 15

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

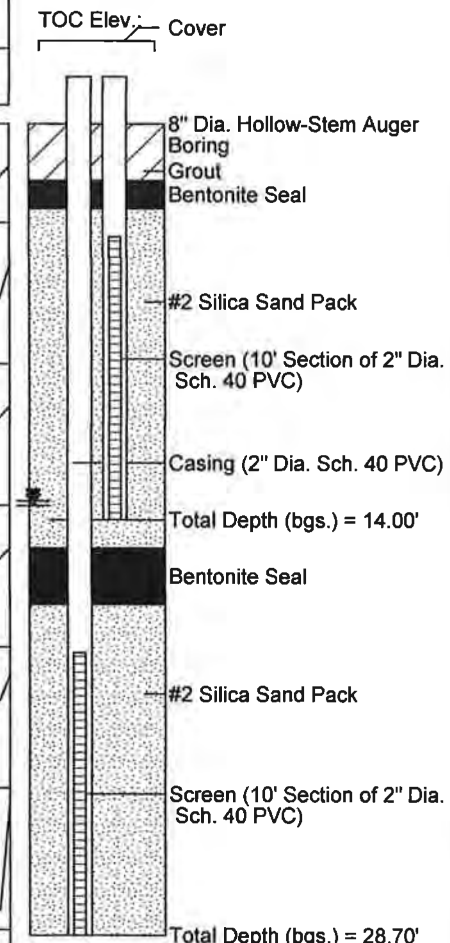
Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	303.11'/303.24'
Drillers Name:	Robert Cassell	Ground Surface Elev.:	300.63'
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

Water Levels
- ▼ 1 Hour = 13.48'/15.34' bgs
- ▽ 24 Hours = 13.65'/13.31' bgs

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)
0	300.63
5	295.63
10	290.63
15	285.63
20	280.63
25	275.63
30	270.63
35	265.63
40	260.63
45	

Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
5 6 6	SS	18	moist; medium; yellowish red (7.5YR 6/6); coarse quartz sandy silty clay; medium plasticity; cohesive; Soil Horizon
5 7 11	SS	20	moist; very stiff; yellow (10YR 7/6) with rust and orange mottles; coarse quartz sandy silty clay; low plasticity; cohesive; Soil Horizon
7 9 13	SS	21	moist; very stiff; red (2.5YR 4/6) with light gray and yellow mottles; silty clay; medium plasticity; cohesive; Residuum
12 17 28	SS	18	moist; hard; red (10R 4/6) with white specks; blocky; silty clay; low plasticity; cohesive; Residuum
24 50/4"	SS	18	moist; very hard; red (2.5YR 4/6) with white specks; blocky; silty clay; low plasticity; cohesive; Residuum
50/6"	SS,BAG	16	wet; very hard; red (10R 4/6) with white specks; medium horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-15 Bag (23.5-24'): USCS=CL; Gravel=0.7%; Sand=4.5%; Silt=52.8%; Clay=19.9%; Effective Porosity=8; Atterberg Limits: PI=16, LL=32, PI=16)
50/5"	SS	18	wet; very hard; weak red (10R 5/4) with light gray specks; highly horizontal fissile; weathered mudstone; Partially Weathered Rock



WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

1. Well Contractor Information:

Robert M Cassell, Jr.

Well Contractor Name

NCWC 4143-A

NC Well Contractor Certification Number

Summit

Company Name

2. Well Construction Permit #: PZ-15S PZ-15

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well: PZ-15S PZ-15

☐Agricultural ☐Municipal/Public

☐Geothermal (Heating/Cooling Supply) ☐Residential Water Supply (single)

☐Industrial/Commercial ☐Residential Water Supply (shared)

☐Irrigation

Non-Water Supply Well:

☒Monitoring ☐Recovery

Injection Well:

☐Aquifer Recharge ☐Groundwater Remediation

☐Aquifer Storage and Recovery ☐Salinity Barrier

☐Aquifer Test ☐Stormwater Drainage

☐Experimental Technology ☐Subsidence Control

☐Geothermal (Closed Loop) ☐Tracer

☐Geothermal (Heating/Cooling Return) ☐Other (explain under #21 Remarks)

PZ-15S PZ-15

4. Date Well(s) Completed: 7-23-14 **Well ID#** PZ-15S PZ-15

5a. Well Location:

Facility/Owner Name Facility ID# (if applicable)

1303 Brickyard Rd. Sanford NC

Physical Address, City, and Zip

Lee

County Parcel Identification No. (PIN)

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

________ N ________ W

6. Is (are) the well(s): ☒Permanent or ☐Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 2

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: PZ-15S 14' PZ-15 28.5' (ft.)

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ________ (ft.)

If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

12. Well construction method: HSA

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ______ **Method of test:** ______

13b. Disinfection type: ______ **Amount:** ______

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	4 ft.	2 in.	Sch 40	PVC
+2 ft.	18.5 ft.	2 in.	Sch 40	PVC

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
4 ft.	14 ft.	2 in.	.010	Sch 40	PVC
18.5 ft.	28.5 ft.	2 in.	.010	Sch 40	PVC

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
0.0 ft.	2.0 ft.	Port	Pumped
ft.	ft.		
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
14 ft.	2 ft.	well sand	Trickle Down
28.5 ft.	16.5 ft.	well sand	Trickle Down

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	2.8 ft.	or yellow cl si
2.8 ft.	ft.	Reddish si (PWR)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	30.0 ft.	
ft.	ft.	

21. REMARKS

2 wells constructed in one Bore Hole.

22. Certification:

[signature] 7-29-14

Signature of Certified Well Contractor Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells:

Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-16

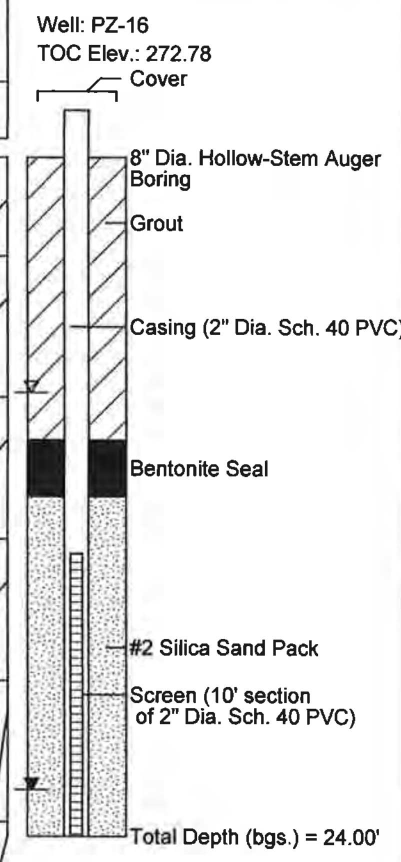
Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	: 7/23/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/23/14	Drilling Method:	: HSA; CME-550x
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 272.78'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 270.63'(Lawrence Survey)
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade:	: natural (drainage bottom)

Water Levels
- 1 Hour = 22.35' bgs
- 24 Hours = 8.33' bgs

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	270.63	4 5 6	SS	24	moist; stiff; strong brown (7.5YR 5/6) with white specks; quartz gravelly clayey silt; no plasticity; cohesive; Soil Horizon
5	265.63	3 5 5	SS	16	moist; stiff; yellowish red (5YR 4/6) with light gray mottles; silty clay; low plasticity; cohesive; Soil Horizon
10	260.63	32 35 39	SS	14	dry; very hard; dark red (10R 3/6); horizontal fissile; weathered mudstone; Residuum
15	255.63	17 31 50/5"	SS	16	moist; very hard; red (10R 4/6) with purple mottles; mica sandy silty clay; no plasticity; cohesive; Residuum
20	250.63	24 50/5"	SS,BAG	10	moist; very hard; red (10R 4/6) with purple mottles; silty clay; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-16 Bag (18.5-20'): USCS=CL; Sand=3.1%; Silt=65.5%; Clay=31.4%; Effective Porosity=3; Atterberg Limits: PI=19, LL=38, PI=19)
25	245.63	50/3"	SS	6	wet; very hard; red (10R 4/6) with purple mottles; highly horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	240.63				
35	235.63				
40	230.63				
45					



WELL CONSTRUCTION RECORD
This form can be used for single or multiple wells

1. Well Contractor Information:

Robert M Cassell JR

Well Contractor Name

NCWC 4143-A

NC Well Contractor Certification Number

Summit

Company Name

2. Well Construction Permit #: ____________________

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐Agricultural ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply) ☐Residential Water Supply (single)
- ☐Industrial/Commercial ☐Residential Water Supply (shared)
- ☐Irrigation

Non-Water Supply Well:
- ☒Monitoring ☐Recovery

Injection Well:
- ☐Aquifer Recharge ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery ☐Salinity Barrier
- ☐Aquifer Test ☐Stormwater Drainage
- ☐Experimental Technology ☐Subsidence Control
- ☐Geothermal (Closed Loop) ☐Tracer
- ☐Geothermal (Heating/Cooling Return) ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-23-14 **Well ID#** PZ-16

5a. Well Location:

Facility/Owner Name ____________ Facility ID# (if applicable) ____________

1303 Brickyard Rd, Sanford NC

Physical Address, City, and Zip

Lee

County ____________ Parcel Identification No. (PIN) ____________

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

____________ N ____________ W

6. Is (are) the well(s): ☐Permanent or ☐Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 24 **(ft.)**

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ____________ **(ft.)**

If water level is above casing, use "+"

11. Borehole diameter: 10 **(in.)**

12. Well construction method: HSA

(i.e auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ________ **Method of test:** ________

13b. Disinfection type: ________ **Amount:** ________

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	14 ft.	2 in.	Sch 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
14 ft.	24 ft.	2 in.	.010	Sch 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
10 ft.	12 ft.	Bent	Seal
0.0 ft.	10 ft.	Port	Tremmie
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
24 ft.	12 ft.	Well Sand	Tackle Down
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	1.7 ft.	Brownish moist si
17 ft.	ft.	Reddish si (TRI)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	24 ft.	

21. REMARKS

22. Certification:

Signature of Certified Well Contractor 7-29-14 Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-17s and 17

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

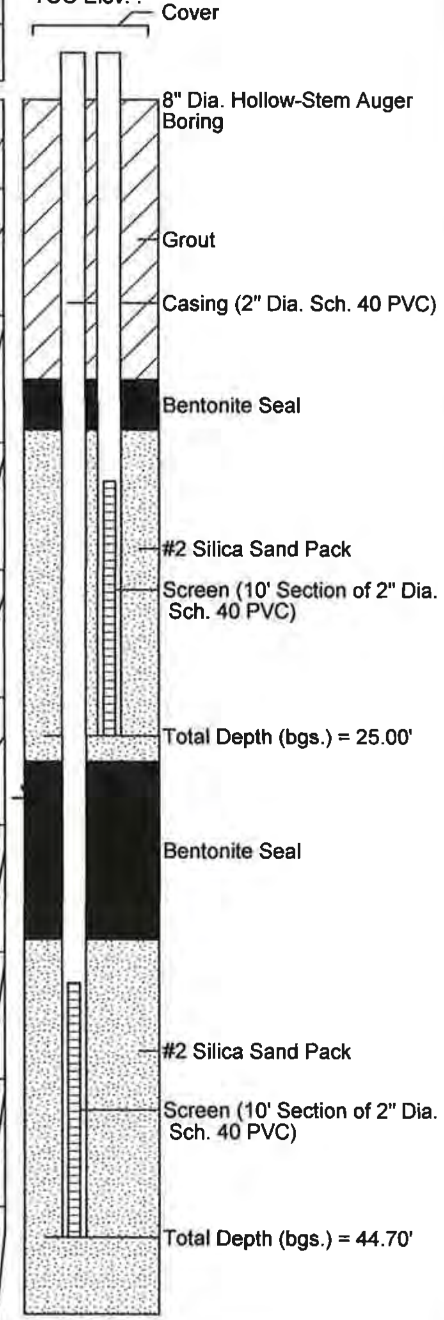
Date Started:	: 7/23/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/23/14	Drilling Method:	: HSA; CME-550x
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 306.62'/306.56'
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 304.00'
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade:	: natural

Water Levels
▼ 1 Hour = dry/27.44"
▽ 24 Hours = dry/27.46" bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	304	3 4 5	SS	24	moist; stiff; reddish brown (5YR 4/4); silty clay; medium plasticity; cohesive; Residuum
5	299	3 5 7	SS	16	moist; stiff; reddish brown (5YR 4/4); silty clay with mudstone rock fragments; medium plasticity; cohesive; Residuum
10	294	50/4"	SS	14	dry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
15	289	50/6"	SS	8	ddry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
20	284	29 50/2"	SS	12	dry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
25	279	18 34 26	SS	18	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissile; weathered mudstone; Residuum
30	274	25 50/3"	SS	12	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissile; weathered mica sandy mudstone; Partially Weathered Rock
35	269	50/3"	SS	8	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissile; weathered mica sandy mudstone; Partially Weathered Rock
40	264	50/4"	SS	6	very moist; very hard; weak red (2.5YR 4/2); blocky; fine sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock
45	259	39 50/3"	SS,BAG	14	wet; very hard; reddish brown (2.5YR 4/4); medium horizontal fissile; weathered mudstone; Partially Weathered Rock; (Lab Results: PZ-17 Bag (43.5-44.5'); USCS=CL; Sand=40.2%; Silt=48.9%; Clay=10.9%; Effective Porosity=16%; Atterberg Limits: PL=19, LL=32, PI=13)
50					

Well1: PZ-17s
Well2: PZ-17
TOC Elev. :



WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

For Internal Use ONLY:

1. Well Contractor Information:

Robert M Cassell JR

Well Contractor Name

NCWC 4143-A

NC Well Contractor Certification Number

Summit

Company Name

2. Well Construction Permit #: PZ-17S PZ-17

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐Agricultural
- ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply)
- ☐Residential Water Supply (single)
- ☐Industrial/Commercial
- ☐Residential Water Supply (shared)
- ☐Irrigation

PZ-17S PZ-17

Non-Water Supply Well:
- ☒Monitoring
- ☐Recovery

Injection Well:
- ☐Aquifer Recharge
- ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery
- ☐Salinity Barrier
- ☐Aquifer Test
- ☐Stormwater Drainage
- ☐Experimental Technology
- ☐Subsidence Control
- ☐Geothermal (Closed Loop)
- ☐Tracer
- ☐Geothermal (Heating/Cooling Return)
- ☐Other (explain under #21 Remarks)

PZ-17S PZ-17

4. Date Well(s) Completed: 7-24-14 **Well ID#** PZ-17S PZ-17

5a. Well Location:

Facility/Owner Name | Facility ID# (if applicable)

1303 Brickyard Rd. Sanford NC

Physical Address, City, and Zip

Lee

County | Parcel Identification No. (PIN)

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

_____ N _____ W

6. Is (are) the well(s): ☒Permanent or ☐Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 2

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: PZ-17S 25 PZ-17 44.5' (ft.)

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: _____ (ft.)

If water level is above casing, use "+"

11. Borehole diameter: 10" (in.)

12. Well construction method: HSA

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) _____ **Method of test:** _____

13b. Disinfection type: _____ **Amount:** _____

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	15 ft.	2 in.	Sch 40	PVC
+2 ft.	34.5 ft.	2 in.	Sch 40	PVC

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
15 ft.	25 ft.	2 in.	.010	Sch 40	PVC
34.5 ft.	44.5 ft.	2 in.	.010	Sch 40	PVC

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
13. ft.	11 ft.	Bent	Sur
11 ft.	0.0 ft.	Port	Tremie
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
25 ft.	13 ft.	well sand	Tremie Down
44.5 ft.	32.5 ft.	well sand	Tremie Down

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.2 ft.	Brown si
3.2 ft.	ft.	Reddish si (TRI)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	45.0 ft.	

21. REMARKS

2 wells constructed in same Bore Hole

22. Certification:

Signature of Certified Well Contractor | Date 7-29-14

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells:

Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-18

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	294.72'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	292.27'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

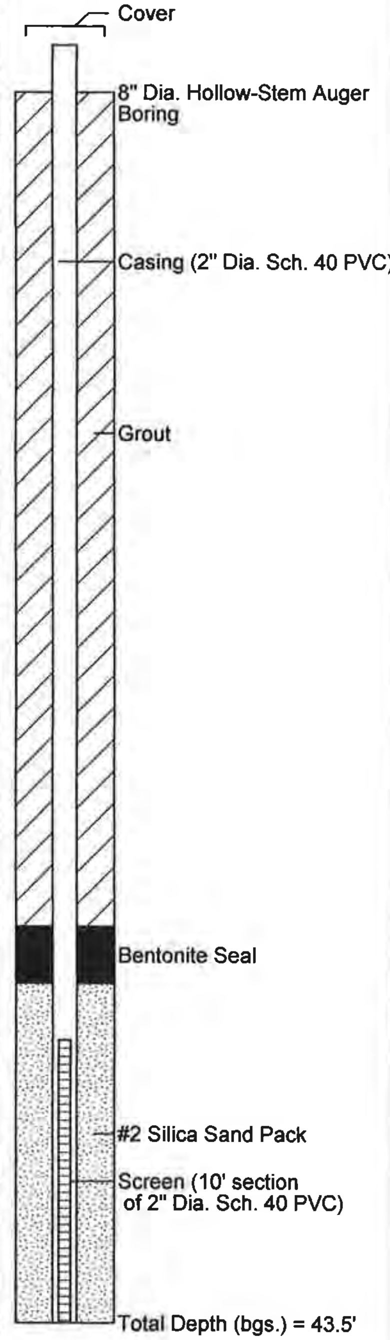
Water Levels
- 1 Hour = dry
- 24 Hours = dry

Sample Type
- SS = Split Spoon
- ST = Shelby Tube
- RC = Rock Core
- BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)
0	292.27
5	287.27
10	282.27
15	277.27
20	272.27
25	267.27
30	262.27
35	257.27
40	252.27
45	

Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
1 1 5	SS	22	moist; medium, brownish yellow (10R 6/6); slightly clayey silt; no plasticity; cohesive; Soil Horizon
4 4 5	SS	16	moist; stiff; reddish yellow (7.5YR 6/8) with tan and rust mottles; silty clay; medium plasticity; cohesive; Soil Horizon
5 7 12	SS	15	moist; very stiff; red (10R 4/8) with light green gray mottles; silty clay; low plasticity; cohesive; Residuum
27 21 24	SS	18	moist; hard; red (10R 4/8) with light green gray mottles; highly horizontal fissile; very fine sandy clayey silt; no plasticity; cohesive; Residuum
40 50/3"	SS,BAG	12	moist; very hard; red (10R 4/8) with light green gray mottles; highly horizontal fissile; very fine sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-18 Bag (18.5-19.5'); USCS=CL; Sand=24.4%; Silt=55.7%; Clay=19.9%; Effective Porosity=8%; Atterberg Limits: PL=17, LL=32, PI=15)
9 50/3"	SS	10	moist; very hard; red (10R 4/8) with black horizontal planes; blocky and medium horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
50/6"	SS	6	moist; very hard; red (10R 4/8); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
50/3"	SS	6	dry; very hard; weak red (10R 4/3); highly horizontal fissile; fine mica sandy silt; no plasticity; cohesive; Partially Weathered Rock
50/3"	SS	5	moist; very hard; red (10R 4/8); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
50/3"	SS	4	moist; very hard; red (10R 4/8) with purple mottles; blocky; weathered mudstone; Partially Weathered Rock

Well: PZ-18
TOC Elev.: 294.72



WELL CONSTRUCTION RECORD

This form can be used for single or multiple wells

1. Well Contractor Information:

Robert M Cassell Jr

Well Contractor Name

NCWC 4143-A

NC Well Contractor Certification Number

SUMMIT

Company Name

2. Well Construction Permit #: ______

List all applicable well permits (i.e. County, State, Variance, Injection, etc.)

3. Well Use (check well use):

Water Supply Well:

- ☐Agricultural
- ☐Municipal/Public
- ☐Geothermal (Heating/Cooling Supply)
- ☐Residential Water Supply (single)
- ☐Industrial/Commercial
- ☐Residential Water Supply (shared)
- ☐Irrigation

Non-Water Supply Well:

- ☒Monitoring
- ☐Recovery

Injection Well:

- ☐Aquifer Recharge
- ☐Groundwater Remediation
- ☐Aquifer Storage and Recovery
- ☐Salinity Barrier
- ☐Aquifer Test
- ☐Stormwater Drainage
- ☐Experimental Technology
- ☐Subsidence Control
- ☐Geothermal (Closed Loop)
- ☐Tracer
- ☐Geothermal (Heating/Cooling Return)
- ☐Other (explain under #21 Remarks)

4. Date Well(s) Completed: 7-24-14 **Well ID#** PZ-18

5a. Well Location:

Facility/Owner Name ______ Facility ID# (if applicable) ______

1303 BRICKYARD RD. SANFORD NC

Physical Address, City, and Zip

LEE

County ______ Parcel Identification No. (PIN) ______

5b. Latitude and Longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

______ N ______ W

6. Is (are) the well(s): ☒Permanent or ☐Temporary

7. Is this a repair to an existing well: ☐Yes or ☒No

If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. Number of wells constructed: 1

For multiple injection or non-water supply wells ONLY with the same construction, you can submit one form.

9. Total well depth below land surface: 43.5 (ft.)

For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: ______ (ft.)

If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

12. Well construction method: HSA

(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) ______ **Method of test:** ______

13b. Disinfection type: ______ **Amount:** ______

For Internal Use ONLY:

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2 ft.	33.5 ft.	2 in.	Sch 40	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
33.5 ft.	43.5 ft.	2 in.	.010	Sch 40	PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
31.5 ft.	29.5 ft.	BENT	SEAL
29.5 ft.	0.0 ft.	PORT	TRIMMIE
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
43.5 ft.	31.5 ft.	well sand	Trickle Down
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0.0 ft.	3.7 ft.	OR & yellow Cl Si
3.7 ft.	ft.	Reddish si (TRI)
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	45.0 ft.	

21. REMARKS

22. Certification:

Signature of Certified Well Contractor ______ Date 7-24-14

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:

You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells ONLY: In addition to sending the form to the address in 24a above, also submit a copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program, 1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells:

Also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-19

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

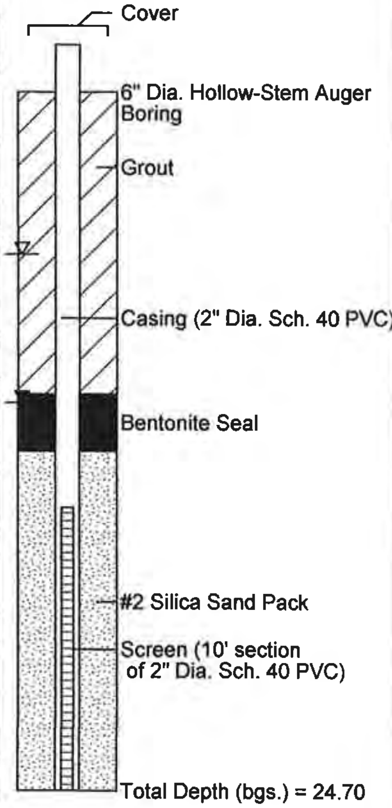
Date Started:	: 8/29/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/29/14	Drilling Method:	: HSA; Geoprobe 7822
Drilling Company:	: Environmental Drilling & Probing	Top-of-Casing Elev.:	: 269.30'(Lawrence Survey)
Drillers Name:	: Tommy Bolyard	Ground Surface Elev.:	: 265.99'(Lawrence Survey)
NC Driller Certification:	: 3307	Natural, Cut, Fill Grade:	: slight cut

Water Levels
1 Hour = 11.00' bgs
24 Hours = 5.75' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	265.99	2 2 3	SS	24	wet; medium; light brownish gray (10YR 6/2) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon
5	260.99	1 1 2	SS	18	wet; soft; light brownish gray (10YR 6/2) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon
10	255.99	15 20 27	SS	17	moist; hard; yellowish brown (10YR 5/4); medium horizontal fissile; clayey silt; no plasticity; cohesive; Residuum
15	250.99	6 18 50/4"	SS	24	moist; very hard; yellowish brown (10YR 5/4) with black manganese planes; medium horizontal fissile; clayey silt; no plasticity; cohesive; Residuum
20	245.99	24 50/3"	SS	10	dry; very hard; brown (10YR 5/3); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
25	240.99	14 14 50/3"	SS	12	wet; very hard; reddish brown (5YR 4/3); medium horizontal fissile; weathered mudstone; Partially Weathered Rock
30	235.99				
35	230.99				
40	225.99				
45					

Well: PZ-19
TOC Elev.:



NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3307

1. WELL CONTRACTOR:

Tommy Bolyard
Well Contractor (Individual) Name

Environmental Drilling & Probing Services, LLC
Well Contractor Company Name

17538 Greenhill Road
Street Address

Charlotte NC 28278
City or Town State Zip Code

(704) 607-7529
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT# NA

OTHER ASSOCIATED PERMIT#(if applicable) NA

SITE WELL ID #(if applicable) PZ-19

3. WELL USE (Check One Box) Monitoring ☑ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use) ____

DATE DRILLED 8/29/14

4. WELL LOCATION:

1303 Brickyard Road
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY ____

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ☐ Valley ☑ Flat ☐ Ridge ☐ Other ____

LATITUDE 36 ° ' " DMS OR 3x.xxxxxxxxx DD

LONGITUDE 75 ° ' " DMS OR 7x.xxxxxxxxx DD

Latitude/longitude source: ☐ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Mining Site
Facility Name Facility ID# (if applicable)

1303 Brickyard Road
Street Address

Sanford NC
City or Town State Zip Code

Contact Name

Mailing Address

City or Town State Zip Code

( )
Area code Phone number

6. WELL DETAILS:

a. **TOTAL DEPTH:** 25 ft.

b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☑

c. **WATER LEVEL** Below Top of Casing: ____ FT.
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** ____ FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. **YIELD (gpm):** ____ **METHOD OF TEST** ____

f. **DISINFECTION: Type** ____ **Amount** ____

g. **WATER ZONES** (depth):

Top	Bottom	Top	Bottom

7. CASING:

	Depth Top	Bottom	Diameter	Thickness/ Weight	Material
	15	0 Ft.	2"	sch.40	PVC
		Ft.			
		Ft.			

8. GROUT:

Depth Top	Bottom	Material	Method
13	11 Ft.	Bentonite	Tremie
11	0 Ft.	Grout	Tremie
	Ft.		

9. SCREEN:

Depth Top	Bottom	Diameter	Slot Size	Material
25	15 Ft.	2 in.	0.01 in.	PVC
	Ft.	in.	in.	
	Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth Top	Bottom	Size	Material
25	13 Ft.	#2med	Sand
	Ft.		
	Ft.		

11. DRILLING LOG

Top	Bottom	Formation Description
/		
/		
/		
/		
/		
/		
/		
/		
/		
/		
/		

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE 9/1/14

Tommy Bolyard
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZ-20

Colon Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

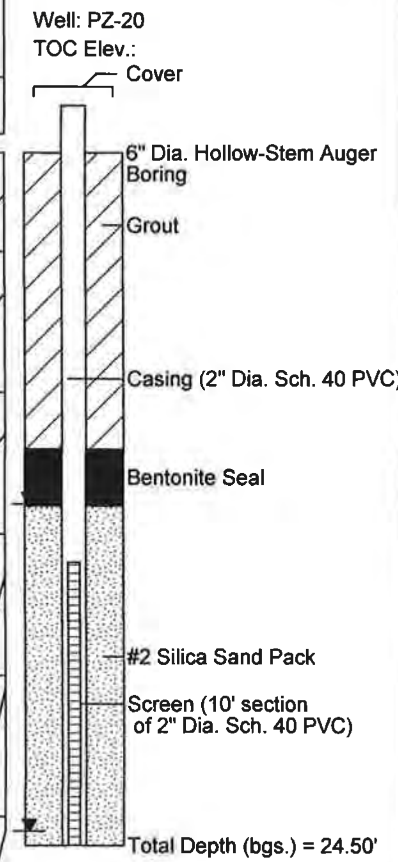
Date Started:	: 8/29/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/29/14	Drilling Method:	: HSA; Geoprobe 7822
Drilling Company:	: Environmental Drilling & Probing	Top-of-Casing Elev.:	: 299.56'(Lawrence Survey)
Drillers Name:	: Tommy Bolyard	Ground Surface Elev.:	: 296.51'(Lawrence Survey)
NC Driller Certification:	: 3307	Natural, Cut, Fill Grade:	: natural

Water Levels
▼ 1 Hour = 24.00' bgs
▽ 24 Hours = 12.44' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)
0	296.51
5	291.51
10	286.51
15	281.51
20	276.51
25	271.51
30	266.51
35	261.51
40	256.51
45	

Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
2 3 3	SS	24	moist; medium; Red (2.5YR 4/6) with yellow mottles; fine sandy silty clay; low plasticity; cohesive; Soil Horizon
2 4 5	SS	24	moist; stiff; red (2.5YR 4/6) with yellow mottles; fine sandy silty clay; low plasticity; cohesive; Soil Horizon
5 5 6	SS	20	moist; stiff; red (2.5YR 4/6) with yellow mottles; mica sandy silty clay; low plasticity; cohesive; Soil Horizon
4 5 7	SS	18	very moist; stiff; weak red (10R 4/4) with white and light gray specks; phyllite and quartz gravelly sandy silty clay; no plasticity; cohesive; Residuum
50/3"	SS	8	dry; very hard; weak red (10R 4/4) with white and light gray specks; weathered mudstone; Partially Weathered Rock
50/4"	SS	8	wet; very hard; red (10R 4/6); highly horizontal fissile; mica sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock



NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3307

1. WELL CONTRACTOR:

Tommy Bolyard
Well Contractor (Individual) Name

Environmental Drilling & Probing Services, LLC
Well Contractor Company Name

17538 Greenhill Road
Street Address

Charlotte | NC | 28278
City or Town | State | Zip Code

(704) 607-7529
Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT# NA

OTHER ASSOCIATED PERMIT#(if applicable) NA

SITE WELL ID #(if applicable) PZ-20

3. WELL USE (Check One Box) Monitoring ☑ Municipal/Public ☐
Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐
Irrigation ☐ Other ☐ (list use) ______

DATE DRILLED 8/29/14

4. WELL LOCATION:

1303 Brickyard Road
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Sanford COUNTY ______

TOPOGRAPHIC / LAND SETTING: (check appropriate box)
☐ Slope ☐ Valley ☑ Flat ☐ Ridge ☐ Other ______

LATITUDE 36 ° ' " DMS **OR** 3x.xxxxxxxxx DD

LONGITUDE 75 ° ' " DMS **OR** 7x.xxxxxxxxx DD

Latitude/longitude source: ☐ GPS ☐ Topographic map
(location of well must be shown on a USGS topo map andattached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Mining Site
Facility Name Facility ID# (if applicable)

1303 Brickyard Road
Street Address

Sanford NC
City or Town State Zip Code

______
Contact Name

______
Mailing Address

______
City or Town State Zip Code

( ) ______
Area code Phone number

6. WELL DETAILS:

a. TOTAL DEPTH: 25 ft.

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑

c. WATER LEVEL Below Top of Casing: ______ FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS ______ FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): ______ **METHOD OF TEST** ______

f. DISINFECTION: Type ______ **Amount** ______

g. WATER ZONES (depth):

Top	Bottom	Top	Bottom

7. CASING:

Depth		Diameter	Thickness/ Weight	Material
Top 15	Bottom 0 Ft.	2"	sch.40	PVC
Top	Bottom Ft.			
Top	Bottom Ft.			

8. GROUT:

Depth		Material	Method
Top 13	Bottom 11 Ft.	Bentonite	Tremie
Top 11	Bottom 0 Ft.	Grout	Tremie
Top	Bottom Ft.		

9. SCREEN:

Depth		Diameter	Slot Size	Material
Top 25	Bottom 15 Ft.	2 in.	0.01 in.	PVC
Top	Bottom Ft.	in.	in.	
Top	Bottom Ft.	in.	in.	

10. SAND/GRAVEL PACK:

Depth		Size	Material
Top 25	Bottom 13 Ft.	#2med	Sand
Top	Bottom Ft.		
Top	Bottom Ft.		

11. DRILLING LOG

Top / Bottom	Formation Description
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	
/	

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

______ 9/1/14
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Tommy Bolyard
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit within 30 days of completion to: Division of Water Quality - Information Processing, 1617 Mail Service Center, Raleigh, NC 27699-161, Phone : (919) 807-6300

Form GW-1b
Rev. 2/09

APPENDIX H
Geotechnical Laboratory Data Sheets

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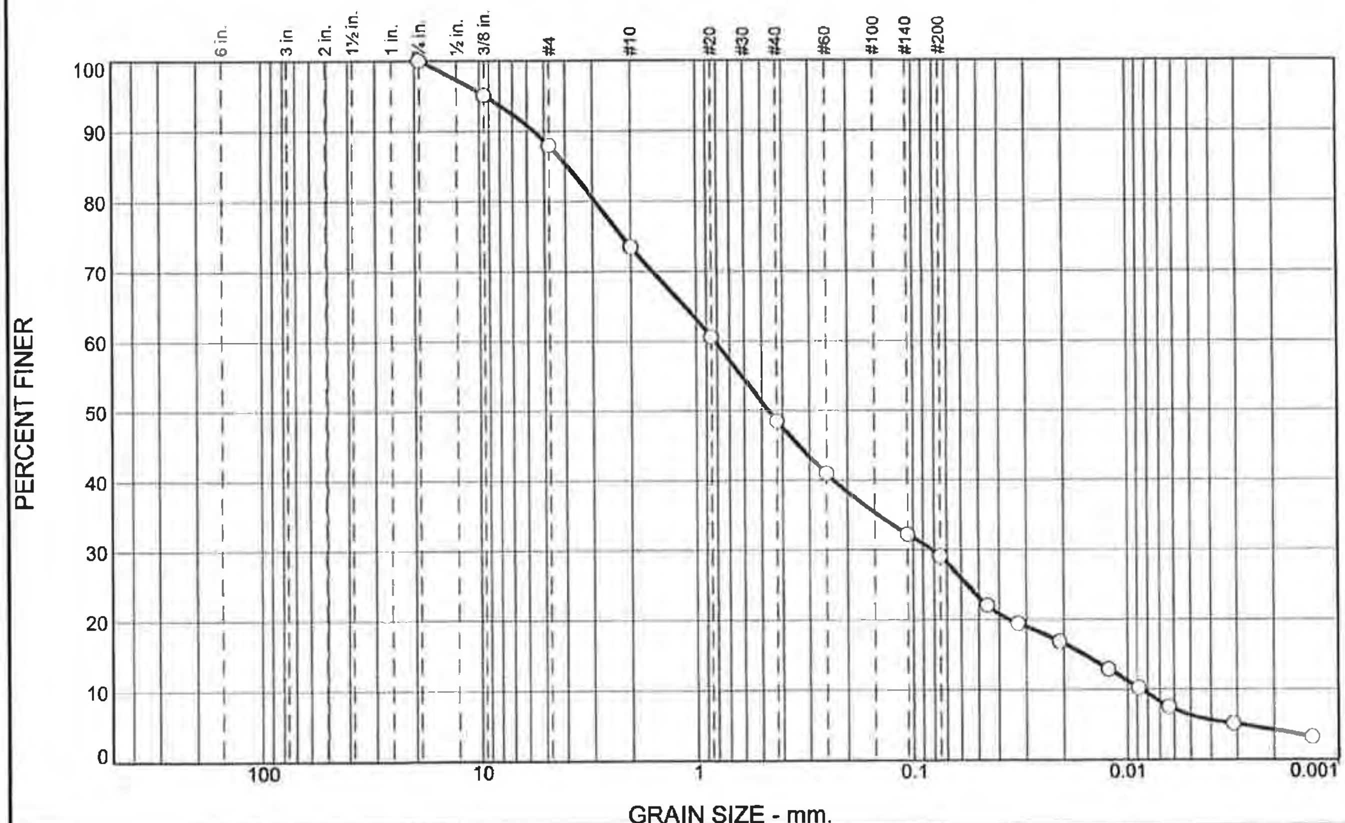
Summary of Laboratory Test Results
Sanford Mine
Sanford, North Carolina
August 23, 2014

Sample Location	USCS Classification	Hydraulic Conductivity (cm/sec)	% Total Porosity	% Specific Yield
PZ-1 SS @ 19'-20'	SC	---	---	26, Silty Sand
PZ-1 SS @ 24'-25'	CL	---	---	15, Sandy Silt
PZ-2 SS @ 29'-30.5'	CL	---	---	4, Clay Silt
PZ-3 SS @ 34'-34.5'	SM	---	---	30, Sand
PZ-4 SS @ 4'-5.5'	CH	---	---	2, Silty Clay
PZ-4 SS @ 24'-24.5'	CL	---	---	11, Sandy Silt
PZ-5 SS @ 34'-34.5'	CL	---	---	8, Silt
PZ-6 SS @ 19'-19.5'	SC	---	---	16, Silty Sand
PZ-7 SS @ 14'-15.5'	CL	---	---	4, Clay Silt
PZ-8 SS @ 13.5'-15'	CL	---	---	3, Clay Silt
PZ-9 SS @ 13.5'-15'	SC	---	---	17, Silty Sand
PZ-10 SS @ 28.5'-30'	CL	---	---	5, Clay Silt
PZ-11 SS @ 23.5'-25'	CL	---	---	4, Clay Silt
PZ-12 SS @ 18.5'-20'	CL	---	---	2, Silty Clay
PZ-13 SS @ 0'-1.5'	SC-SM	---	---	25, Silty Sand
PZ-15 SS @ 23.5'-24'	CL	---	---	8, Clay Silt
PZ-16 SS @ 18.5'-20'	CL	---	---	3, Silty Clay
PZ-17 SS @ 43.5'-44.5'	CL	---	---	16, Silty Sand
PZ-18 SS @ 18.5'-19.5'	CL	---	---	8, Sandy Silt
PZ-2 UD @ 9'-11'	CH	6.23×10^{-5}	40.7	2, Silty Clay
PZ-3 UD @ 0'-2'	CL	2.42×10^{-6}	39.3	2, Silty Clay
PZ-5 UD @ 6'-8'	CL	2.43×10^{-7}	30.6	2, Silty Clay
PZ-6 UD @ 10.5'-11'	CL	6.01×10^{-6}	30.7	8, Sandy Silt
PZ-7 UD @ 6'-8'	CL	1.76×10^{-6}	30.1	3, Clay Silt
PZ-11 UD @ 6'-6.5'	SM	3.86×10^{-6}	19.7	25, Silty Sand
PZ-14 UD @ 6'-7.5'	CH	1.35×10^{-7}	38.6	2, Silty Clay
PZ-9 Bulk @ 15'-30'	CL	8.07×10^{-8}	28.5	7, Clay Sand
PZ-14 Bulk @ 18.5'-20'	CL	1.41×10^{-7}	31.7	3, Silty Clay

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.1	14.4	25.0	19.5	22.7	6.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.375	95.0		
#4	87.9		
#10	73.5		
#20	60.6		
#40	48.5		
#60	40.9		
#140	32.2		
#200	29.0		

* (no specification provided)

Material Description

Tan-Brown Clayey Sand

Atterberg Limits

PL= 17 LL= 29 PI= 12

Coefficients

D_{90}= 5.5910 D_{85}= 3.9158 D_{60}= 0.8196
D_{50}= 0.4651 D_{30}= 0.0819 D_{15}= 0.0163
D_{10}= 0.0086 C_u= 95.16 C_c= 0.95

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Location: PZ-1 SS @ 19'-20'

Date: 08-12-14

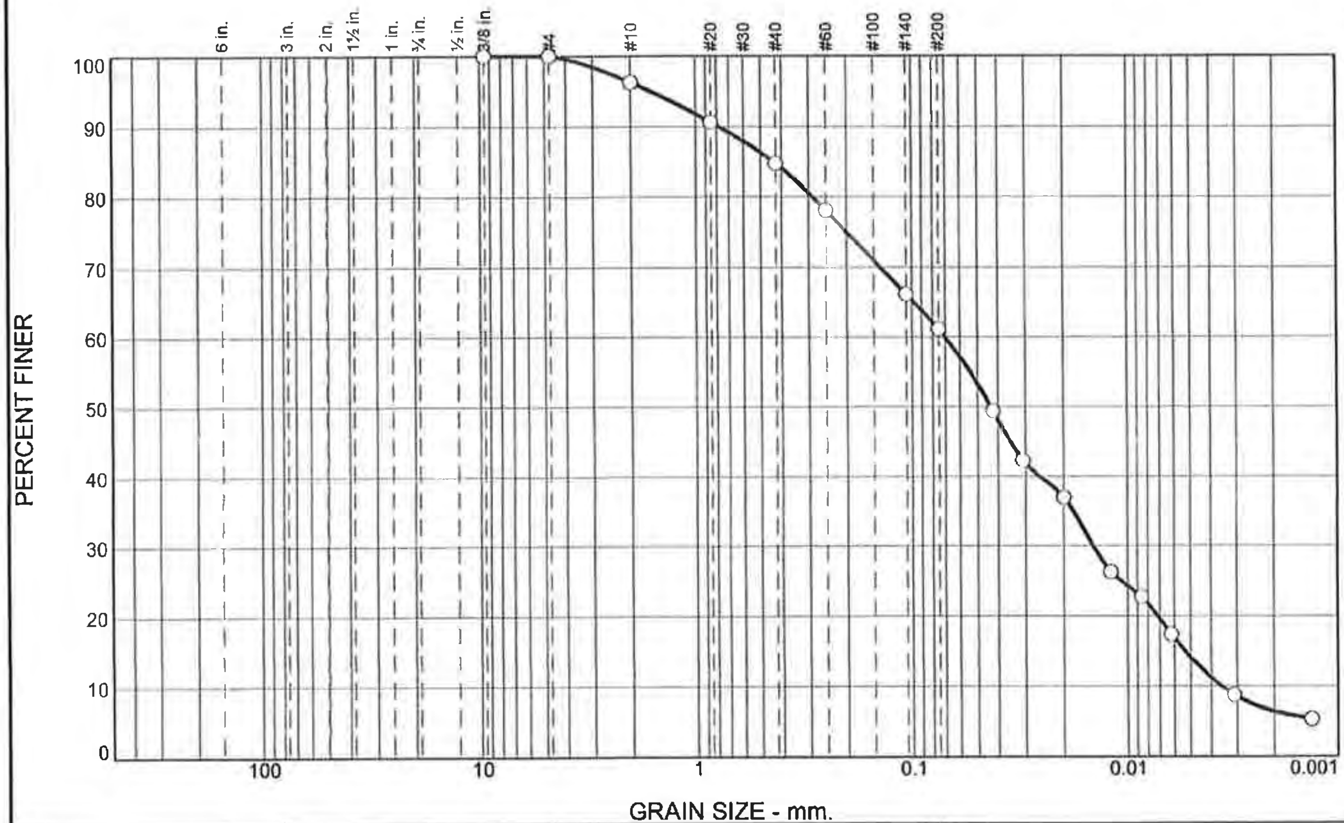
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	3.7	11.6	23.6	47.1	14.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	96.3		
#20	90.6		
#40	84.7		
#60	78.1		
#140	66.1		
#200	61.1		

* (no specification provided)

Material Description

Purple Sandy Lean Clay

Atterberg Limits

PL= 17 LL= 30 PI= 13

Coefficients

D_{90}= 0.7775 D_{85}= 0.4360 D_{60}= 0.0702
D_{50}= 0.0436 D_{30}= 0.0145 D_{15}= 0.0053
D_{10}= 0.0036 C_u= 19.59 C_c= 0.84

Classification

USCS= CL AASHTO= A-6(5)

Remarks

Location: PZ-1 SS @ 24'-25'

Date: 08-12-14

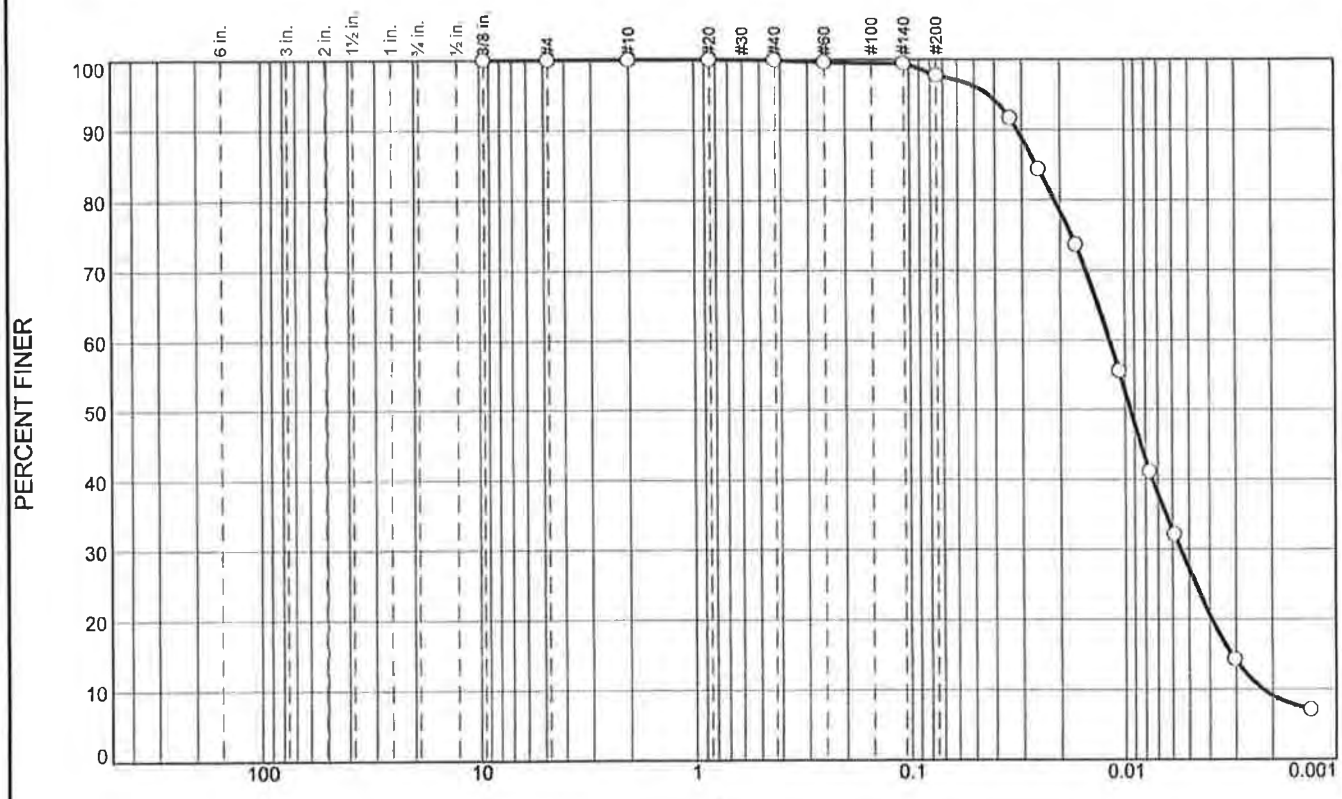
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	2.1	70.7	27.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.6		
#140	99.4		
#200	97.8		

* (no specification provided)

Material Description

Tan-Brown Lean Clay

Atterberg Limits

PL= 22 LL= 43 PI= 21

Coefficients

D_{90}= 0.0315 D_{85}= 0.0258 D_{60}= 0.0118
D_{50}= 0.0094 D_{30}= 0.0055 D_{15}= 0.0032
D_{10}= 0.0022 C_u= 5.28 C_c= 1.14

Classification

USCS= CL AASHTO= A-7-6(23)

Remarks

Location: PZ-2 SS @ 29'-30.5'

Date: 08-13-14

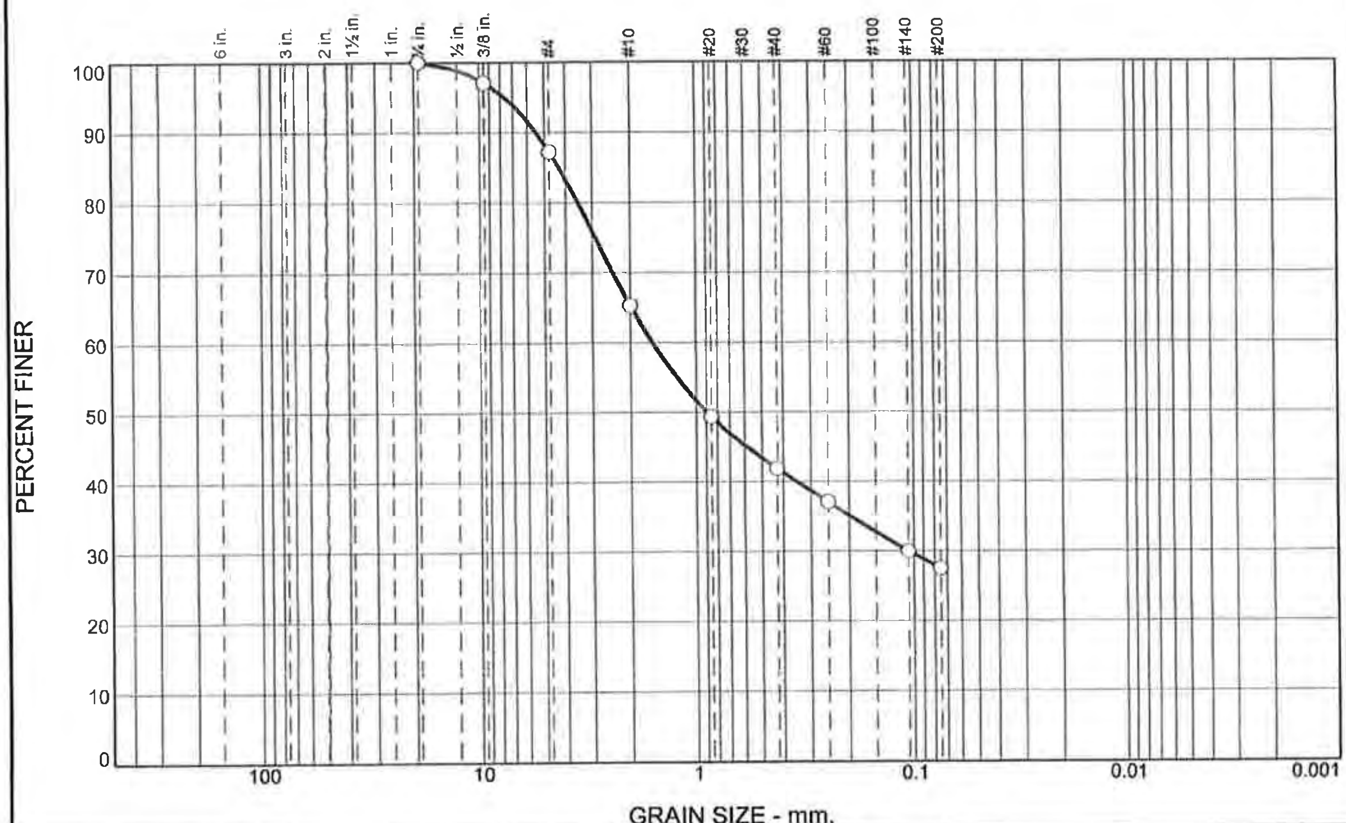
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.8	22.0	23.4	14.3	27.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.375	97.1		
#4	87.2		
#10	65.2		
#20	49.3		
#40	41.8		
#60	37.0		
#140	30.0		
#200	27.5		

* (no specification provided)

Material Description

Purple-Brown Silty Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 5.4707 D_{85}= 4.2975 D_{60}= 1.5872
D_{50}= 0.8927 D_{30}= 0.1063 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Location: PZ-3 SS @ 34'-34.5'

Date: 08-12-14

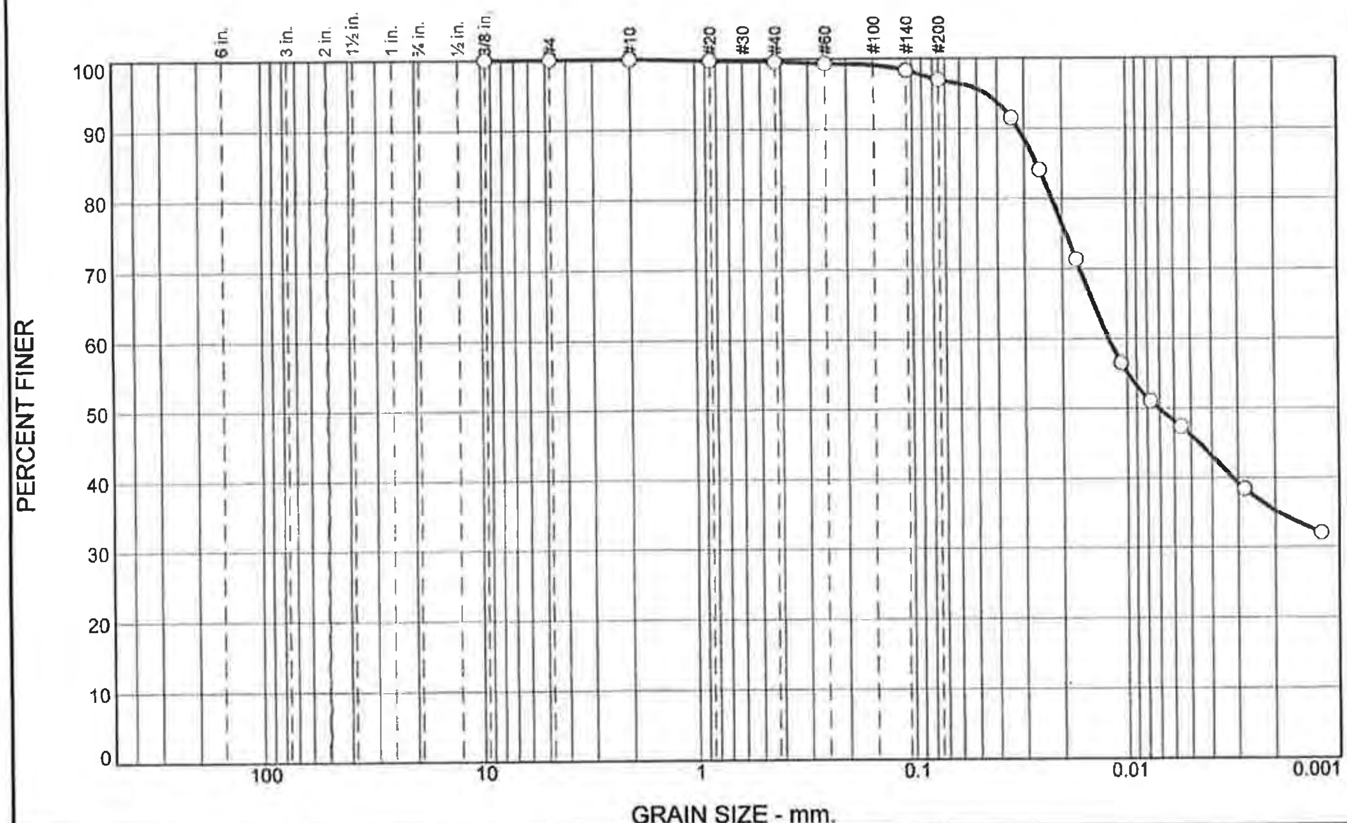
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	2.6	50.9	46.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.6		
#60	99.3		
#140	98.3		
#200	97.0		

* (no specification provided)

Material Description

Orange-Brown Fat Clay

Atterberg Limits

PL= 27 LL= 60 PI= 33

Coefficients

D_{90}= 0.0320 D_{85}= 0.0263 D_{60}= 0.0122
D_{50}= 0.0071 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(37)

Remarks

Location: PZ-4 SS @ 4'-5.5'

Date: 08-12-14

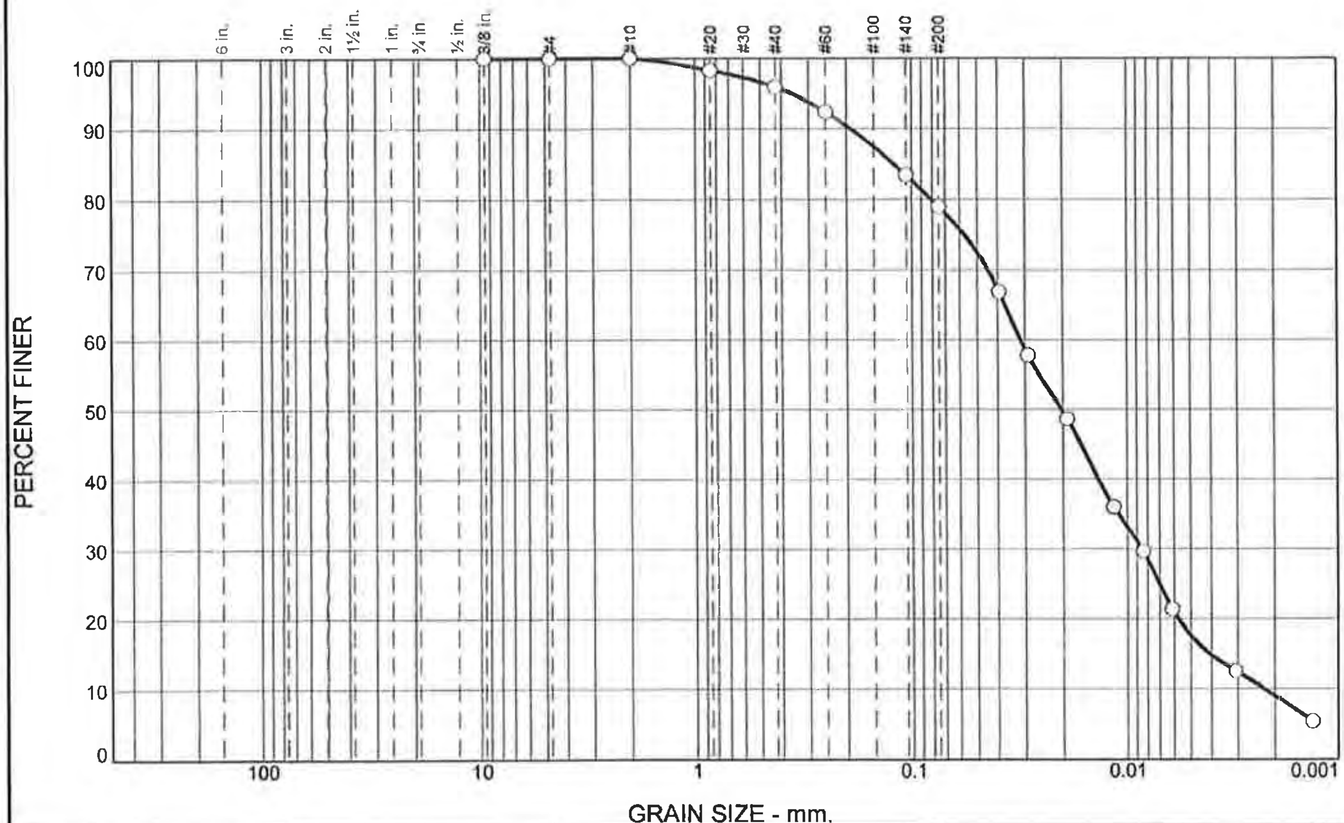
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	4.1	16.9	61.6	17.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	98.3		
#40	95.9		
#60	92.4		
#140	83.4		
#200	79.0		

* (no specification provided)

Material Description

Tan-Brown Lean Clay with Sand

Atterberg Limits

PL= 16 LL= 31 PI= 15

Coefficients

D_{90}= 0.1919 D_{85}= 0.1206 D_{60}= 0.0315
D_{50}= 0.0203 D_{30}= 0.0085 D_{15}= 0.0041
D_{10}= 0.0023 C_u= 13.92 C_c= 1.03

Classification

USCS= CL AASHTO= A-6(10)

Remarks

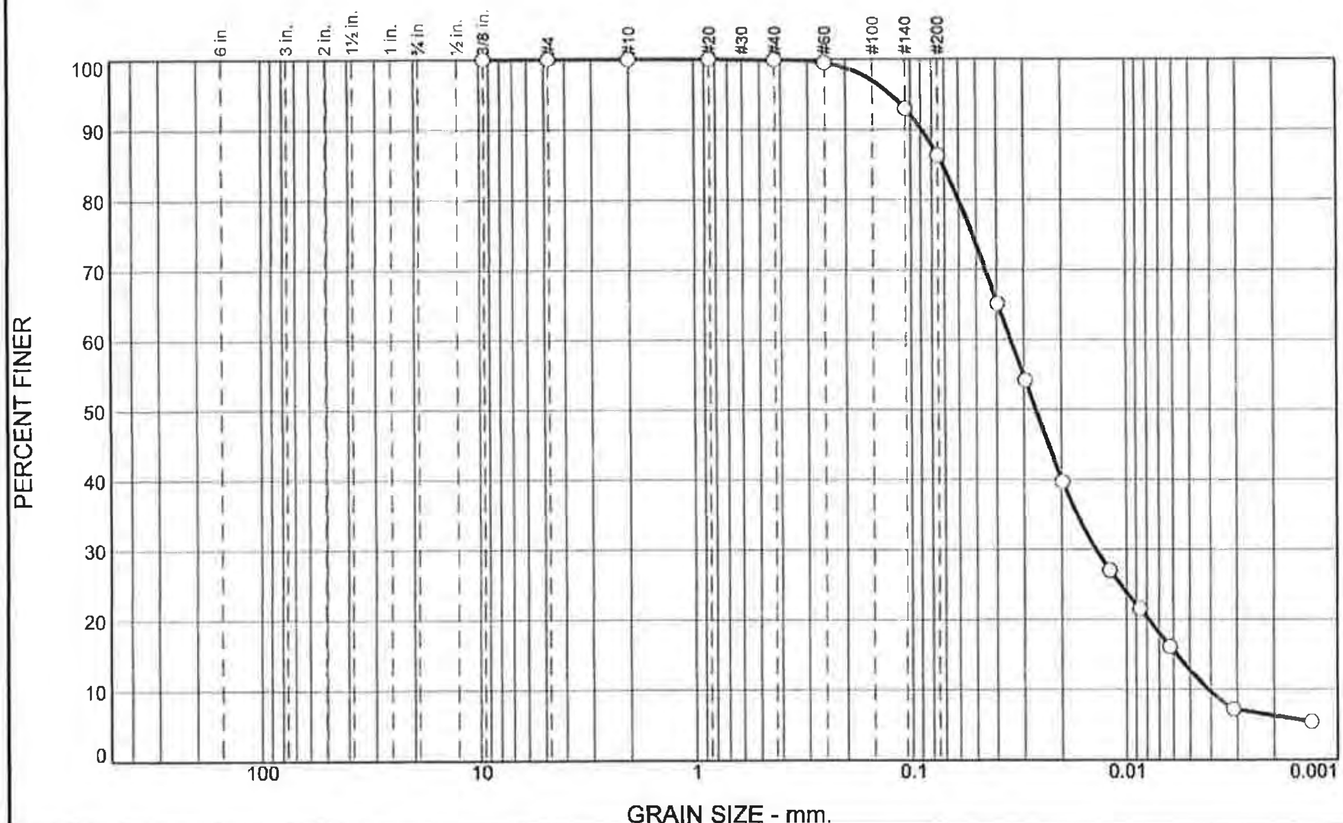
Location: PZ-4 SS @ 24'-24.5'

Date: 08-12-14

Summit Engineering **Ft. Mill, South Carolina**	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	13.6	73.6	12.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.5		
#140	92.9		
#200	86.3		

* (no specification provided)

Material Description

Tan-Brown Lean Clay

Atterberg Limits

PL= 20 LL= 32 PI= 12

Coefficients

D_{90}= 0.0889 D_{85}= 0.0713 D_{60}= 0.0345
D_{50}= 0.0264 D_{30}= 0.0139 D_{15}= 0.0058
D_{10}= 0.0041 C_u= 8.38 C_c= 1.36

Classification

USCS= CL AASHTO= A-6(10)

Remarks

Location: PZ-5 SS @ 34'-34.5'

Date: 08-12-14

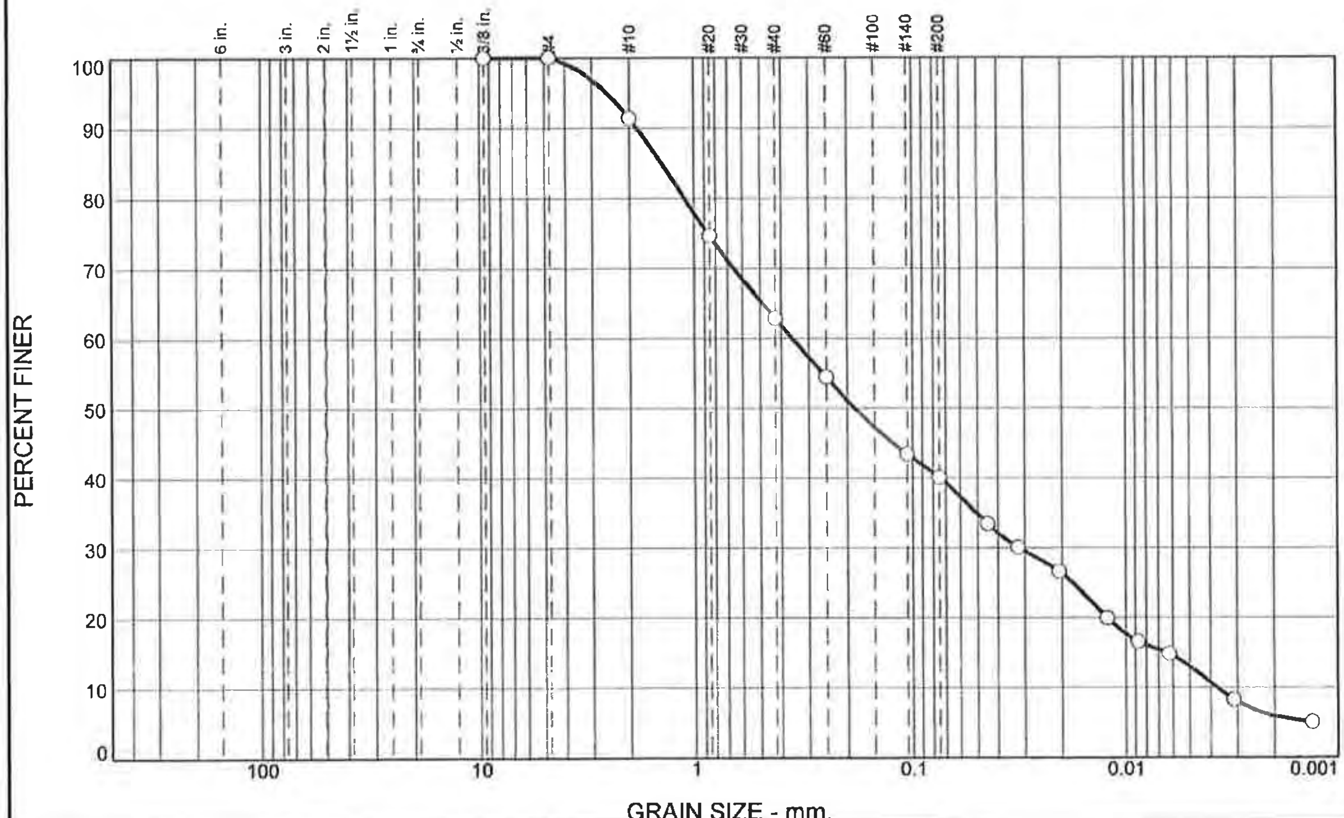
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	8.7	28.5	22.7	27.1	13.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	91.3		
#20	74.7		
#40	62.8		
#60	54.4		
#140	43.3		
#200	40.1		

* (no specification provided)

Material Description

Purple-Brown Clayey Sand

Atterberg Limits

PL= 18 LL= 33 PI= 15

Coefficients

D_{90}= 1.8508 D_{85}= 1.4202 D_{60}= 0.3569
D_{50}= 0.1849 D_{30}= 0.0321 D_{15}= 0.0065
D_{10}= 0.0037 C_u= 95.24 C_c= 0.77

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Location: PZ-6 SS @ 19'-19.5'

Date: 08-12-14

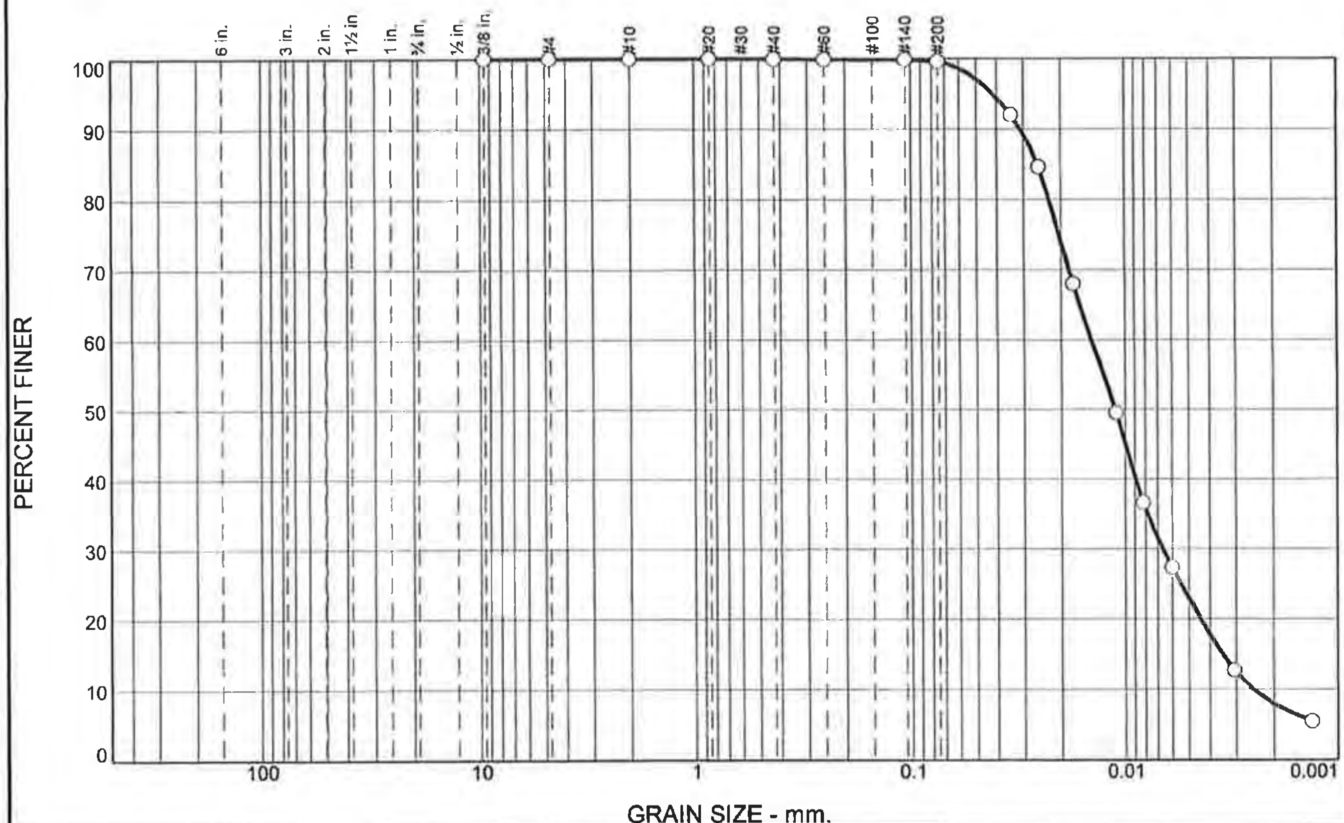
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	0.3	76.8	22.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.9		
#140	99.8		
#200	99.6		

* (no specification provided)

Material Description

Tan-Brown Lean Clay

Atterberg Limits

PL= 22 LL= 41 PI= 19

Coefficients

D_{90}= 0.0310 D_{85}= 0.0258 D_{60}= 0.0144
D_{50}= 0.0112 D_{30}= 0.0066 D_{15}= 0.0035
D_{10}= 0.0025 C_u= 5.75 C_c= 1.22

Classification

USCS= CL AASHTO= A-7-6(21)

Remarks

Location: PZ-7 SS @ 14'-15.5'

Date: 08-12-14

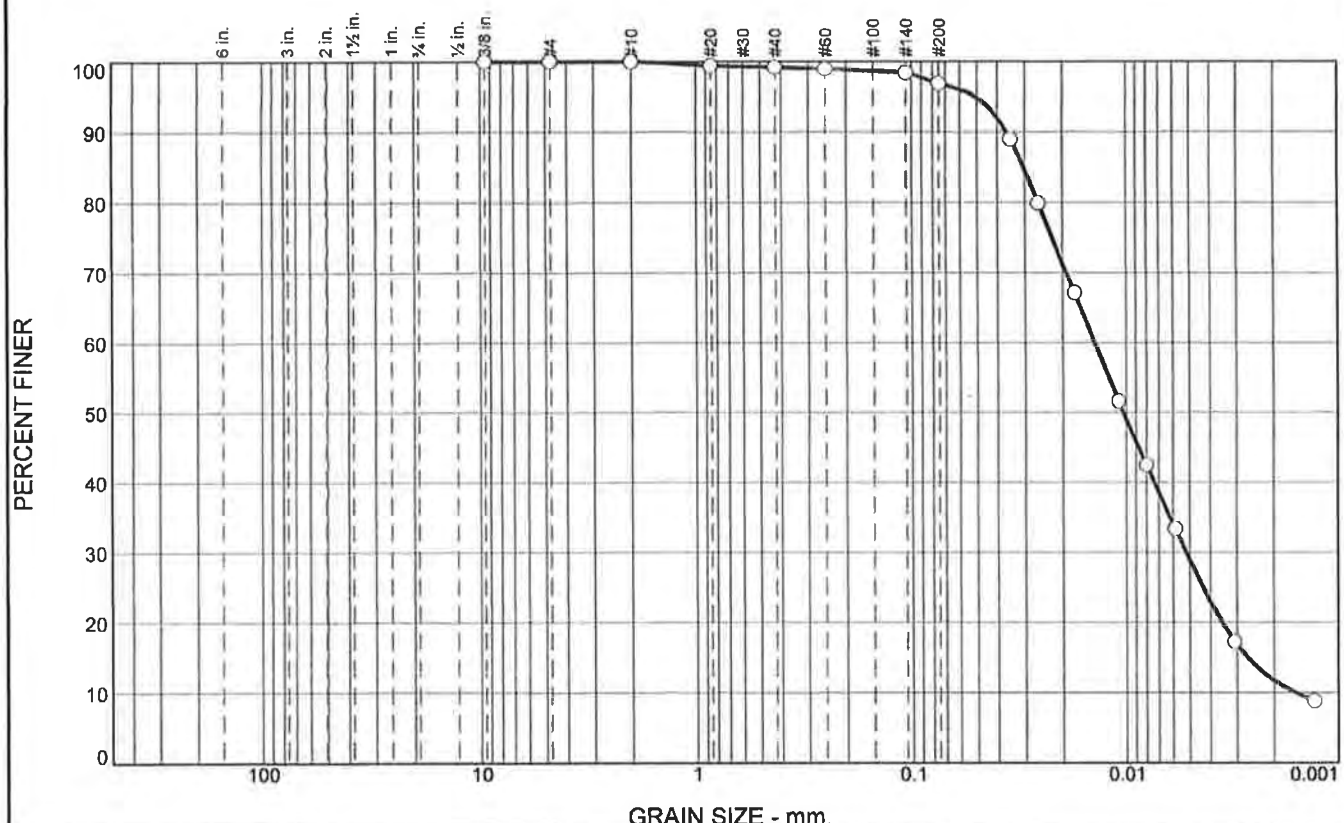
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.8	2.3	68.1	28.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.4		
#40	99.2		
#60	98.9		
#140	98.4		
#200	96.9		

* (no specification provided)

Material Description

Red-Brown Lean Clay

Atterberg Limits

PL= 23 LL= 39 PI= 16

Coefficients

D_{90}= 0.0363 D_{85}= 0.0303 D_{60}= 0.0142
D_{50}= 0.0104 D_{30}= 0.0052 D_{15}= 0.0027
D_{10}= 0.0016 C_u= 8.89 C_c= 1.21

Classification

USCS= CL AASHTO= A-7-6(23)

Remarks

Location: PZ-8 SS @ 13.5'-15'

Date: 08-12-14

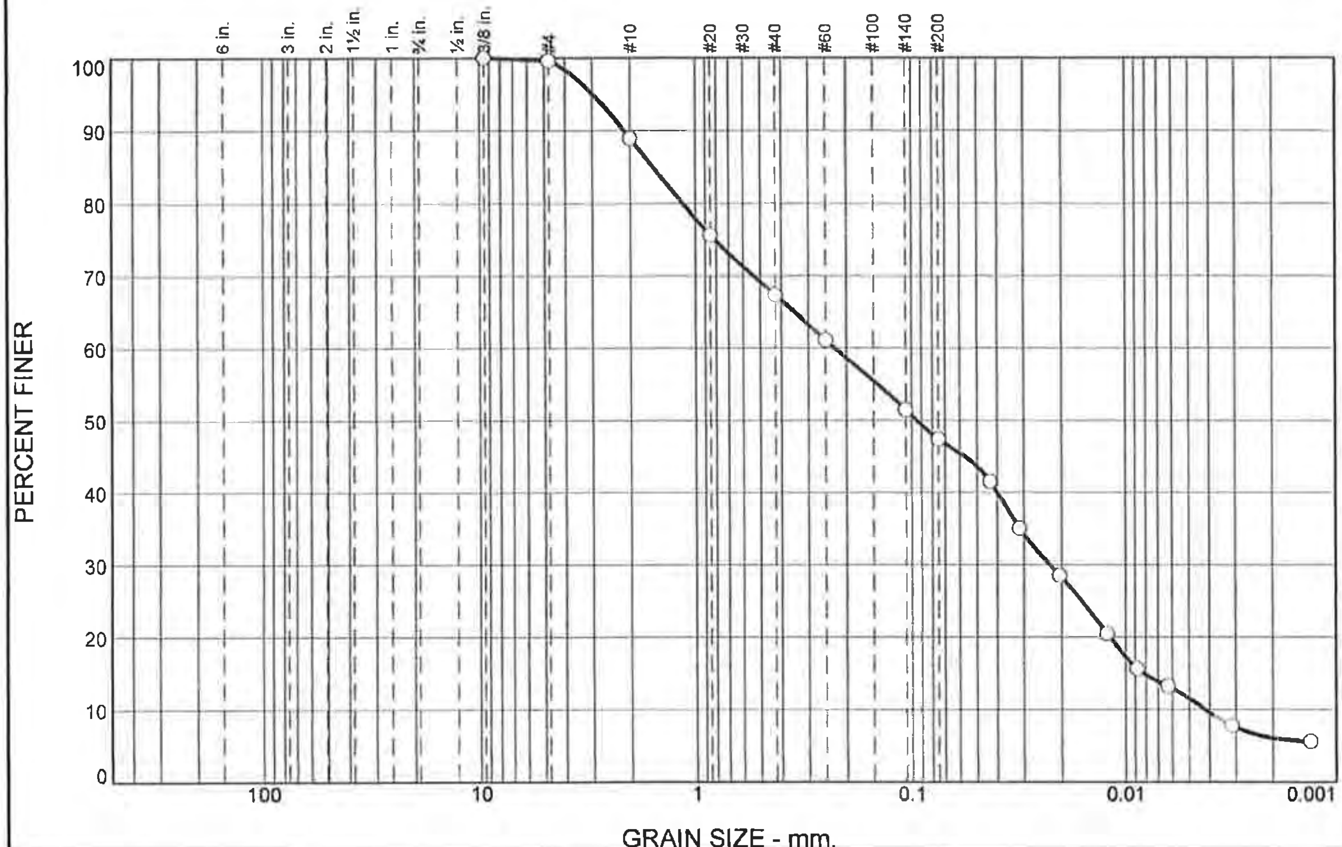
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	10.7	21.6	19.9	35.9	11.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.6		
#10	88.9		
#20	75.6		
#40	67.3		
#60	61.1		
#140	51.4		
#200	47.4		

* (no specification provided)

Material Description

Light Purple Clayey Sand

Atterberg Limits

PL= 20 LL= 34 PI= 14

Coefficients

D_{90}= 2.1362 D_{85}= 1.5703 D_{60}= 0.2277
D_{50}= 0.0944 D_{30}= 0.0228 D_{15}= 0.0082
D_{10}= 0.0042 C_u= 54.29 C_c= 0.54

Classification

USCS= SC AASHTO= A-6(3)

Remarks

Location: PZ-9 SS @ 13.5'-15'

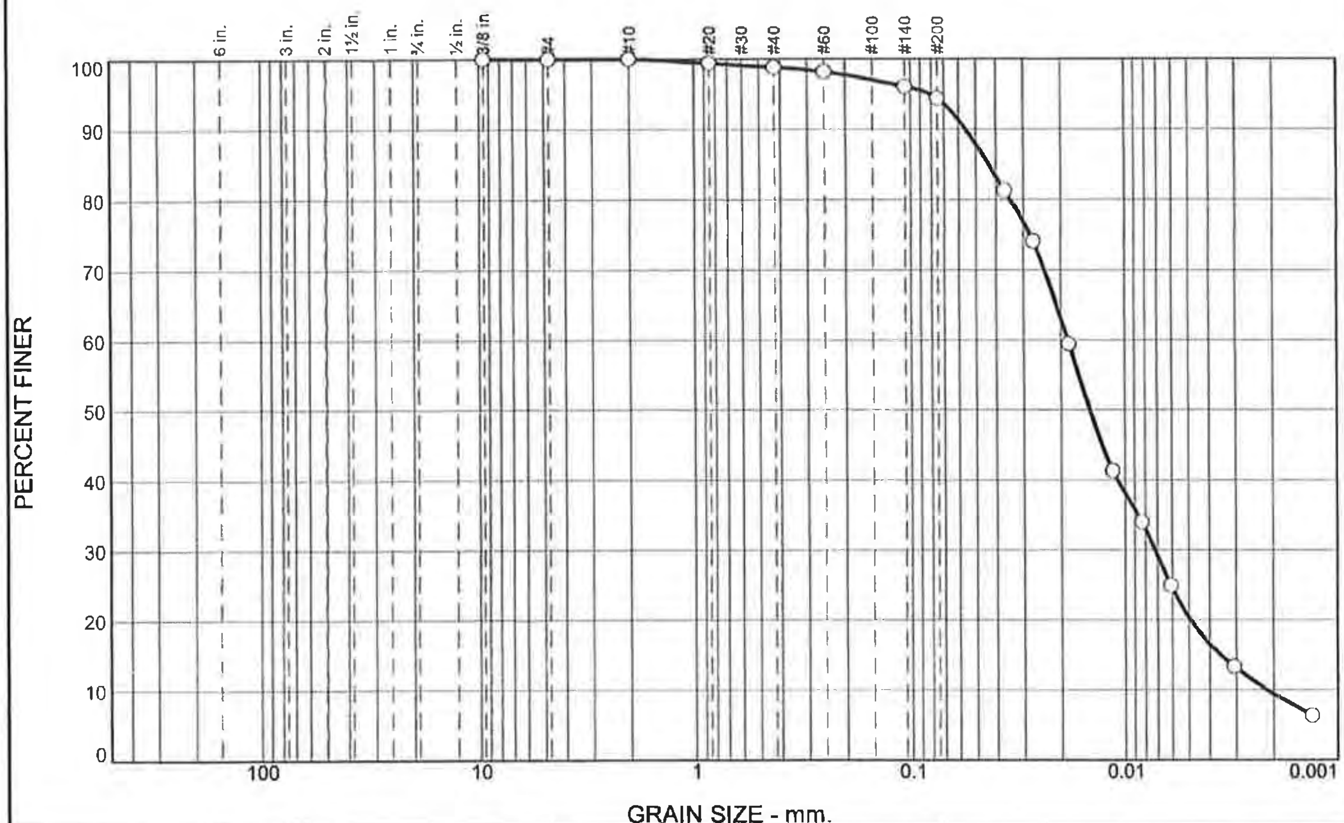
Date: 08-12-14

Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.2	4.5	74.0	20.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.4		
#40	98.8		
#60	98.1		
#140	96.0		
#200	94.3		

* (no specification provided)

Material Description

Red-Brown Lean Clay

Atterberg Limits

PL= 18 LL= 36 PI= 18

Coefficients

D_{90}= 0.0556 D_{85}= 0.0435 D_{60}= 0.0186
D_{50}= 0.0147 D_{30}= 0.0072 D_{15}= 0.0036
D_{10}= 0.0022 C_u= 8.59 C_c= 1.30

Classification

USCS= CL AASHTO= A-6(17)

Remarks

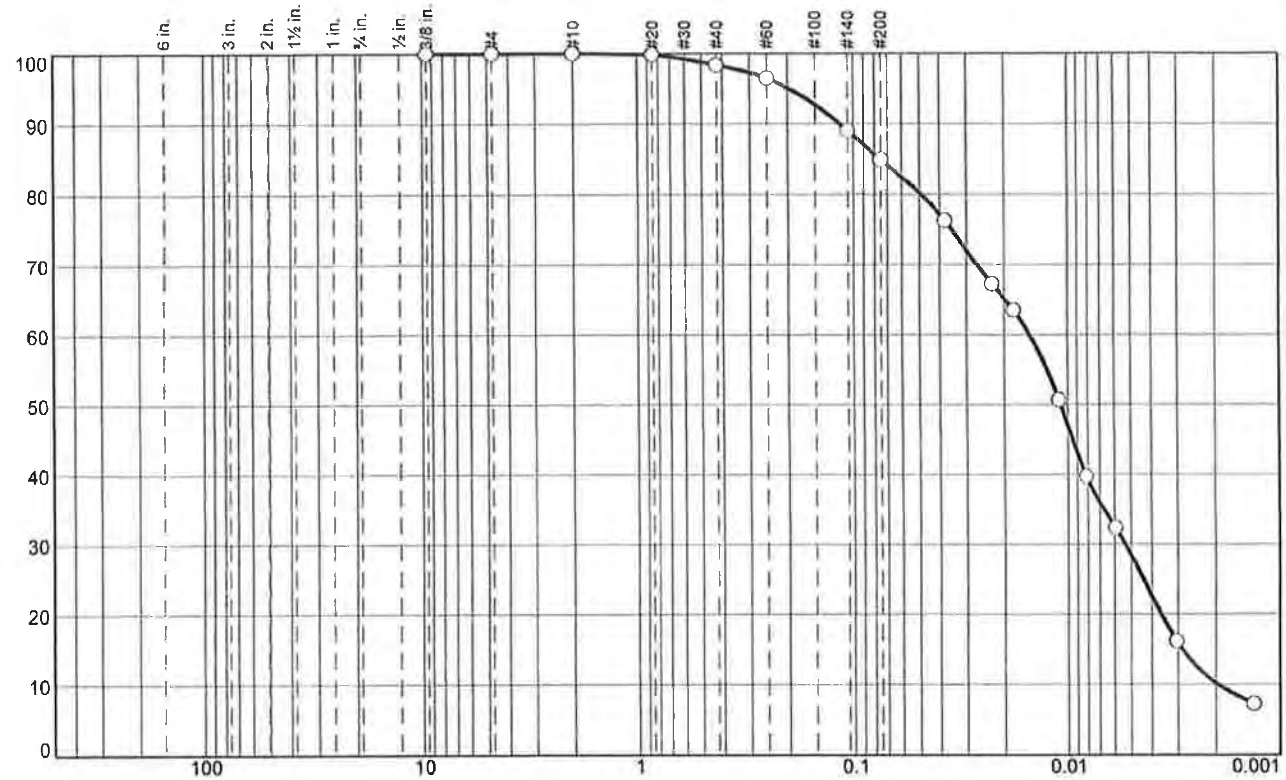
Location: PZ-10 SS @ 28.5'-30'

Date: 08-12-14

Summit Engineering **Ft. Mill, South Carolina**	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.7	13.4	56.6	28.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.8		
#40	98.3		
#60	96.4		
#140	89.0		
#200	84.9		

* (no specification provided)

Material Description

Purple-Brown Lean Clay

Atterberg Limits

PL= 19 LL= 38 PI= 19

Coefficients

D_{90}= 0.1157 D_{85}= 0.0758 D_{60}= 0.0152
D_{50}= 0.0108 D_{30}= 0.0053 D_{15}= 0.0029
D_{10}= 0.0020 C_u= 7.69 C_c= 0.96

Classification

USCS= CL AASHTO= A-6(16)

Remarks

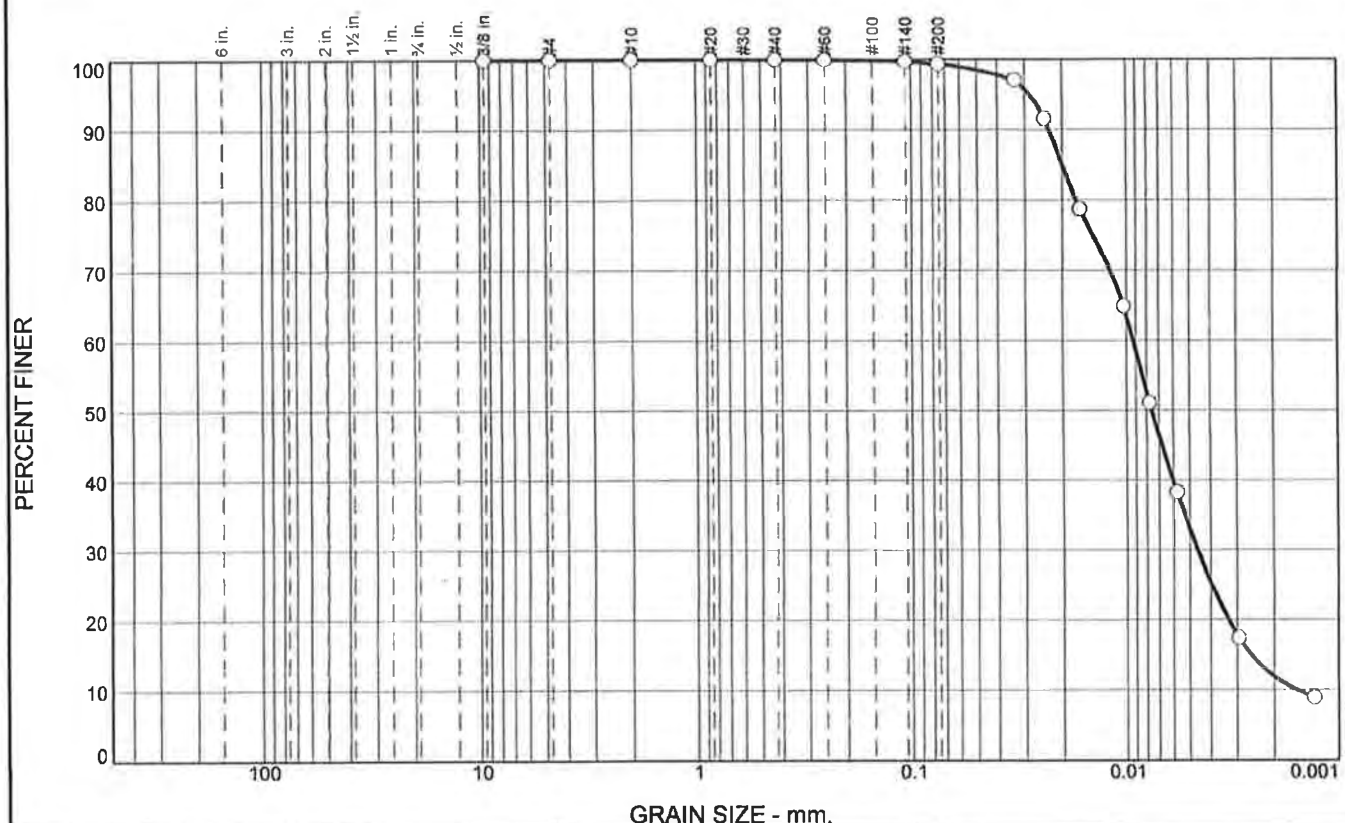
Location: PZ-11 SS @ 23.5'-25'

Date: 08-12-14

Summit Engineering **Ft. Mill, South Carolina**	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	0.6	66.5	32.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.9		
#140	99.7		
#200	99.3		

* (no specification provided)

Material Description

Purple-Brown Lean Clay

Atterberg Limits

PL= 20 LL= 42 PI= 22

Coefficients

D_{90}= 0.0231 D_{85}= 0.0200 D_{60}= 0.0093
D_{50}= 0.0076 D_{30}= 0.0046 D_{15}= 0.0026
D_{10}= 0.0016 C_u= 5.88 C_c= 1.46

Classification

USCS= CL AASHTO= A-7-6(24)

Remarks

Location: PZ-12 SS @ 18.5'-20'

Date: 08-12-14

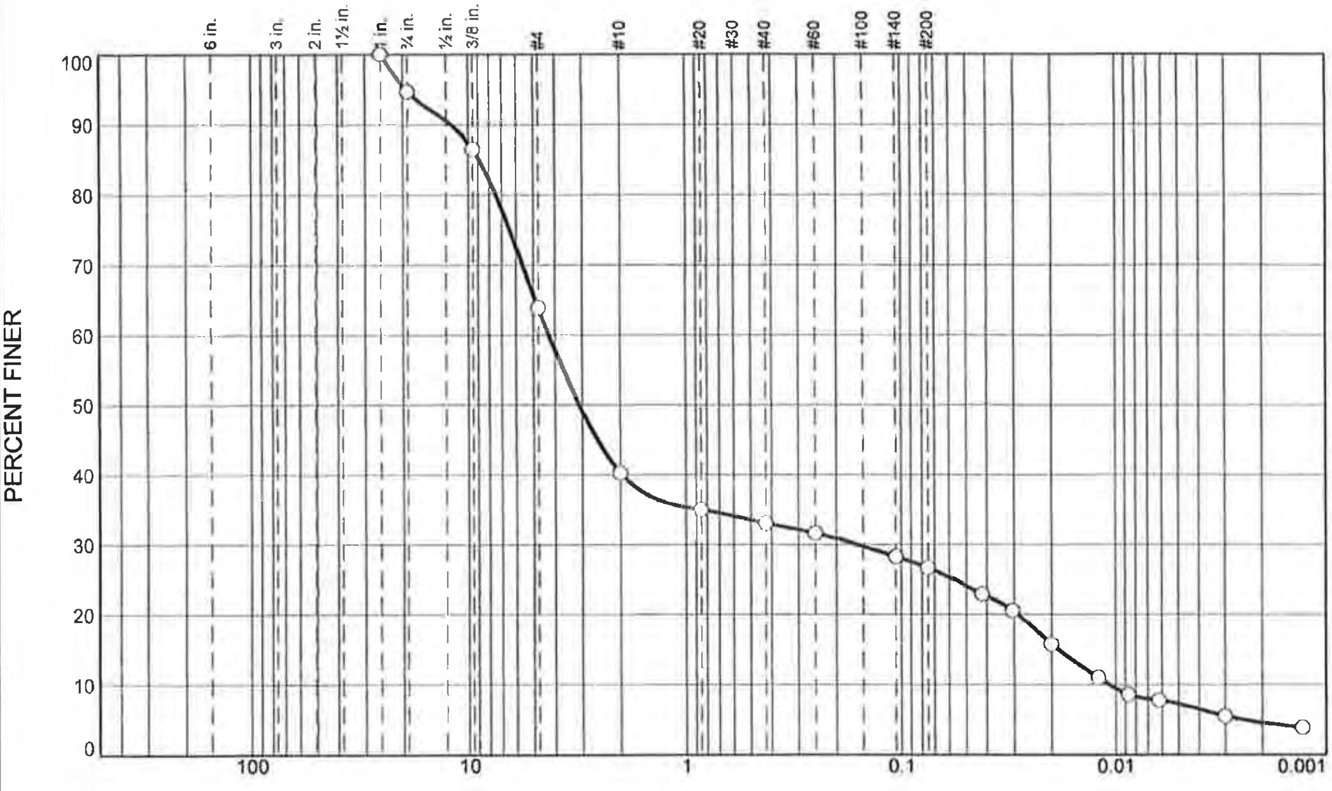
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.3	30.8	23.7	7.2	6.3	19.4	7.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
0.75	94.7		
0.375	86.5		
#4	63.9		
#10	40.2		
#20	35.0		
#40	33.0		
#60	31.6		
#140	28.2		
#200	26.7		

* (no specification provided)

Material Description

Yellow-Brown Silty, Clayey Sand with Gravel

Atterberg Limits

PL= 17 LL= 21 PI= 4

Coefficients

D_{90}= 12.0063 D_{85}= 8.9098 D_{60}= 4.2557
D_{50}= 3.1037 D_{30}= 0.1620 D_{15}= 0.0188
D_{10}= 0.0108 C_u= 394.84 C_c= 0.57

Classification

USCS= SC-SM AASHTO= A-2-4(0)

Remarks

Location: PZ-13 SS @ 0'-1.5'

Date: 08-12-14

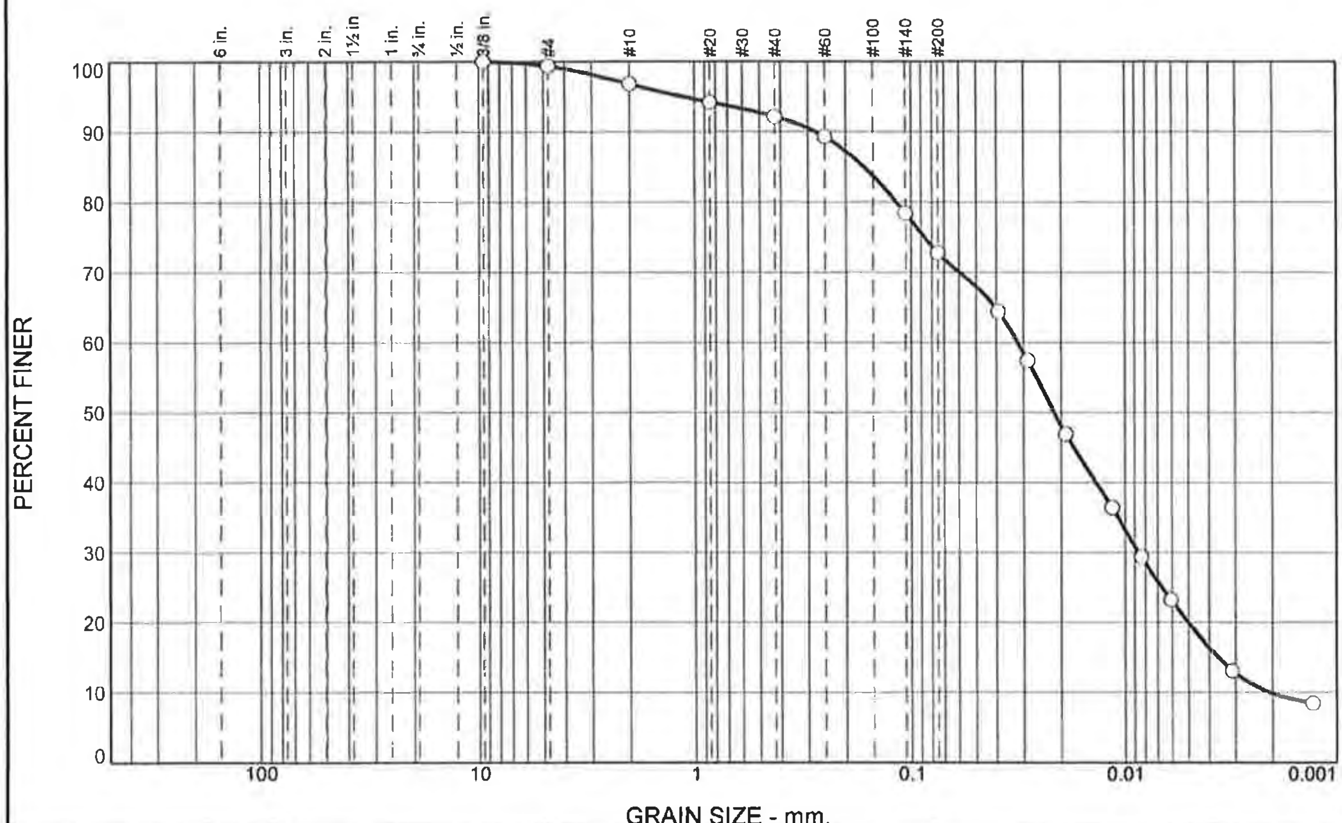
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	2.5	4.7	19.4	52.8	19.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.3		
#10	96.8		
#20	94.2		
#40	92.1		
#60	89.3		
#140	78.4		
#200	72.7		

* (no specification provided)

Material Description

Red-Brown Lean Clay with Sand

Atterberg Limits

PL= 16 LL= 32 PI= 16

Coefficients

D_{90}= 0.2762 D_{85}= 0.1655 D_{60}= 0.0319
D_{50}= 0.0216 D_{30}= 0.0087 D_{15}= 0.0037
D_{10}= 0.0021 C_u= 15.21 C_c= 1.12

Classification

USCS= CL AASHTO= A-6(10)

Remarks

Location: PZ-15 SS @ 23.5'-24'

Date: 08-12-14

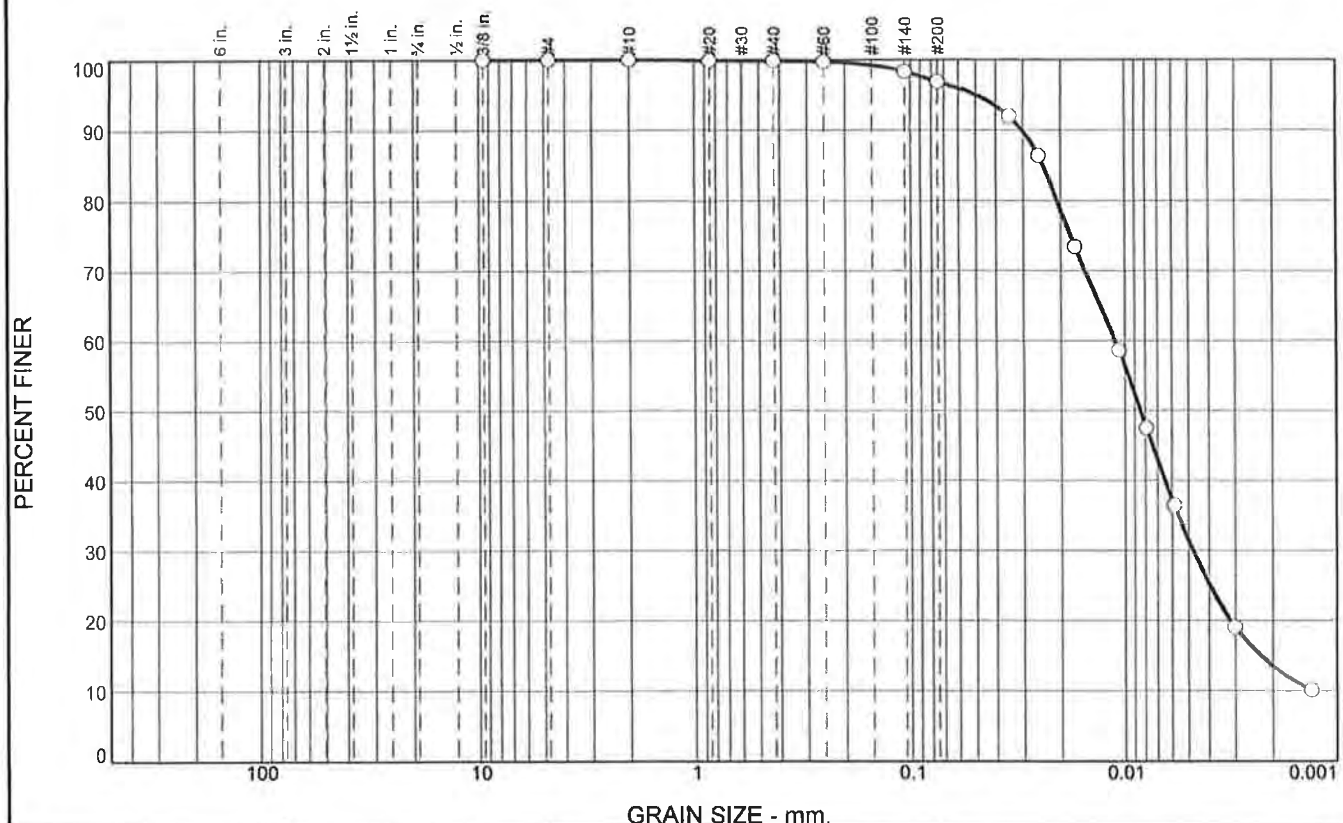
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	2.9	65.5	31.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.8		
#60	99.7		
#140	98.3		
#200	96.9		

* (no specification provided)

Material Description

Purple-Brown Lean Clay

Atterberg Limits

PL= 19 LL= 38 PI= 19

Coefficients

D_{90}= 0.0302 D_{85}= 0.0242 D_{60}= 0.0111
D_{50}= 0.0084 D_{30}= 0.0048 D_{15}= 0.0023
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(19)

Remarks

Location: PZ-16 SS @ 18.5'-20'

Date: 08-12-14

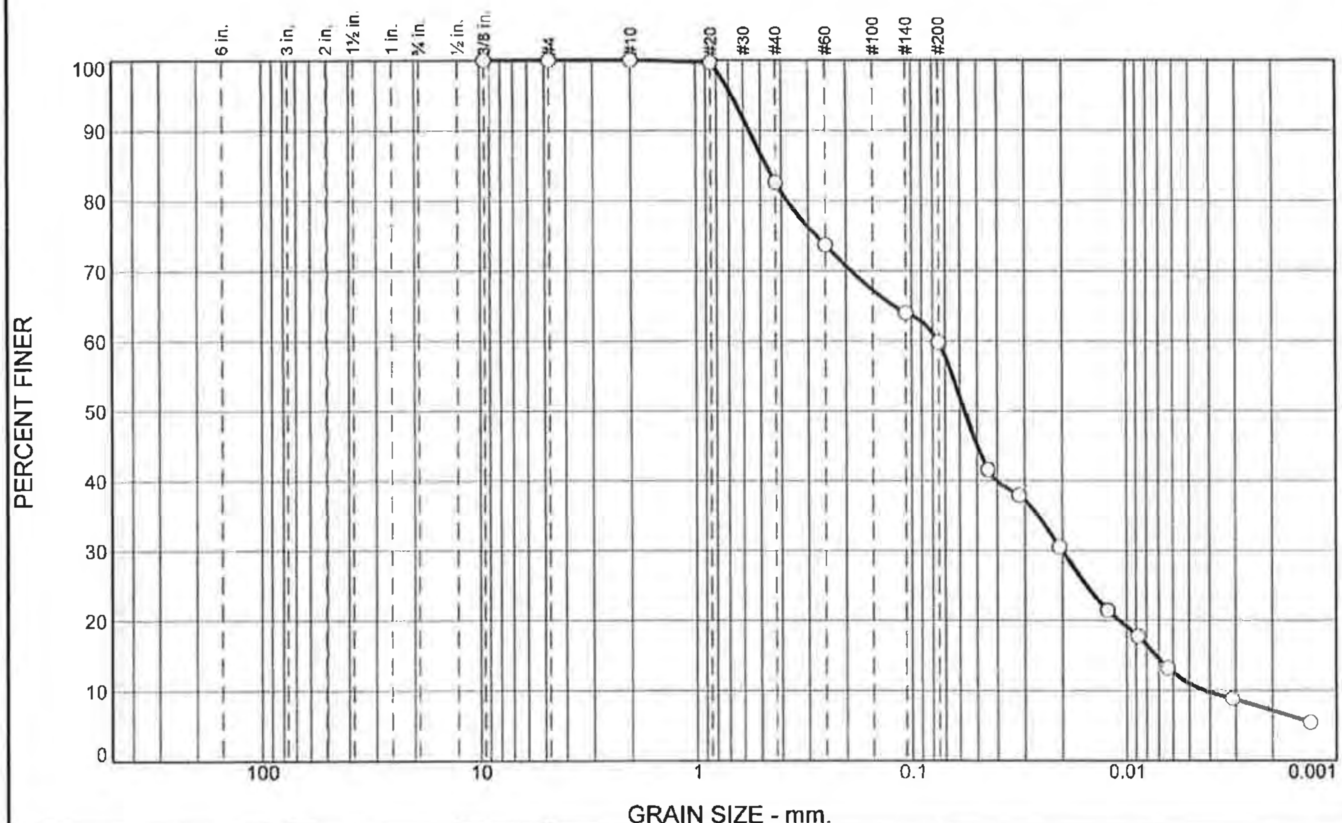
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	17.4	22.8	48.9	10.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.6		
#40	82.6		
#60	73.6		
#140	64.0		
#200	59.8		

* (no specification provided)

Material Description

Purple-Brown Sandy Lean Clay

Atterberg Limits

PL= 19 LL= 32 PI= 13

Coefficients

D_{90}= 0.5630 D_{85}= 0.4688 D_{60}= 0.0756
D_{50}= 0.0569 D_{30}= 0.0201 D_{15}= 0.0072
D_{10}= 0.0043 C_u= 17.62 C_c= 1.25

Classification

USCS= CL AASHTO= A-6(5)

Remarks

Location: PZ-17 SS @ 43.5'-44.5'

Date: 08-12-14

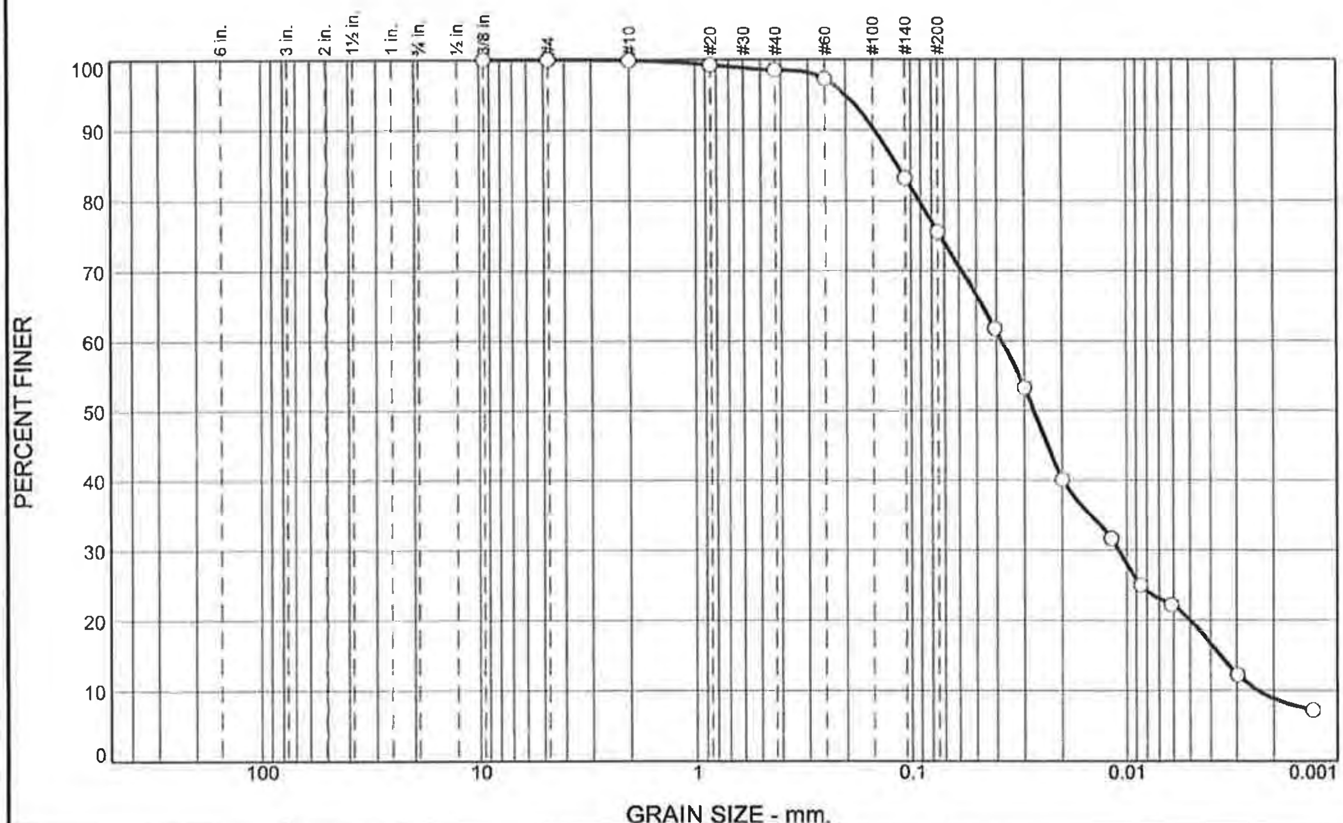
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.4	22.9	55.7	19.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	99.9		
#20	99.2		
#40	98.5		
#60	97.3		
#140	83.2		
#200	75.6		

* (no specification provided)

Material Description

Red-Brown Lean Clay with Sand

Atterberg Limits

PL= 17 LL= 32 PI= 15

Coefficients

D_{90}= 0.1476 D_{85}= 0.1152 D_{60}= 0.0380
D_{50}= 0.0271 D_{30}= 0.0109 D_{15}= 0.0036
D_{10}= 0.0024 C_u= 15.91 C_c= 1.32

Classification

USCS= CL AASHTO= A-6(10)

Remarks

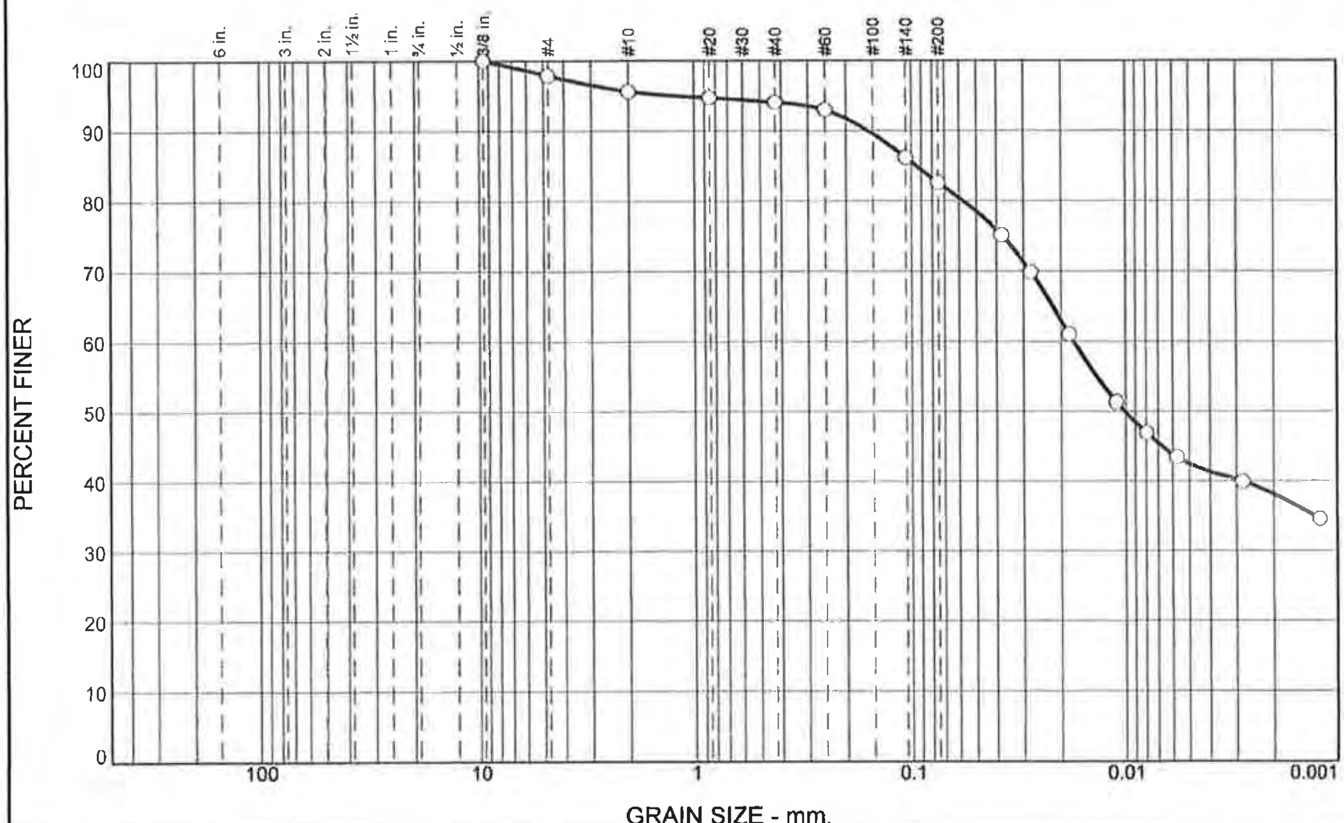
Location: PZ-18 SS @ 18.5'-19.5'

Date: 08-12-14

Summit Engineering Ft. Mill, South Carolina	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.1	2.3	1.6	11.4	40.2	42.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	97.9		
#10	95.6		
#20	94.7		
#40	94.0		
#60	92.9		
#140	86.1		
#200	82.6		

* (no specification provided)

Material Description

Yellow-Grey Fat Clay with Sand

Atterberg Limits

PL= 25 LL= 50 PI= 25

Coefficients

D_{90}= 0.1593 D_{85}= 0.0948 D_{60}= 0.0175
D_{50}= 0.0101 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(22)

Remarks

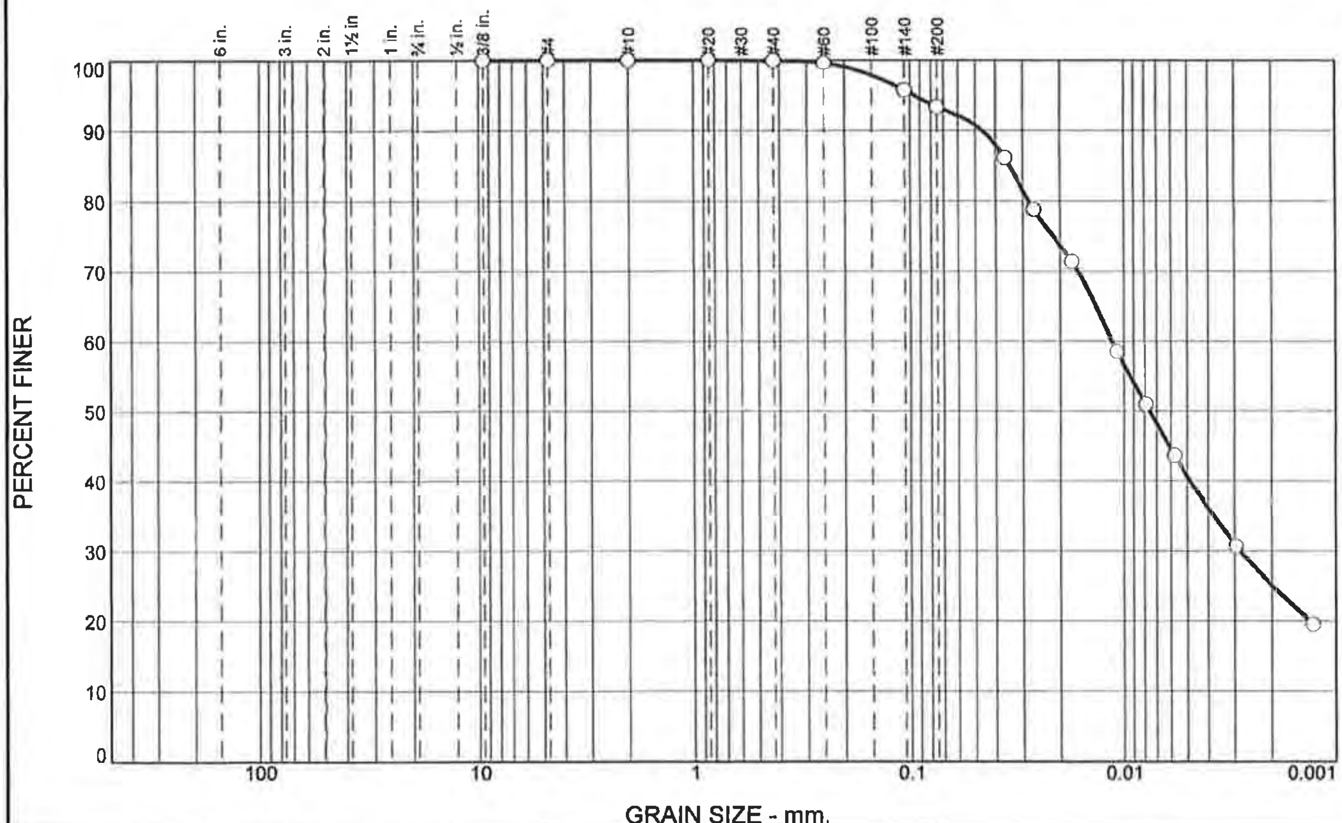
Location: PZ-2 UD @ 9'-11'

Date: 08-12-14

Summit Engineering **Ft. Mill, South Carolina**	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	6.6	52.8	40.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.6		
#140	95.8		
#200	93.3		

* (no specification provided)

Material Description

Light Yellow Lean Clay

Atterberg Limits

PL= 27 LL= 48 PI= 21

Coefficients

D_{90}= 0.0463 D_{85}= 0.0345 D_{60}= 0.0114
D_{50}= 0.0076 D_{30}= 0.0028 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(22)

Remarks

Location: PZ-3 UD @ 0'-2'

Date: 08-12-14

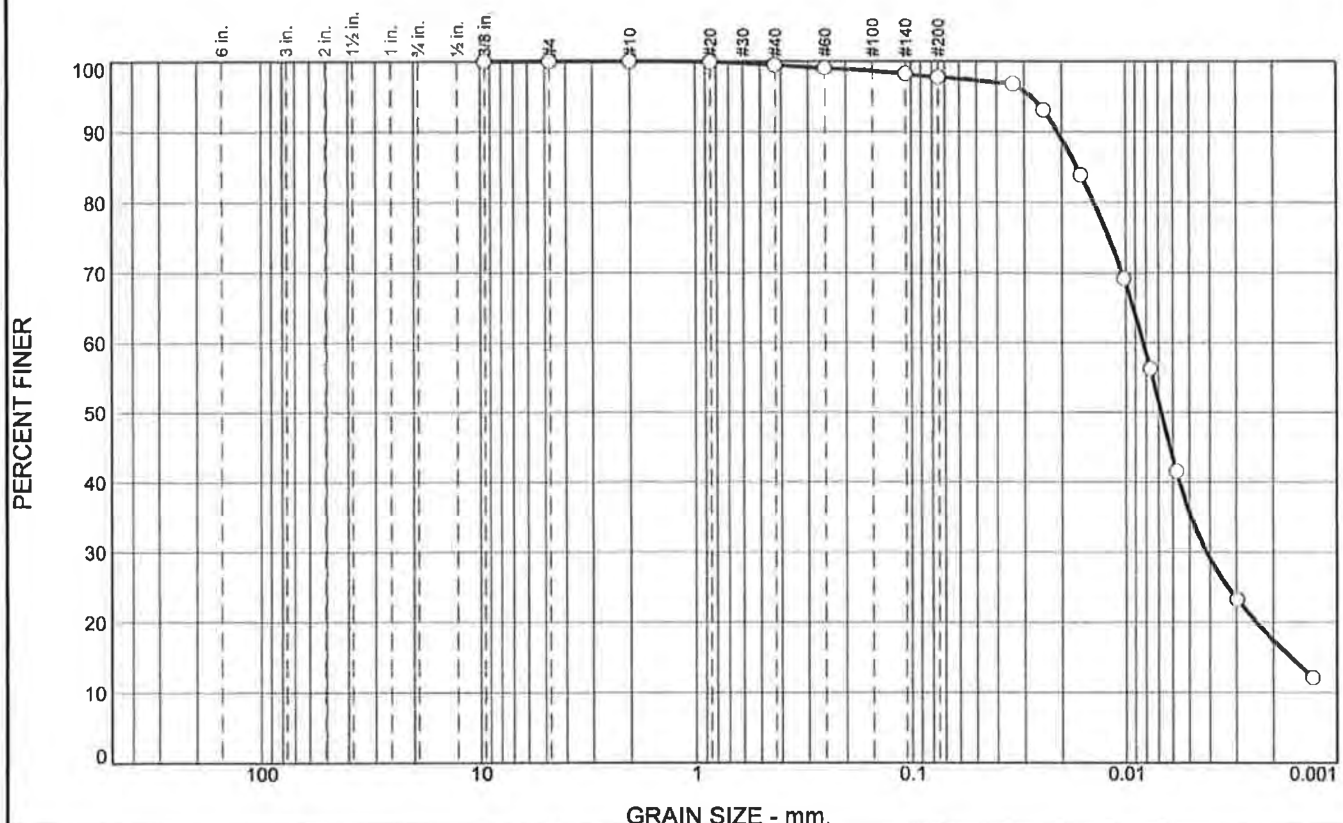
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	1.6	62.1	35.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.4		
#60	99.0		
#140	98.2		
#200	97.8		

* (no specification provided)

Material Description

Purple-Grey Lean Clay

Atterberg Limits

PL= 26 LL= 48 PI= 22

Coefficients

D_{90}= 0.0209 D_{85}= 0.0170 D_{60}= 0.0082
D_{50}= 0.0068 D_{30}= 0.0042 D_{15}= 0.0017
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(25)

Remarks

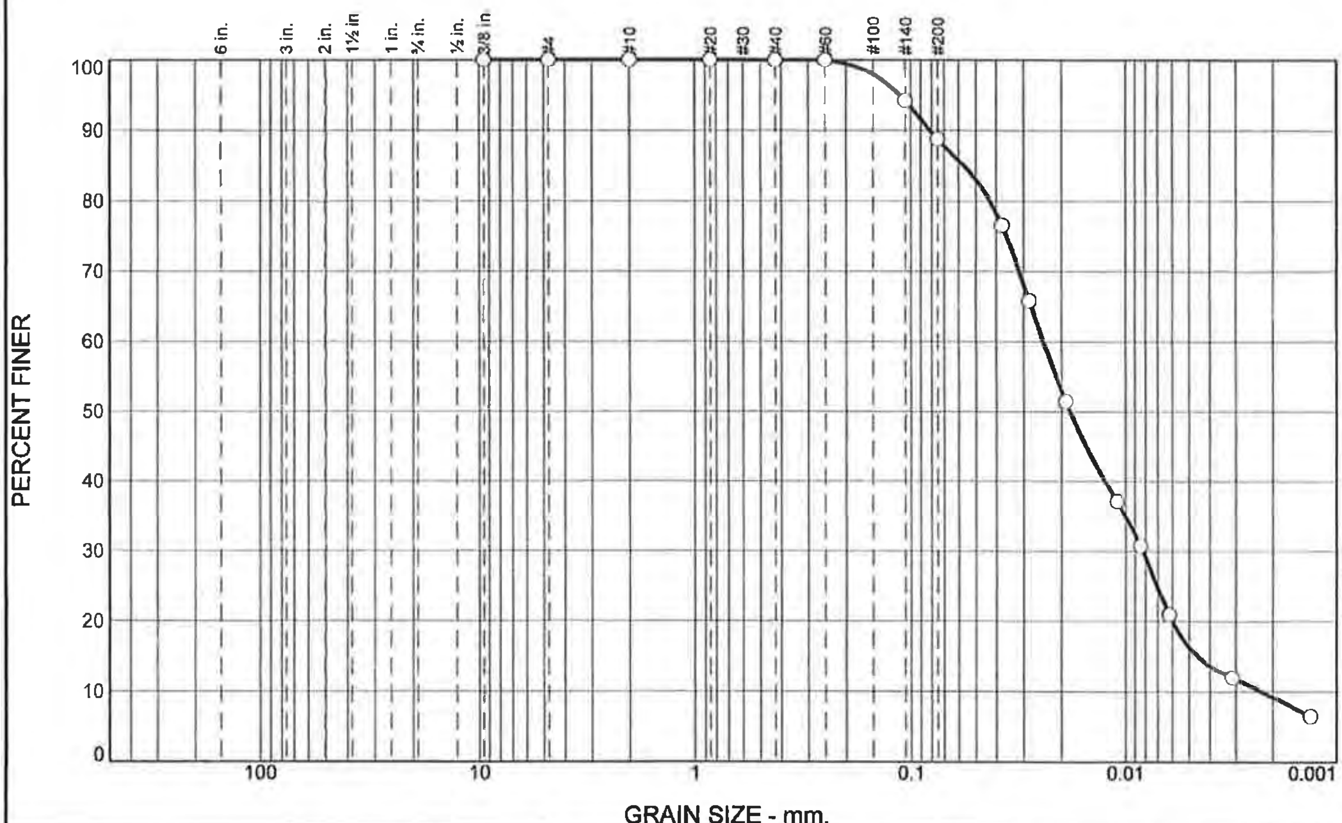
Location: PZ-5 UD @ 6'-8'

Date: 08-12-14

Summit Engineering Ft. Mill, South Carolina	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	11.2	72.5	16.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.9		
#140	94.1		
#200	88.7		

* (no specification provided)

Material Description

Tan-Brown Lean Clay

Atterberg Limits

PL= 23 LL= 37 PI= 14

Coefficients

D_{90}= 0.0815 D_{85}= 0.0568 D_{60}= 0.0243
D_{50}= 0.0182 D_{30}= 0.0083 D_{15}= 0.0046
D_{10}= 0.0023 C_u= 10.64 C_c= 1.23

Classification

USCS= CL AASHTO= A-6(13)

Remarks

Location: PZ-6 UD @ 10.5'-11'

Date: 08-12-14

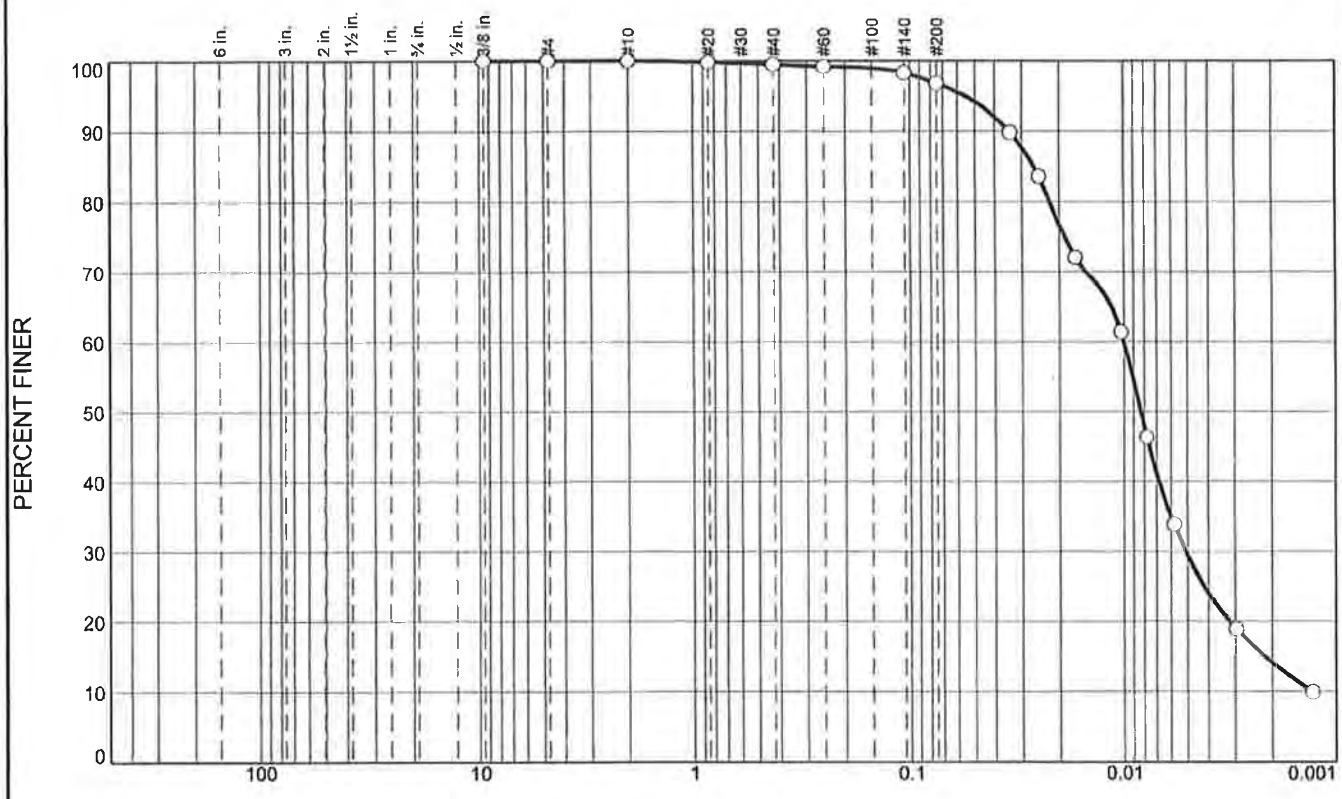
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	2.6	67.5	29.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.4		
#60	99.1		
#140	98.2		
#200	96.8		

* (no specification provided)

Material Description

Purple-Brown Lean Clay

Atterberg Limits

PL= 24 LL= 40 PI= 16

Coefficients

D_{90}= 0.0345 D_{85}= 0.0264 D_{60}= 0.0100
D_{50}= 0.0083 D_{30}= 0.0051 D_{15}= 0.0022
D_{10}= 0.0013 C_u= 7.61 C_c= 2.01

Classification

USCS= CL AASHTO= A-6(17)

Remarks

Location: PZ-7 UD @ 6'-8'

Date: 08-12-14

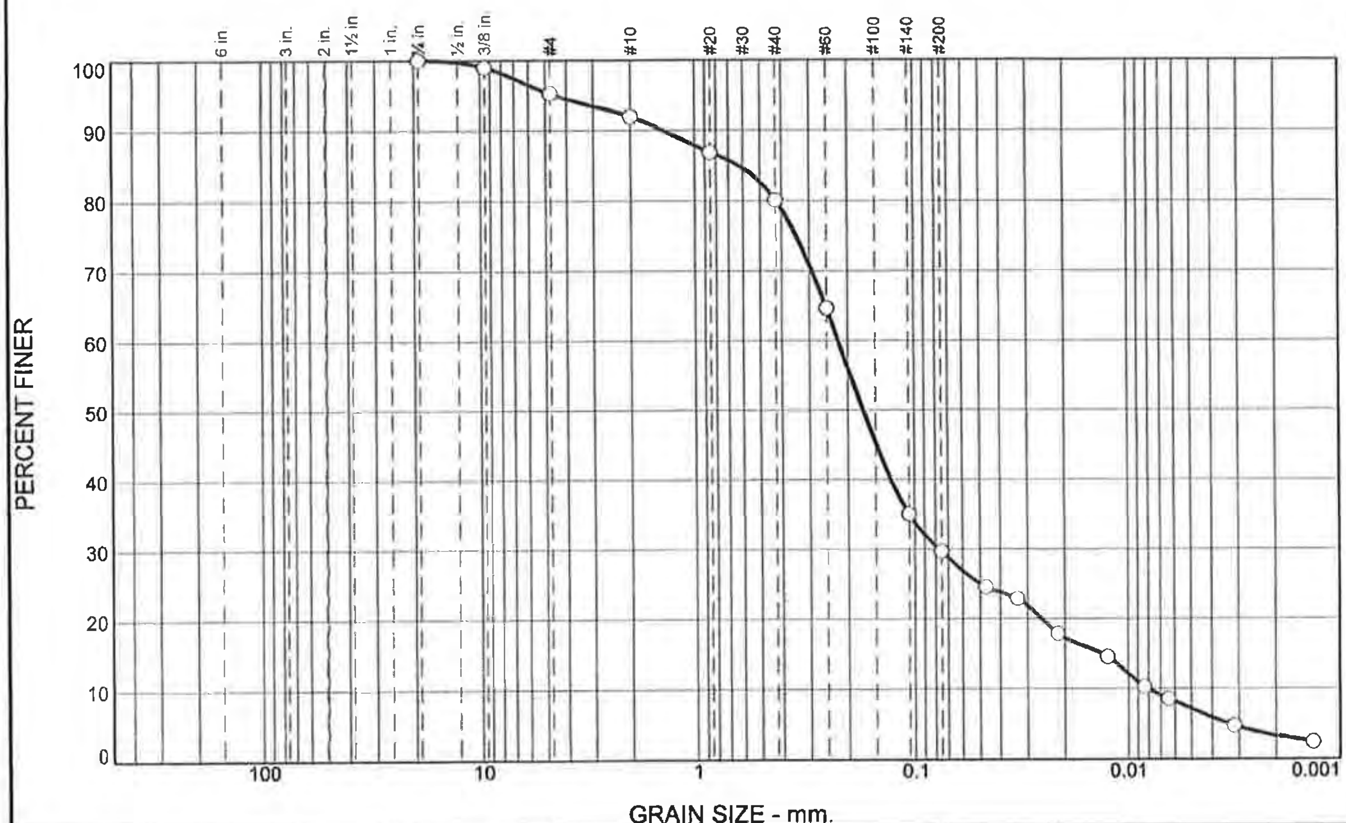
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.8	3.3	11.8	50.4	22.6	7.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.375	99.0		
#4	95.2		
#10	91.9		
#20	86.9		
#40	80.1		
#60	64.6		
#140	34.9		
#200	29.7		

* (no specification provided)

Material Description

Purple Silty Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 1.4170 D_{85}= 0.6257 D_{60}= 0.2214
D_{50}= 0.1711 D_{30}= 0.0769 D_{15}= 0.0135
D_{10}= 0.0081 C_u= 27.35 C_c= 3.30

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Location: PZ-11 UD @ 6'-6.5'

Date: 08-14-14

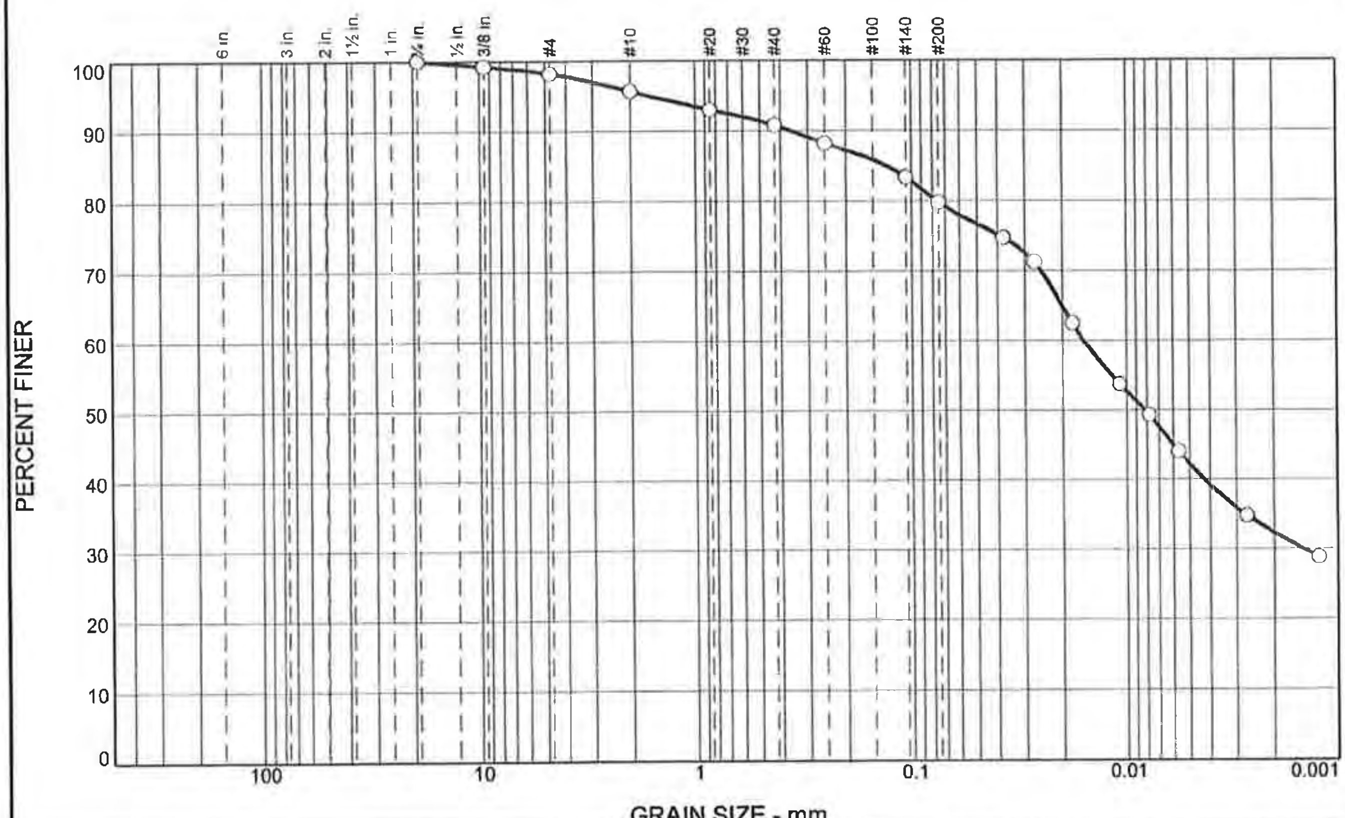
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.8	2.5	4.9	11.0	37.7	42.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.375	99.2		
#4	98.2		
#10	95.7		
#20	93.0		
#40	90.8		
#60	88.2		
#140	83.3		
#200	79.8		

* (no specification provided)

Material Description

Orange-Brown Fat Clay with Sand

Atterberg Limits

PL= 28 LL= 55 PI= 27

Coefficients

D_{90}= 0.3606 D_{85}= 0.1307 D_{60}= 0.0159
D_{50}= 0.0082 D_{30}= 0.0015 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(23)

Remarks

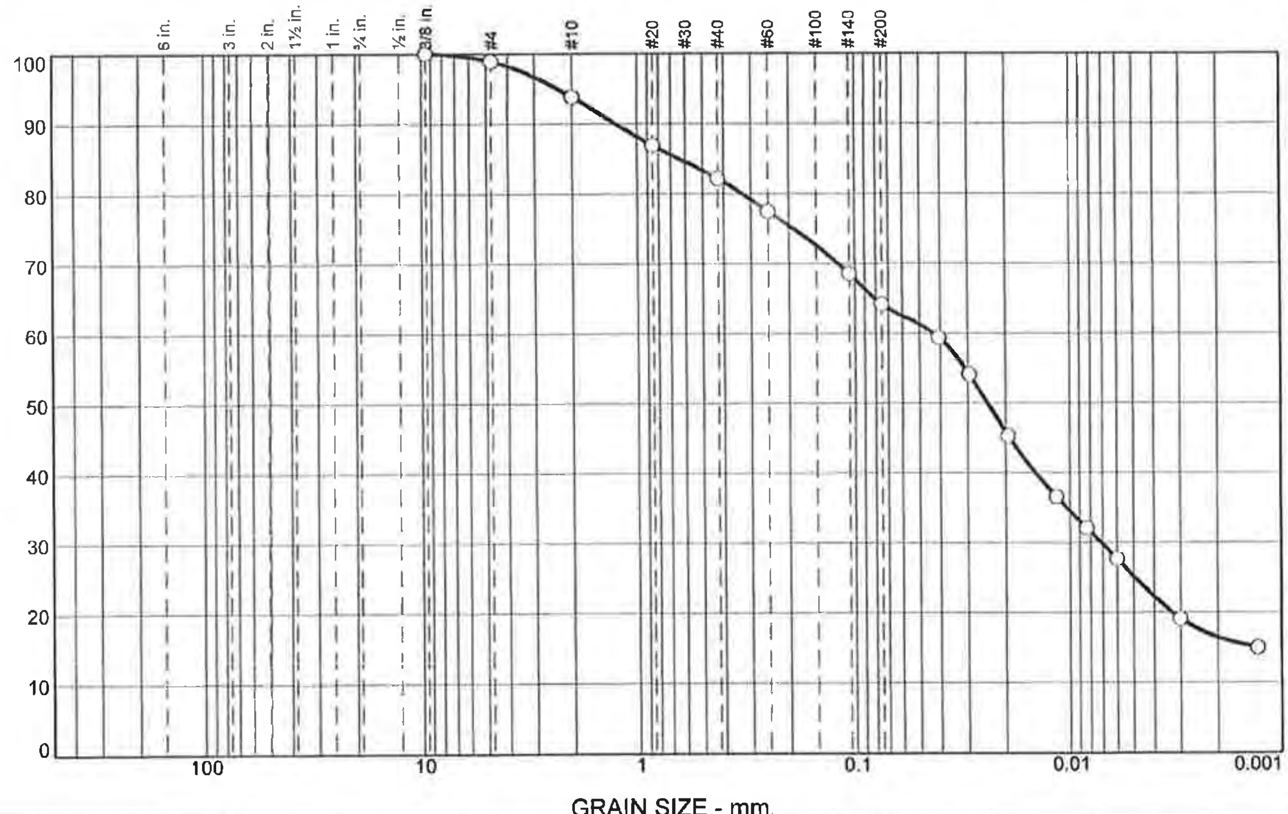
Location: PZ-14 UD @ 6'-7.5'

Date: 08-14-14

Summit Engineering **Ft. Mill, South Carolina**	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	5.1	11.7	17.9	39.1	25.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	98.9		
#10	93.8		
#20	86.9		
#40	82.1		
#60	77.5		
#140	68.5		
#200	64.2		

* (no specification provided)

Material Description

Tan-Brown Sandy Lean Clay

Atterberg Limits

PL= 17 LL= 33 PI= 16

Coefficients

D_{90}= 1.2617 D_{85}= 0.6418 D_{60}= 0.0431
D_{50}= 0.0242 D_{30}= 0.0071 D_{15}= 0.0013
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(8)

Remarks

Location: PZ-9 Bulk @ 15'-30'

Date: 08-12-14

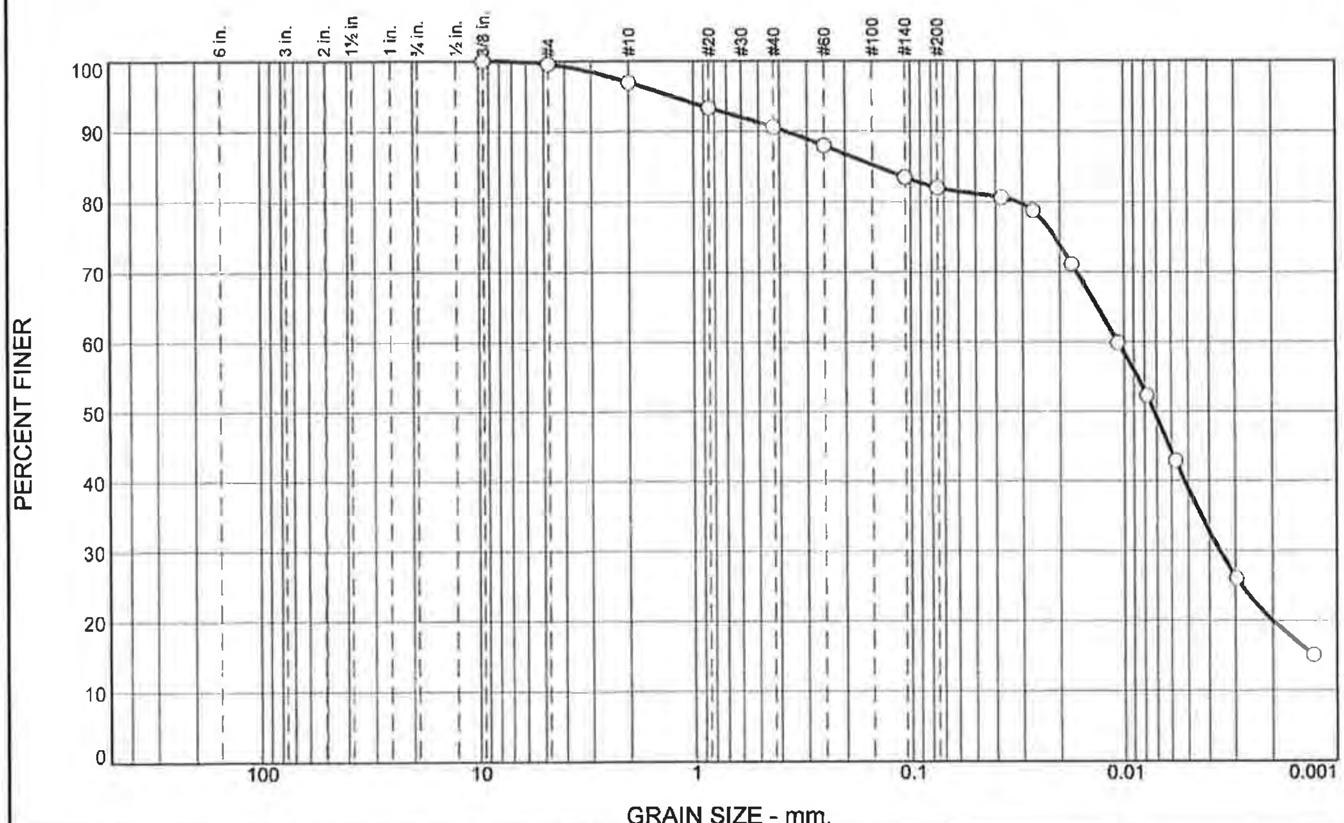
Summit Engineering

Ft. Mill, South Carolina

Client: Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
Project No: SL-309-14 **Figure**

Tested By: Mimi Hourani

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	2.7	6.3	8.6	43.2	38.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.6		
#10	96.9		
#20	93.3		
#40	90.6		
#60	87.9		
#140	83.5		
#200	82.0		

* (no specification provided)

Material Description

Purple -Brown Lean Clay with Sand

Atterberg Limits

PL= 21 LL= 45 PI= 24

Coefficients

D_{90}= 0.3751 D_{85}= 0.1442 D_{60}= 0.0108
D_{50}= 0.0072 D_{30}= 0.0036 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(20)

Remarks

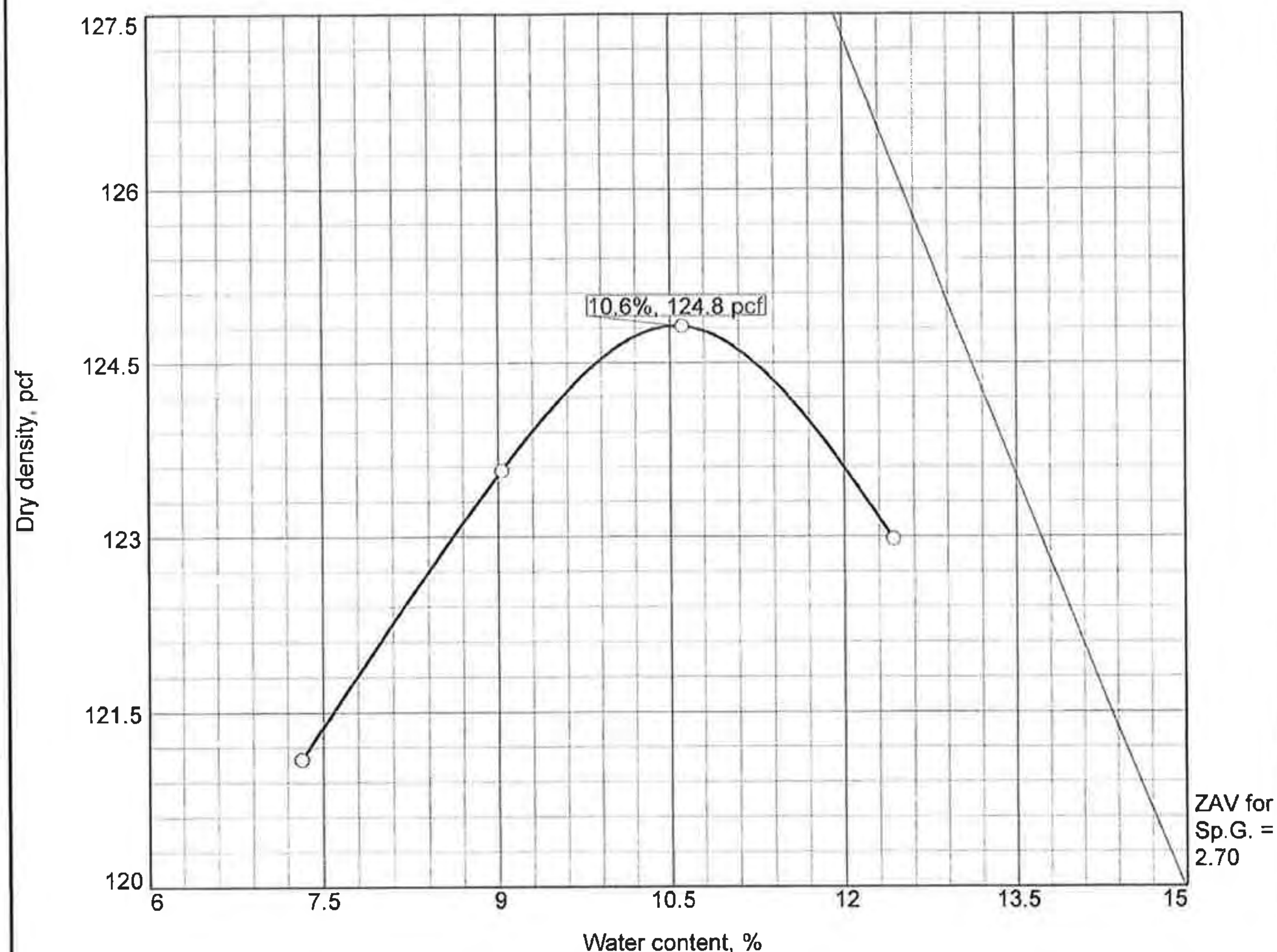
Location: PZ-14 Bulk @ 18.5'-20'

Date: 08-12-14

Summit Engineering Ft. Mill, South Carolina	**Client:** Buxton Environmental **Project:** Sanford Mine 1303 Brickyard Road - Sanford, NC **Project No:** SL-309-14 **Figure**

Tested By: Mimi Hourani

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	CL	A-6(8)			33	16	1.1	64.2

TEST RESULTS

Maximum dry density = 124.8 pcf

Optimum moisture = 10.6 %

MATERIAL DESCRIPTION

Tan-Brown Sandy Lean Clay

Project No. SL-309-14 **Client:** Buxton Environmental

Project: Sanford Mine

1303 Brickyard Road - Sanford, NC

○ **Location:** PZ-9 Bulk @ 15'-30'

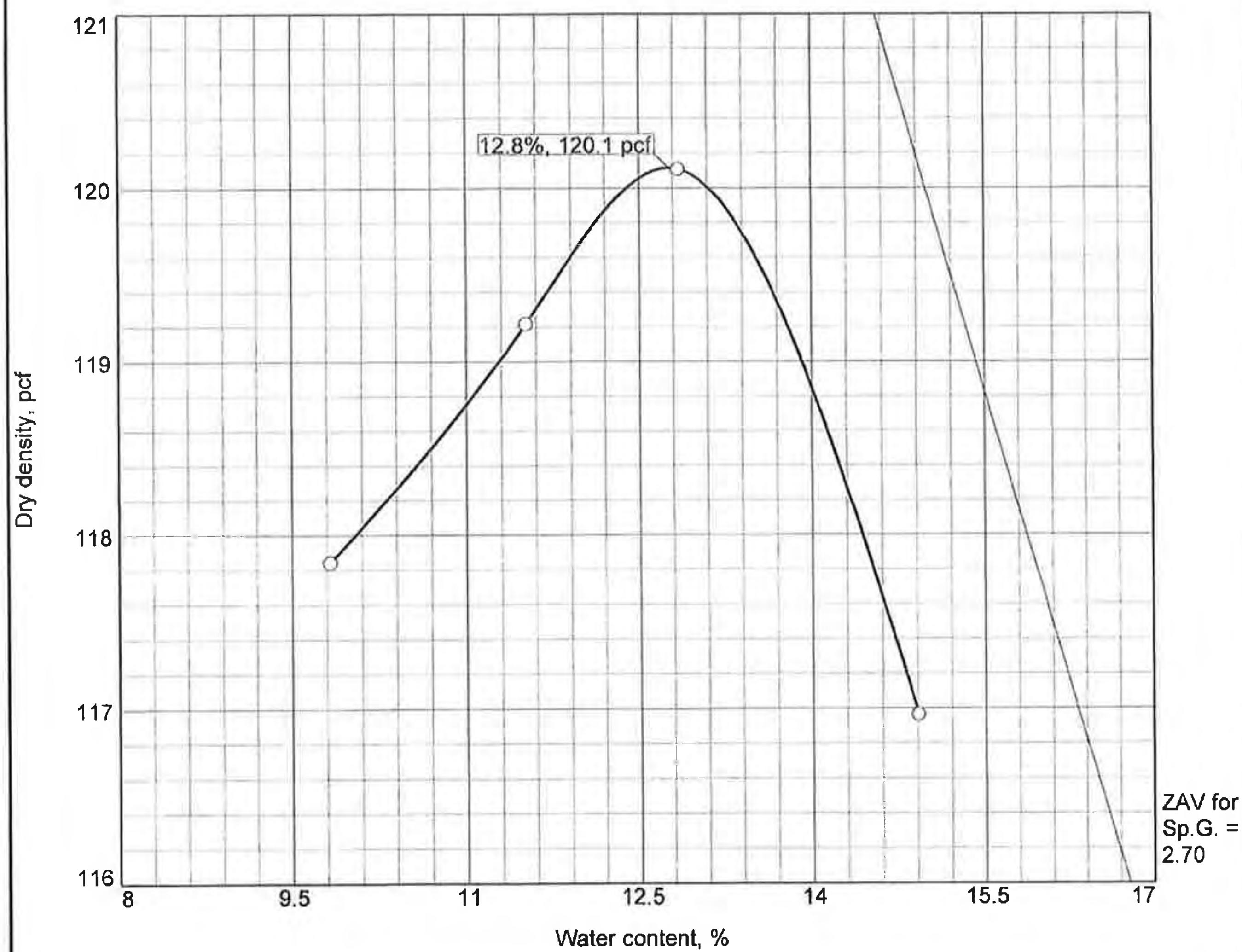
Remarks:

Summit Engineering

Ft. Mill, South Carolina

Figure

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
	CL	A-7-6(20)			45	24	0.4	82.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 120.1 pcf Optimum moisture = 12.8 %	Purple -Brown Lean Clay with Sand

Project No. SL-309-14 **Client:** Buxton Environmental
Project: Sanford Mine
1303 Brickyard Road - Sanford, NC
o **Location:** PZ-14 Bulk @ 18.5'-20'

Summit Engineering

Ft. Mill, South Carolina

Remarks:

Figure

PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 9.04
Specimen Diameter (cm): 7.18
Dry Unit Weight (pcf): 98.4
Moisture Before Test (%): 22.3
Moisture After Test (%): 27.7
Run Number: 1 ● 2 ▲
Cell Pressure (psi): 87.0
Test Pressure(psi): 81.0
Back Pressure(psi): 80.1
Diff. Head (psi): 0.9
Flow Rate (cc/sec): 1.98 x 10^-2
Perm. (cm/sec): 6.23 x 10^-5

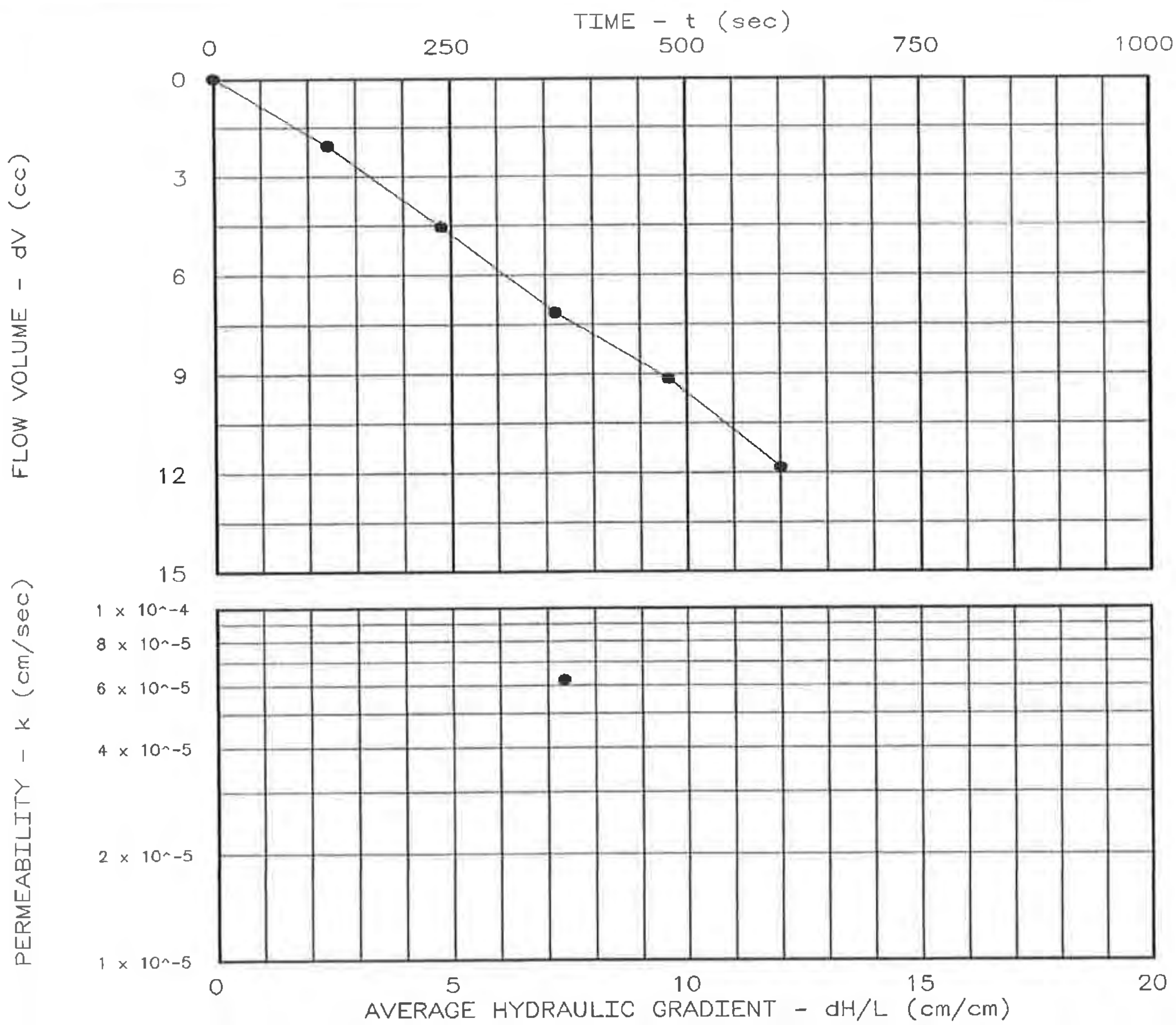
SAMPLE DATA:

Sample Identification: PZ-2 UD @ 9'-11'

Visual Description: Yellow-Grey Fat Clay with Sand (CH)
Remarks:

Maximum Dry Density (pcf):
Optimum Moisture Content (%):

Percent Compaction:
Permeameter type: Flexible Wall
Sample type: Shelby Tube



Project: Sanford Mine
Location: 1303 Brickyard Road - Sanford, NC
Date: 07-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-2 UD @ 9'-11'
Lab No.:	
Description:	Yellow-Grey Fat Clay with Sand (CH)
Sample Type:	Shelby Tube
Max. Dry Dens.:	
Method (D1557/D698):	
Opt. Water Content:	
Date:	07-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test: 1	Before test: 2	Before test: 3	After test: 1	After test: 2	After test: 3
Diameter:						
Top:	2.825 in	in		2.833 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.83 in	7.18 cm		2.83 in	7.20 cm	
Length:	3.560 in	in	in	3.570 in	in	in
Average:	3.56 in	9.04 cm		3.57 in	9.07 cm	

Moisture, Density and Sample Parameters:

	Before test	After test
Specific Gravity:	2.66	
Wet Wt. & Tare:	705.20	735.80
Dry Wt. & Tare:	576.40	576.40
Tare Wt.:	0.00	0.00
Moisture Content:	22.3 %	27.7 %
Dry Unit Weight:	98.4 pcf	97.6 pcf
Porosity:	0.4074	0.4124
Saturation:	86.5 %	104.8 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 3 Panel No.: 3 Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	OUT	BURET READING-cc IN	OUT	OUTFLOW/ INFLOW RATIO
S	7/30/14	12:00:00	0	81.0	80.0	5.00	5.00	0.00
	7/30/14	12:02:00	120	81.0	80.0	7.06	2.94	1.00
R						7.06	2.94	
R						5.00	5.00	
	7/30/14	12:04:00	240	81.0	80.0	7.48	2.52	1.00
R						7.48	2.52	
R						5.00	5.00	
	7/30/14	12:06:00	360	81.0	80.0	7.60	2.40	1.00
R						7.60	2.40	
R						5.00	5.00	
	7/30/14	12:08:00	480	81.0	80.0	7.00	3.00	1.00
R						7.00	3.00	
R						5.00	5.00	
	7/30/14	12:10:00	600	81.0	80.0	7.70	2.30	1.00

Test Pressure = 81.0 psi Differential Head = 0.9 psi, 66.4 cm H2O
Gradient = 7.339E 00 Flow rate = 1.977E-02 cc/sec R squared = 0.99860
Permeability, K22.8° = 6.662E-05 cm/sec, K20° = 6.232E-05 cm/sec

PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 9.55
Specimen Diameter (cm): 7.27
Dry Unit Weight (pcf): 101.3
Moisture Before Test (%): 22.1
Moisture After Test (%): 25.2
Run Number: 1 ● 2 ▲
Cell Pressure (psi): 87.0
Test Pressure(psi): 82.0
Back Pressure(psi): 80.0
Diff. Head (psi): 2.0
Flow Rate (cc/sec): 1.57 x 10^-3
Perm. (cm/sec): 2.42 x 10^-6

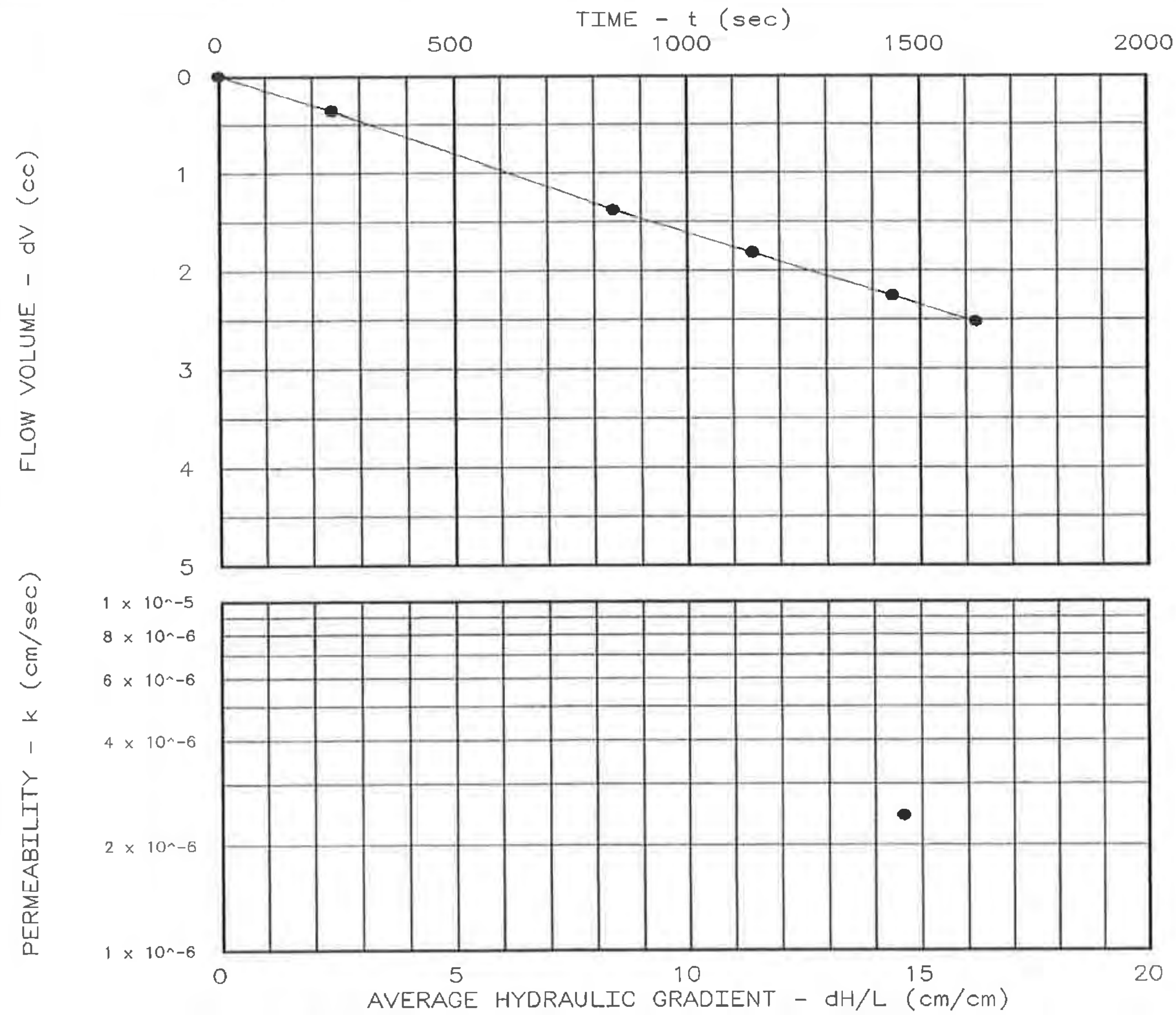
SAMPLE DATA:

Sample Identification: PZ-3 UD @ 0'-2'

Visual Description: Light Yellow Lean Clay (CL)
Remarks:

Maximum Dry Density (pcf):
Optimum Moisture Content (%):

Percent Compaction:
Permeameter type: Flexible Wall
Sample type: Shelby Tube



Project: Sanford Mine
Location: 1303 Brickyard Road - Sanford, NC
Date: 07-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-3 UD @ 0'-2'
Lab No.:	
Description:	Light Yellow Lean Clay (CL)
Sample Type:	Shelby Tube
Max. Dry Dens.:	
Method (D1557/D698):	
Opt. Water Content:	
Date:	07-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test: 1	Before test: 2	Before test: 3	After test: 1	After test: 2	After test: 3
Diameter:	1	2		1	2	
Top:	2.862 in	in		2.843 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.86 in	7.27 cm		2.84 in	7.22 cm	
Length:	1	2	3	1	2	3
	3.760 in	in	in	3.764 in	in	in
Average:	3.76 in	9.55 cm		3.76 in	9.56 cm	

Moisture, Density and Sample Parameters:

	Before test	After test
Specific Gravity:	2.67	
Wet Wt. & Tare:	784.80	805.02
Dry Wt. & Tare:	642.90	642.91
Tare Wt.:	0.00	0.00
Moisture Content:	22.1 %	25.2 %
Dry Unit Weight:	101.3 pcf	102.5 pcf
Porosity:	0.3925	0.3850
Saturation:	91.2 %	107.5 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 1 Panel No.: 1 Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	GAUGE PRESSURE-psi OUT	BURET READING-cc IN	BURET READING-cc OUT	OUTFLOW/ INFLOW RATIO
S	7/30/14	12:00:00	0	82.0	80.0	5.00	5.00	0.00
	7/30/14	12:04:00	240	82.0	80.0	5.36	4.64	1.00
R						5.36	4.64	
R						5.00	5.00	
	7/30/14	12:14:00	840	82.0	80.0	6.02	3.98	1.00
	7/30/14	12:19:00	1,140	82.0	80.0	6.46	3.54	1.00
R						6.46	3.54	
R						5.00	5.00	
	7/30/14	12:24:00	1,440	82.0	80.0	5.44	4.56	1.00
	7/30/14	12:27:00	1,620	82.0	80.0	5.70	4.30	1.00

Test Pressure = 82.0 psi Differential Head = 2.0 psi, 139.3 cm H2O
Gradient = 1.458E 01 Flow rate = 1.569E-03 cc/sec R squared = 0.99903
Permeability, K22.8° = 2.592E-06 cm/sec, K20° = 2.425E-06 cm/sec

PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 9.31
Specimen Diameter (cm): 7.30
Dry Unit Weight (pcf): 116.6
Moisture Before Test (%): 15.2
Moisture After Test (%): 18.1
Run Number: 1 ● 2 ▲
Cell Pressure (psi): 87.0
Test Pressure(psi): 85.0
Back Pressure(psi): 80.0
Diff. Head (psi): 5.0
Flow Rate (cc/sec): 4.08×10^{-4}
Perm. (cm/sec): 2.43×10^{-7}

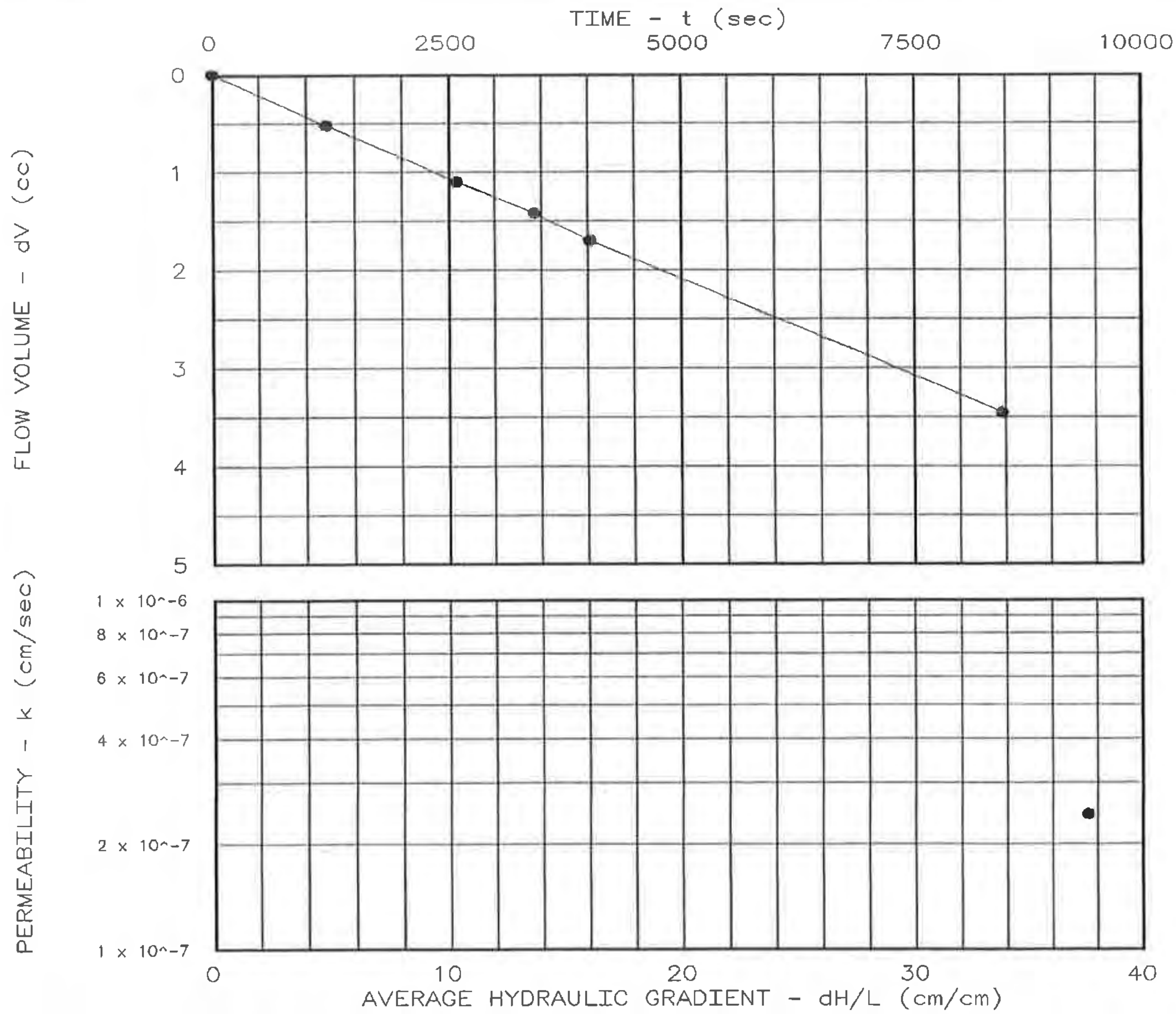
SAMPLE DATA:

Sample Identification: PZ-5 UD @ 6'-8'

Visual Description: Purple-Grey Lean Clay (CL)
Remarks:

Maximum Dry Density (pcf):
Optimum Moisture Content (%):

Percent Compaction:
Permeameter type: Flexible Wall
Sample type: Shelby Tube



Project: Sanford Mine
Location: 1303 Brickyard Road – Sanford, NC
Date: 07-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-5 UD @ 6'-8'
Lab No.:	
Description:	Purple-Grey Lean Clay (CL)
Sample Type:	Shelby Tube
Max. Dry Dens.:	
Method (D1557/D698):	
Opt. Water Content:	
Date:	07-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:			After test:		
Diameter:	1	2		1	2	
Top:	2.873 in	in		2.881 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.87 in	7.30 cm		2.88 in	7.32 cm	
Length:	1	2	3	1	2	3
	3.664 in	in	in	3.678 in	in	in
Average:	3.66 in	9.31 cm		3.68 in	9.34 cm	

Moisture, Density and Sample Parameters:

	Before test	After test
Specific Gravity:	2.69	
Wet Wt. & Tare:	837.52	858.80
Dry Wt. & Tare:	727.16	727.16
Tare Wt.:	0.00	0.00
Moisture Content:	15.2 %	18.1 %
Dry Unit Weight:	116.6 pcf	115.5 pcf
Porosity:	0.3055	0.3120
Saturation:	92.8 %	107.4 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 4   Panel No.: 4   Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

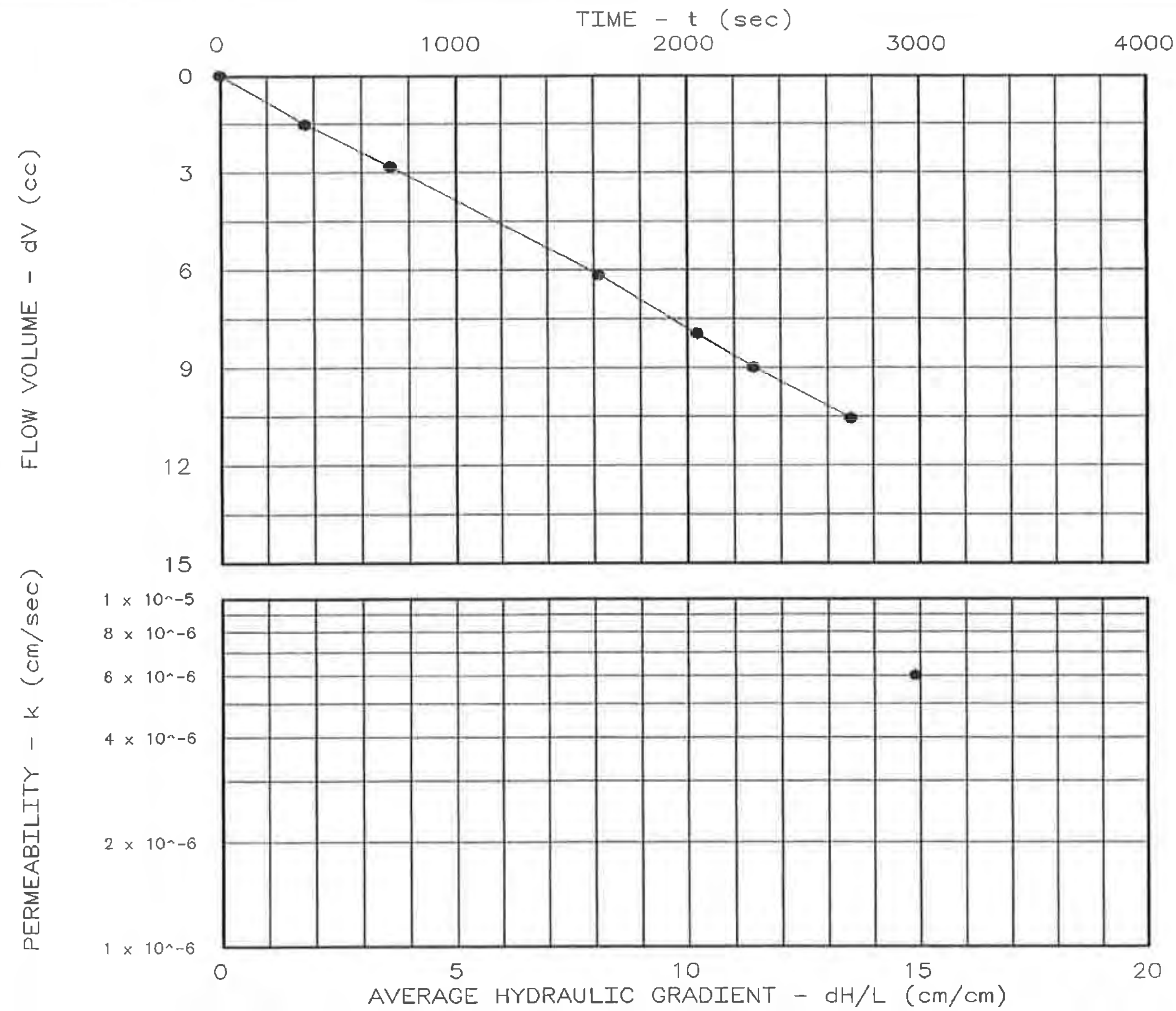
PERMEABILITY TEST READINGS DATA

CASE D S	X R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	OUT	BURET READING-cc IN	OUT	OUTFLOW/ INFLOW RATIO
S		7/30/14	12:00:00	0	85.0	80.0	5.00	5.00	0.00
		7/30/14	12:20:00	1,200	85.0	80.0	5.52	4.48	1.00
		7/30/14	12:43:00	2,580	85.0	80.0	6.10	3.90	1.00
		7/30/14	12:57:00	3,420	85.0	80.0	6.42	3.58	1.00
		7/30/14	13:07:00	4,020	85.0	80.0	6.70	3.30	1.00
	R						6.70	3.30	
	R						5.00	5.00	
		7/30/14	14:21:00	8,460	85.0	80.0	6.76	3.24	1.00

Test Pressure = 85.0 psi Differential Head = 5.0 psi, 349.4 cm H2O
Gradient = 3.754E 01 Flow rate = 4.079E-04 cc/sec R squared = 0.99964
Permeability, K22.8° = 2.598E-07 cm/sec, K20° = 2.430E-07 cm/sec

PERMEABILITY TEST REPORT

TEST DATA:			SAMPLE DATA:
Specimen Height (cm): 9.25			Sample Identification: PZ-6 UD @ 10.5'-11'
Specimen Diameter (cm): 7.20			
Dry Unit Weight (pcf): 116.0			Visual Description: Tan-Brown Lean Clay (CL)
Moisture Before Test (%): 12.8			
Moisture After Test (%): 17.9			Remarks:
Run Number:	1 ●	2 ▲	
Cell Pressure (psi):	87.0		Maximum Dry Density (pcf):
Test Pressure(psi):	82.0		Optimum Moisture Content (%):
Back Pressure(psi):	80.0		
Diff. Head (psi):	2.0		Percent Compaction:
Flow Rate (cc/sec):	3.90 x 10^-3		Permeameter type: Flexible Wall
Perm. (cm/sec):	6.01 x 10^-6		Sample type: Shelby Tube



Project: Sanford Mine	Project No.: SL-309-14
Location: 1303 Brickyard Road - Sanford, NC	File No.:
Date: 07-28-14	Lab No.:
PERMEABILITY TEST REPORT	Tested by: MH
	Checked by: CPT
SUMMIT ENG. & CONST. SERV., INC.	Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-6 UD @ 10.5'-11'
Lab No.:	
Description:	Tan-Brown Lean Clay (CL)
Sample Type:	Shelby Tube
Max. Dry Dens.:	
Method (D1557/D698):	
Opt. Water Content:	
Date:	07-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test: 1	Before test: 2	Before test: 3	After test: 1	After test: 2	After test: 3
Diameter:						
Top:	2.836 in	in		2.882 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.84 in	7.20 cm		2.88 in	7.32 cm	
Length:	3.640 in	in	in	3.682 in	in	in
Average:	3.64 in	9.25 cm		3.68 in	9.35 cm	

Moisture, Density and Sample Parameters:

	Before test	After test
Specific Gravity:	2.68	
Wet Wt. & Tare:	789.63	825.17
Dry Wt. & Tare:	700.04	700.04
Tare Wt.:	0.00	0.00
Moisture Content:	12.8 %	17.9 %
Dry Unit Weight:	116.0 pcf	111.0 pcf
Porosity:	0.3068	0.3364
Saturation:	77.5 %	94.5 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 5 Panel No.: 5 Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D S	X R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	OUT	BURET READING-cc IN	OUT	OUTFLOW/ INFLOW RATIO
S		7/30/14	12:00:00	0	82.0	80.0	5.00	5.00	0.00
		7/30/14	12:06:00	360	82.0	80.0	6.52	3.48	1.00
	R						6.52	3.48	
	R						5.00	5.00	
		7/30/14	12:12:00	720	82.0	80.0	6.30	3.70	1.00
	R						6.30	3.70	
	R						5.00	5.00	
		7/30/14	12:27:00	1,620	82.0	80.0	8.34	1.66	1.00
	R						8.34	1.66	
	R						5.00	5.00	
		7/30/14	12:34:00	2,040	82.0	80.0	6.80	3.20	1.00
	R						6.80	3.20	
	R						5.00	5.00	
		7/30/14	12:38:00	2,280	82.0	80.0	6.04	3.96	1.00
	R						6.04	3.96	
	R						5.00	5.00	
		7/30/14	12:45:00	2,700	82.0	80.0	6.56	3.44	1.00

Test Pressure = 82.0 psi Differential Head = 2.0 psi, 137.6 cm H2O
Gradient = 1.488E 01 Flow rate = 3.896E-03 cc/sec R squared = 0.99950
Permeability, K22.8° = 6.424E-06 cm/sec, K20° = 6.009E-06 cm/sec

PERMEABILITY TEST REPORT

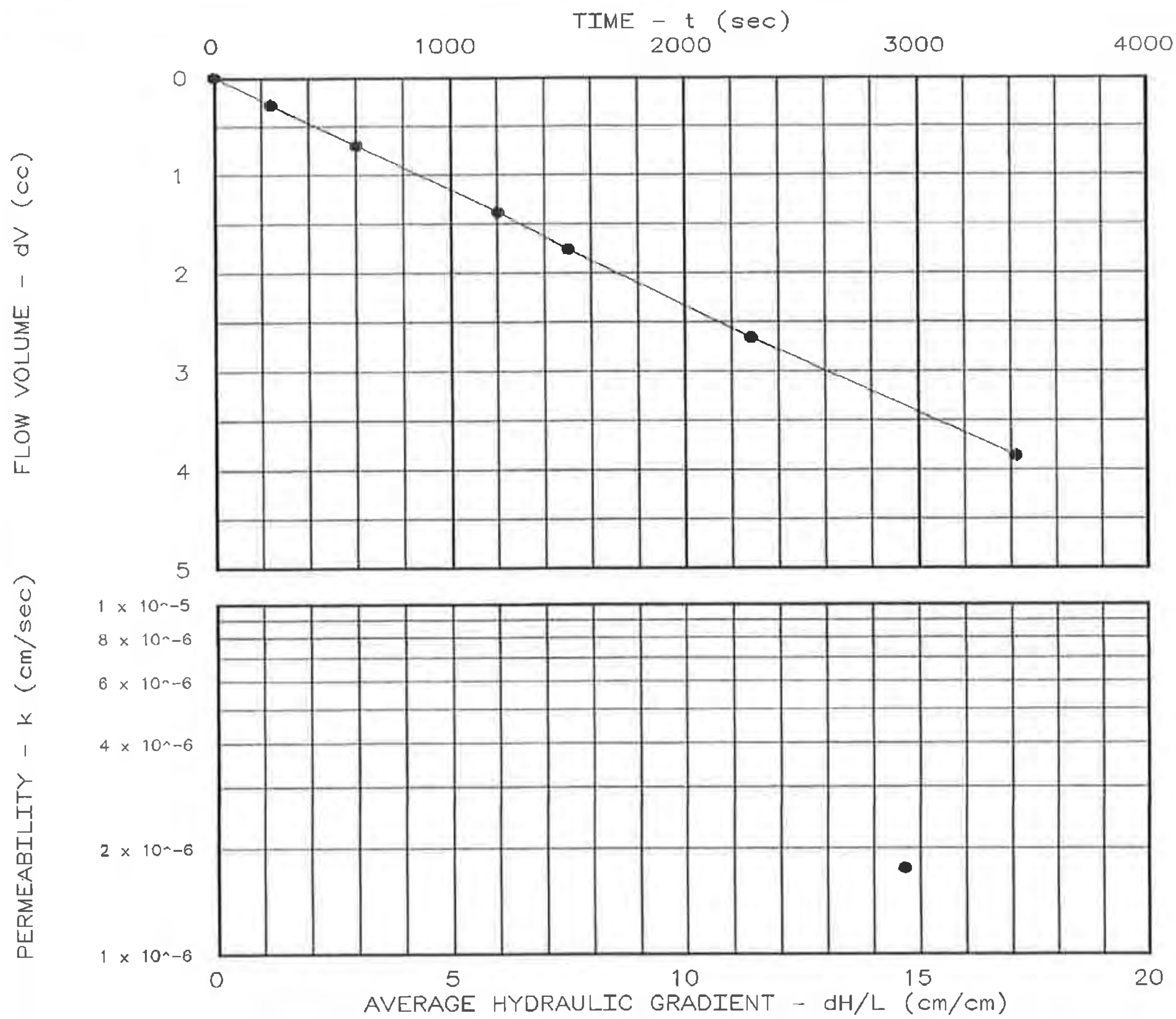
TEST DATA:
Specimen Height (cm): 9.47
Specimen Diameter (cm): 7.25
Dry Unit Weight (pcf): 119.5
Moisture Before Test (%): 12.7
Moisture After Test (%): 15.4
Run Number: 1 ● 2 ▲
Cell Pressure (psi): 87.0
Test Pressure(psi): 82.0
Back Pressure(psi): 80.0
Diff. Head (psi): 2.0
Flow Rate (cc/sec): 1.14 x 10^-3
Perm. (cm/sec): 1.76 x 10^-6

SAMPLE DATA:
Sample Identification: PZ-7 UD @ 6'-8'

Visual Description: Purple-Brown Lean Clay (CL)
Remarks:

Maximum Dry Density (pcf):
Optimum Moisture Content (%):

Percent Compaction:
Permeameter type: Flexible Wall
Sample type: Shelby Tube



Project: Sanford Mine
Location: 1303 Brickyard Road - Sanford, NC
Date: 07-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-7 UD @ 6'-8'
Lab No.:	
Description:	Purple-Brown Lean Clay (CL)
Sample Type:	Shelby Tube
Max. Dry Dens.:	
Method (D1557/D698):	
Opt. Water Content:	
Date:	07-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:			After test:		
Diameter:	1	2		1	2	
Top:	2.854 in	in		2.865 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.85 in	7.25 cm		2.87 in	7.28 cm	
Length:	1	2	3	1	2	3
	3.730 in	in	in	3.720 in	in	in
Average:	3.73 in	9.47 cm		3.72 in	9.45 cm	

Moisture, Density and Sample Parameters:

	Before test	After test
Specific Gravity:	2.74	
Wet Wt. & Tare:	843.70	863.80
Dry Wt. & Tare:	748.76	748.76
Tare Wt.:	0.00	0.00
Moisture Content:	12.7 %	15.4 %
Dry Unit Weight:	119.5 pcf	116.5 pcf
Porosity:	0.3011	0.3046
Saturation:	80.6 %	96.1 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 2   Panel No.: 2   Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	OUT	BURET READING-cc IN	OUT	OUTFLOW/ INFLOW RATIO
S	7/30/14	12:00:00	0	82.0	80.0	5.00	5.00	0.00
	7/30/14	12:04:00	240	82.0	80.0	5.28	4.72	1.00
	7/30/14	12:10:00	600	82.0	80.0	5.70	4.30	1.00
	7/30/14	12:20:00	1,200	82.0	80.0	6.38	3.62	1.00
R						6.38	3.62	
R						5.00	5.00	
	7/30/14	12:25:00	1,500	82.0	80.0	5.38	4.62	1.00
	7/30/14	12:38:00	2,280	82.0	80.0	6.28	3.72	1.00
	7/30/14	12:57:00	3,420	82.0	80.0	7.48	2.52	1.00

Test Pressure = 82.0 psi   Differential Head = 2.0 psi, 138.8 cm H2O
Gradient = 1.465E 01   Flow rate = 1.136E-03 cc/sec   R squared = 0.99944
Permeability, K22.8° = 1.880E-06 cm/sec, K20° = 1.758E-06 cm/sec

PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 8.56
Specimen Diameter (cm): 7.23
Dry Unit Weight (pcf): 135.9
Moisture Before Test (%): 8.0
Moisture After Test (%): 10.6
Run Number: 1 ● 2 ▲
Cell Pressure (psi): 87.0
Test Pressure(psi): 82.0
Back Pressure(psi): 80.0
Diff. Head (psi): 2.0
Flow Rate (cc/sec): 2.74 x 10^-3
Perm. (cm/sec): 3.86 x 10^-6

SAMPLE DATA:

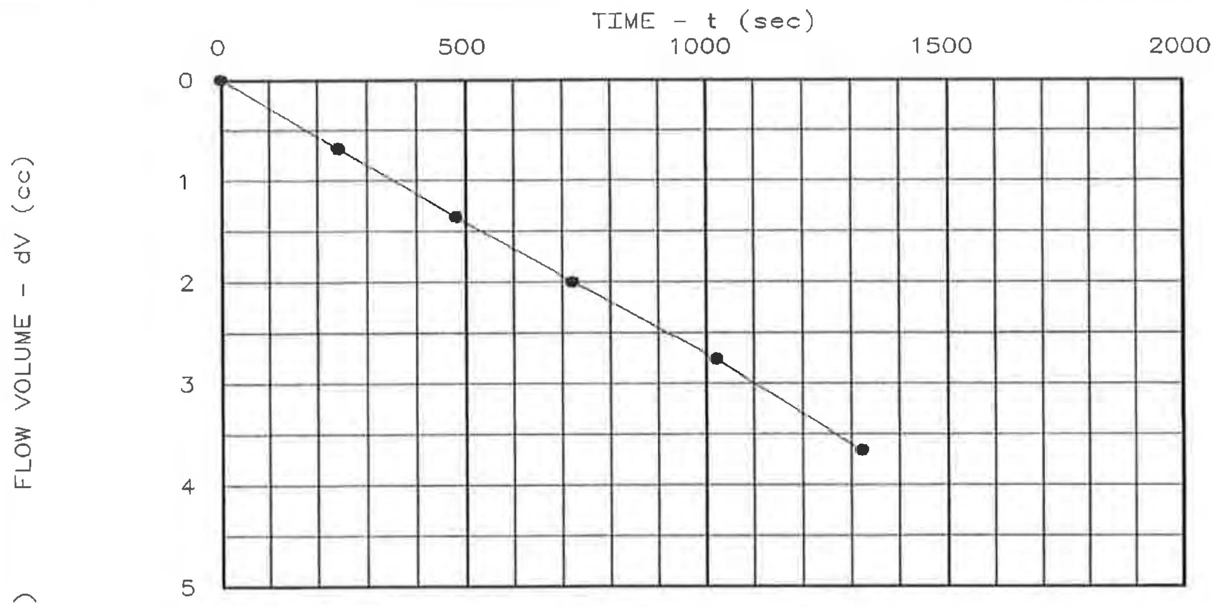
Sample Identification: PZ-11 UD @ 6'-6.5'

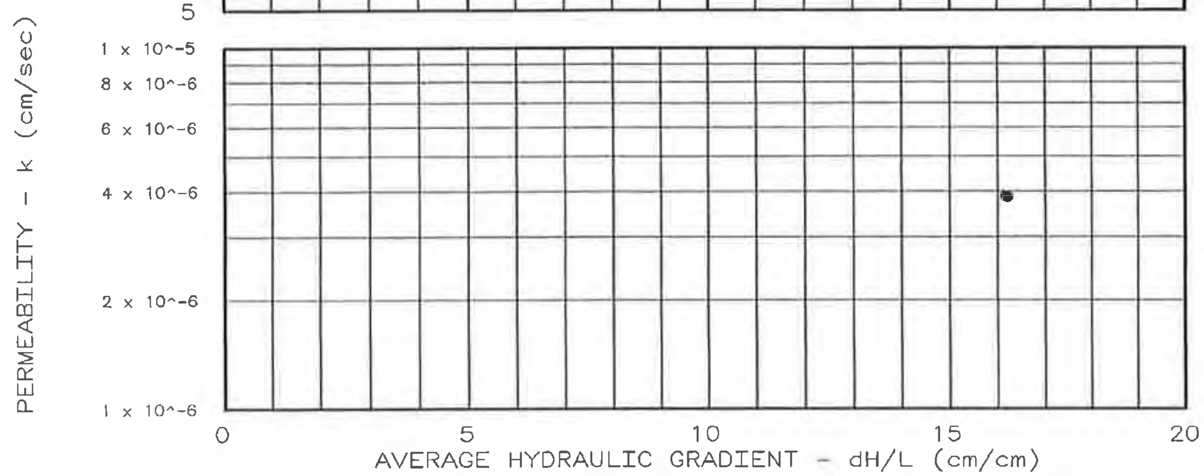
Visual Description: Purple Silty Sand (SM)

Remarks:

Maximum Dry Density (pcf):
Optimum Moisture Content (%):

Percent Compaction:
Permeameter type: Flexible Wall
Sample type: Shelby Tube





Project: Sanford Mine
Location: 1303 Brickyard Road - Sanford, NC
Date: 07-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-11 UD @ 6'-6.5'
Lab No.:	
Description:	Purple Silty Sand (SM)
Sample Type:	Shelby Tube
Max. Dry Dens.:	
Method (D1557/D698):	
Opt. Water Content:	
Date:	07-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test: 1	Before test: 2	Before test: 3	After test: 1	After test: 2	After test: 3
Diameter:	1	2		1	2	
Top:	2.847 in	in		2.876 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.85 in	7.23 cm		2.88 in	7.31 cm	
Length:	1	2	3	1	2	3
	3.371 in	in	in	3.364 in	in	in
Average:	3.37 in	8.56 cm		3.36 in	8.54 cm	

Moisture, Density and Sample Parameters:

	Before test	After test
Specific Gravity:	2.71	
Wet Wt. & Tare:	826.51	846.51
Dry Wt. & Tare:	765.62	765.62
Tare Wt.:	0.00	0.00
Moisture Content:	8.0 %	10.6 %
Dry Unit Weight:	135.9 pcf	133.5 pcf
Porosity:	0.1966	0.2111
Saturation:	88.1 %	107.0 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 2 Panel No.: 2 Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D S	CASE X R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	GAUGE PRESSURE-psi OUT	BURET READING-cc IN	BURET READING-cc OUT	OUTFLOW/ INFLOW RATIO
S		7/30/14	12:00:00	0	82.0	80.0	5.00	5.00	0.00
		7/30/14	12:04:00	240	82.0	80.0	5.68	4.32	1.00
		7/30/14	12:08:00	480	82.0	80.0	6.36	3.64	1.00
		7/30/14	12:12:00	720	82.0	80.0	7.00	3.00	1.00
	R						7.00	3.00	
	R						5.00	5.00	
		7/30/14	12:17:00	1,020	82.0	80.0	5.76	4.24	1.00
		7/30/14	12:22:00	1,320	82.0	80.0	6.66	3.34	1.00

Test Pressure = 82.0 psi Differential Head = 2.0 psi, 138.5 cm H2O
Gradient = 1.617E 01 Flow rate = 2.743E-03 cc/sec R squared = 0.99950
Permeability, K22.8° = 4.130E-06 cm/sec, K20° = 3.863E-06 cm/sec

PERMEABILITY TEST REPORT

TEST DATA:
Specimen Height (cm): 6.95
Specimen Diameter (cm): 7.27
Dry Unit Weight (pcf): 102.3
Moisture Before Test (%): 21.7
Moisture After Test (%): 26.7

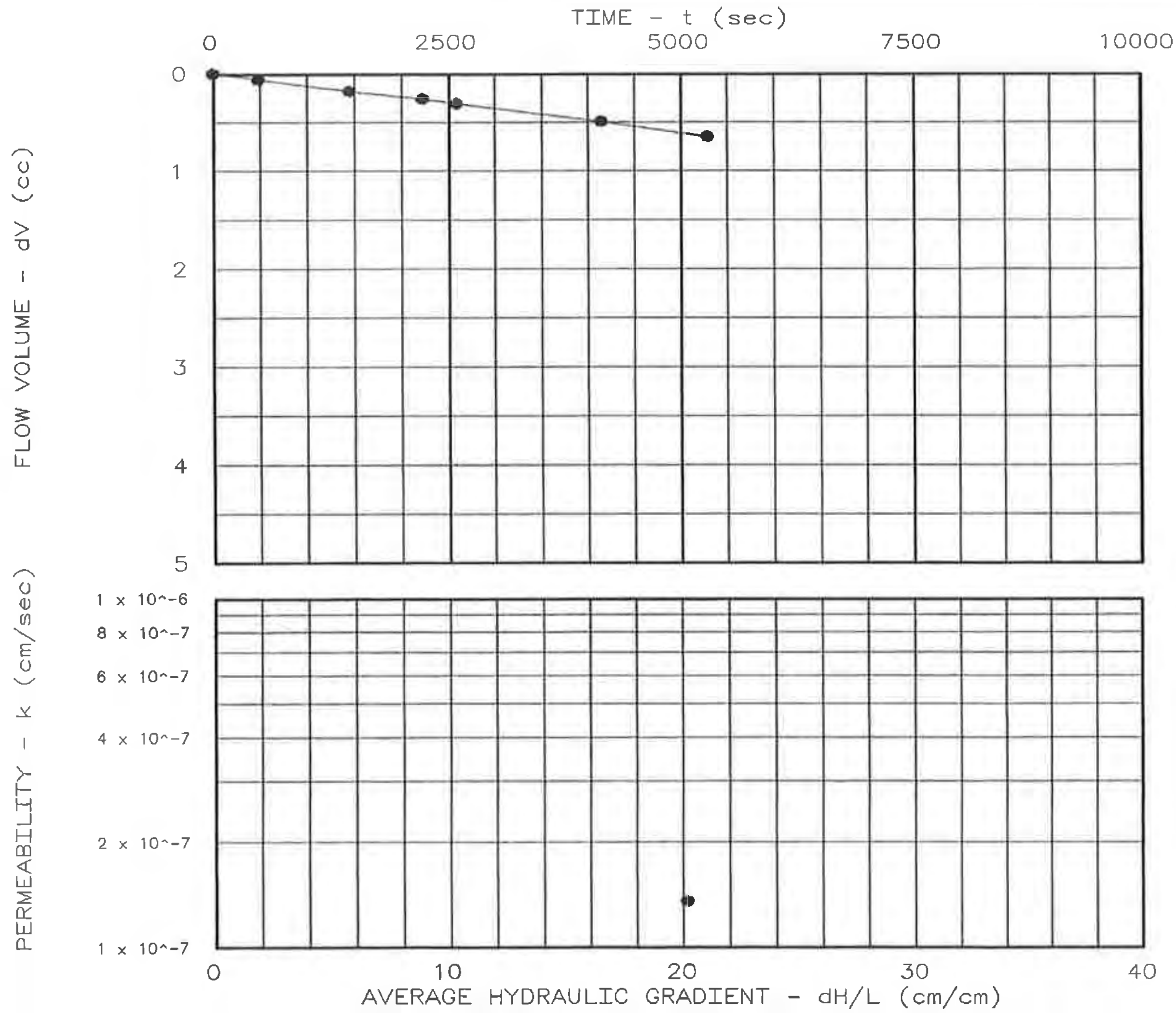
	1 ●	2 ▲
Run Number:	1 ●	2 ▲
Cell Pressure (psi):	87.0	
Test Pressure(psi):	82.0	
Back Pressure(psi):	80.0	
Diff. Head (psi):	2.0	
Flow Rate (cc/sec):	1.21 x 10^-4	
Perm. (cm/sec):	1.35 x 10^-7	

SAMPLE DATA:
Sample Identification: PZ-14 UD @ 6'-7.5'

Visual Description: Orange-Brown Fat Clay with Sand (CH)
Remarks:

Maximum Dry Density (pcf):
Optimum Moisture Content (%):

Percent Compaction:
Permeameter type: Flexible Wall
Sample type: Shelby Tube



Project: Sanford Mine
Location: 1303 Brickyard Road – Sanford, NC
Date: 07-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-14 UD @ 6'-7.5'
Lab No.:	
Description:	Orange-Brown Fat Clay with Sand (CH)
Sample Type:	Shelby Tube
Max. Dry Dens.:	
Method (D1557/D698):	
Opt. Water Content:	
Date:	07-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:			After test:		
Diameter:	1	2		1	2	
Top:	2.864 in	in		2.903 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.86 in	7.27 cm		2.90 in	7.37 cm	
Length:	1	2	3	1	2	3
	2.738 in	in	in	2.772 in	in	in
Average:	2.74 in	6.95 cm		2.77 in	7.04 cm	

Moisture, Density and Sample Parameters:	Before test	After test
Specific Gravity:	2.67	
Wet Wt. & Tare:	576.81	600.51
Dry Wt. & Tare:	473.83	473.83
Tare Wt.:	0.00	0.00
Moisture Content:	21.7 %	26.7 %
Dry Unit Weight:	102.3 pcf	98.4 pcf
Porosity:	0.3860	0.4098
Saturation:	92.3 %	102.8 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 2   Panel No.: 2   Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

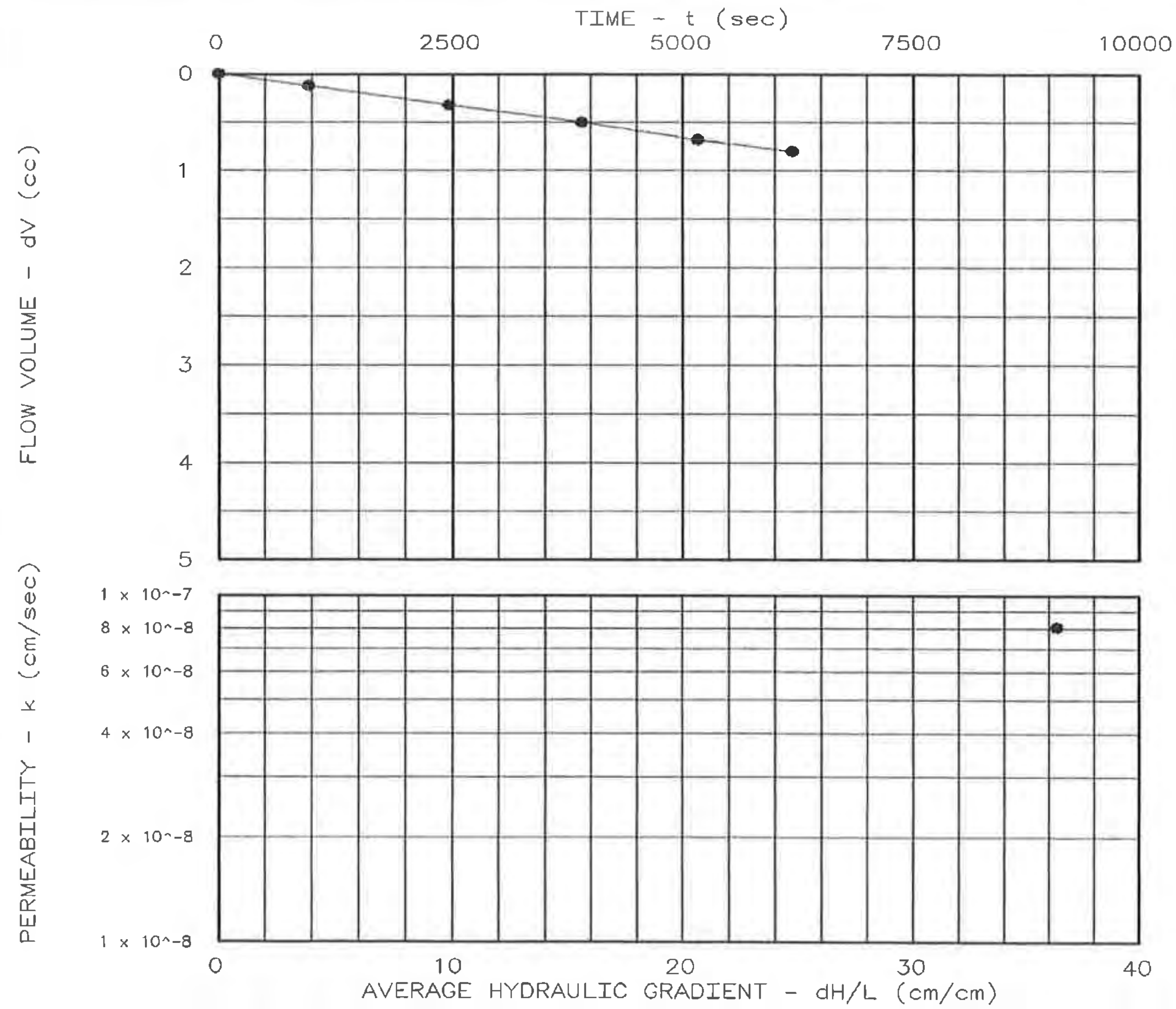
PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	GAUGE PRESSURE-psi OUT	BURET READING-cc IN	BURET READING-cc OUT	OUTFLOW/ INFLOW RATIO
S	8/11/14	12:00:00	0	82.0	80.0	5.00	5.00	0.00
	8/11/14	12:08:00	480	82.0	80.0	5.06	4.94	1.00
	8/11/14	12:24:00	1,440	82.0	80.0	5.18	4.82	1.00
	8/11/14	12:37:00	2,220	82.0	80.0	5.26	4.74	1.00
	8/11/14	12:43:00	2,580	82.0	80.0	5.31	4.69	1.00
	8/11/14	13:09:00	4,140	82.0	80.0	5.49	4.51	1.00
	8/11/14	13:28:00	5,280	82.0	80.0	5.65	4.35	1.00

Test Pressure = 82.0 psi   Differential Head = 2.0 psi, 140.1 cm H2O
Gradient = 2.014E 01   Flow rate = 1.212E-04 cc/sec   R squared = 0.99888
Permeability, K22.8° = 1.448E-07 cm/sec,   K20° = 1.355E-07 cm/sec

PERMEABILITY TEST REPORT

TEST DATA:			SAMPLE DATA:
Specimen Height (cm): 7.72			Sample Identification: PZ-9 Bulk @ 15'-30'
Specimen Diameter (cm): 7.28			
Dry Unit Weight (pcf): 120.5			Visual Description: Tan-Brown Sandy Lean Clay (CL)
Moisture Before Test (%): 13.2			
Moisture After Test (%): 15.2			Remarks:
Run Number:	1 ●	2 ▲	
Cell Pressure (psi):	87.0		Maximum Dry Density (pcf): 124.8
Test Pressure(psi):	84.0		Optimum Moisture Content (%): 10.6 ASTM(D698)
Back Pressure(psi):	80.0		
Diff. Head (psi):	4.0		Percent Compaction: 96.6%
Flow Rate (cc/sec):	1.30 x 10^-4		Permeameter type: Flexible Wall
Perm. (cm/sec):	8.07 x 10^-8		Sample type: Shelby Tube



Project: Sanford Mine
Location: 1303 Brickyard Road - Sanford, NC
Date: 08-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-9 Bulk @ 15'-30'
Lab No.:	
Description:	Tan-Brown Sandy Lean Clay (CL)
Sample Type:	Shelby Tube
Max. Dry Dens.:	124.8
Method (D1557/D698):	D698
Opt. Water Content:	10.6
Date:	08-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test: 1	Before test: 2	Before test: 3	After test: 1	After test: 2	After test: 3
Diameter:						
Top:	2.867 in	in		2.870 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.87 in	7.28 cm		2.87 in	7.29 cm	
Length:	3.040 in	in	in	3.060 in	in	in
Average:	3.04 in	7.72 cm		3.06 in	7.77 cm	

Moisture, Density and Sample Parameters:

	Before test		After test
Specific Gravity:	2.70		
Wet Wt. & Tare:	702.98		715.69
Dry Wt. & Tare:	621.01		621.01
Tare Wt.:	0.00		0.00
Moisture Content:	13.2 %		15.2 %
Dry Unit Weight:	120.5 pcf	96.6 % of max	119.5 pcf
Porosity:	0.2848		0.2910
Saturation:	89.5 %		100.3 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 1 Panel No.: 1 Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	OUT	BURET READING-cc IN	OUT	OUTFLOW/ INFLOW RATIO
S	8/25/14	12:00:00	0	84.0	80.0	5.00	5.00	0.00
	8/25/14	12:16:00	960	84.0	80.0	5.12	4.88	1.00
	8/25/14	12:41:00	2,460	84.0	80.0	5.32	4.68	1.00
	8/25/14	13:05:00	3,900	84.0	80.0	5.50	4.50	1.00
	8/25/14	13:26:00	5,160	84.0	80.0	5.68	4.32	1.00
	8/25/14	13:43:00	6,180	84.0	80.0	5.80	4.20	1.00

Test Pressure = 84.0 psi Differential Head = 4.0 psi, 280.4 cm H2O
Gradient = 3.632E 01 Flow rate = 1.305E-04 cc/sec R squared = 0.99968
Permeability, K22.8° = 8.625E-08 cm/sec, K20° = 8.067E-08 cm/sec

PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 7.74
Specimen Diameter (cm): 7.28
Dry Unit Weight (pcf): 115.2
Moisture Before Test (%): 14.8
Moisture After Test (%): 19.8

Run Number:	1 ●	2 ▲
Cell Pressure (psi):	87.0	
Test Pressure(psi):	84.0	
Back Pressure(psi):	80.0	
Diff. Head (psi):	4.0	
Flow Rate (cc/sec):	2.27 x 10^-4	
Perm. (cm/sec):	1.41 x 10^-7	

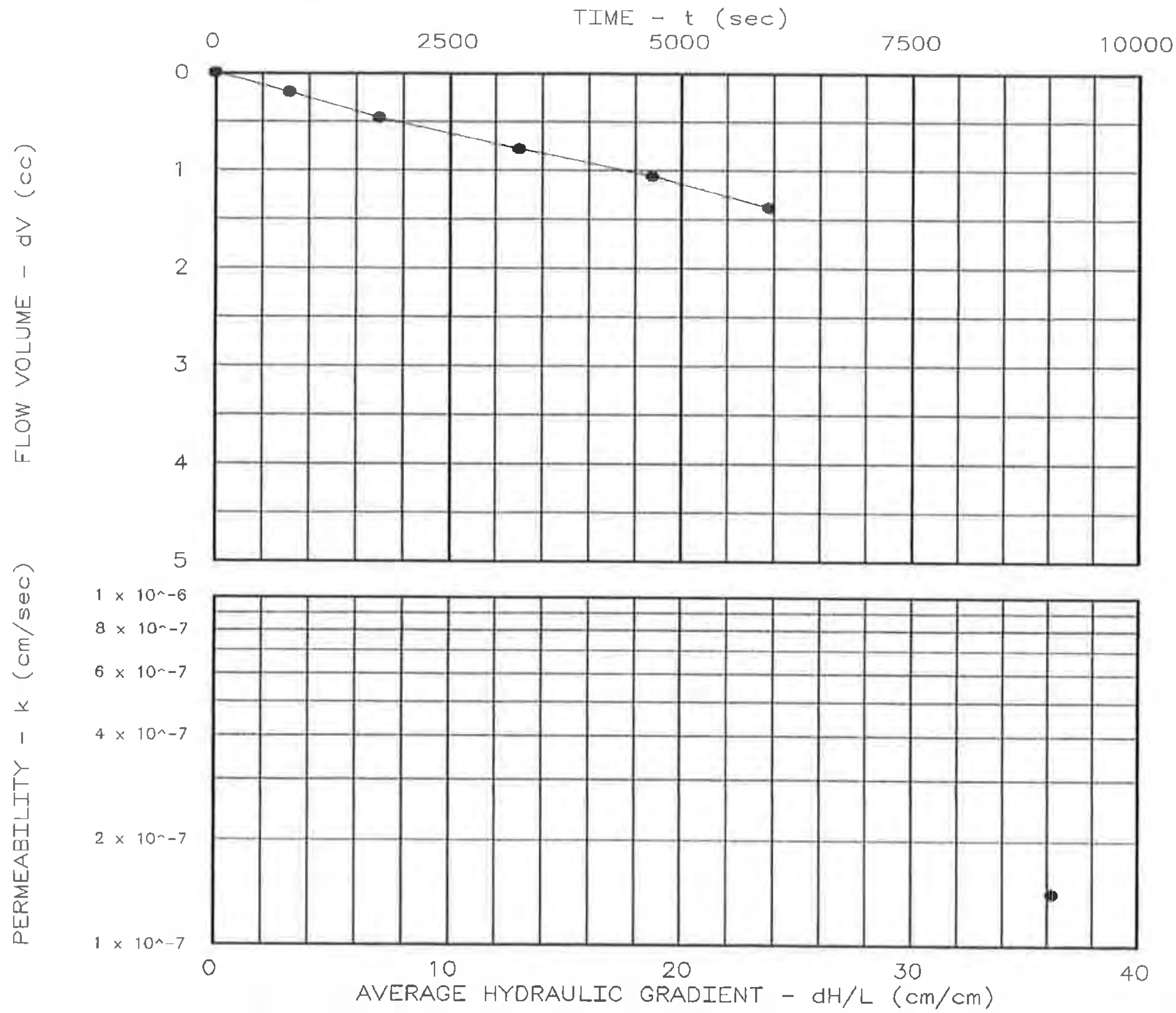
SAMPLE DATA:

Sample Identification: PZ-14 Bulk @ 18.5-20

Visual Description: Purple-Brown Lean Clay with Sand (CL)

Remarks:

Maximum Dry Density (pcf): 120.1
Optimum Moisture Content (%): 12.8
ASTM(D698)
Percent Compaction: 95.9%
Permeameter type: Flexible Wall
Sample type: Shelby Tube



Project: Sanford Mine
Location: 1303 Brickyard Road - Sanford, NC
Date: 08-28-14

PERMEABILITY TEST REPORT

SUMMIT ENG. & CONST. SERV., INC.

Project No.: SL-309-14
File No.:
Lab No.:
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name:	Sanford Mine
File No.:	
Project Location:	1303 Brickyard Road - Sanford, NC
Project No.:	SL-309-14
Sample Identification:	PZ-14 Bulk @ 18.5-20
Lab No.:	
Description:	Purple-Brown Lean Clay with Sand (CL)
Sample Type:	Shelby Tube
Max. Dry Dens.:	120.1
Method (D1557/D698):	D698
Opt. Water Content:	12.8
Date:	08-28-14
Remarks:	
Permeameter Type:	Flexible Wall
Tested by:	MH
Checked by:	CPT
Test type:	CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test: 1	Before test: 2	Before test: 3	After test: 1	After test: 2	After test: 3
Diameter:						
Top:	2.868 in	in		2.916 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.87 in	7.28 cm		2.92 in	7.41 cm	
Length:	3.049 in	in	in	3.102 in	in	in
Average:	3.05 in	7.74 cm		3.10 in	7.88 cm	

Moisture, Density and Sample Parameters:

	Before test		After test
Specific Gravity:	2.70		
Wet Wt. & Tare:	683.60		713.49
Dry Wt. & Tare:	595.47		595.47
Tare Wt.:	0.00		0.00
Moisture Content:	14.8 %		19.8 %
Dry Unit Weight:	115.2 pcf	95.9 % of max	109.5 pcf
Porosity:	0.3167		0.3503
Saturation:	86.2 %		99.2 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 2 Panel No.: 2 Positions: 1

Run Number:	1	2
Cell Pressure:	87.0 psi	0.0 psi
Saturation Pressure:	80.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi IN	OUT	BURET READING-cc IN	OUT	OUTFLOW/ INFLOW RATIO
S	8/24/14	12:00:00	0	84.0	80.0	5.00	5.00	0.00
	8/24/14	12:13:00	780	84.0	80.0	5.20	4.80	1.00
	8/24/14	12:29:00	1,740	84.0	80.0	5.46	4.54	1.00
	8/24/14	12:54:00	3,240	84.0	80.0	5.78	4.22	1.00
	8/24/14	13:18:00	4,680	84.0	80.0	6.06	3.94	1.00
	8/24/14	13:39:00	5,940	84.0	80.0	6.38	3.62	1.00

Test Pressure = 84.0 psi Differential Head = 4.0 psi, 279.9 cm H2O
Gradient = 3.615E 01 Flow rate = 2.274E-04 cc/sec R squared = 0.99755
Permeability, K22.8° = 1.509E-07 cm/sec, K20° = 1.412E-07 cm/sec

APPENDIX I
Slug Test Data

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PZ-1

RISING HEAD SLUG TEST DATA

COLON MINE RECLAMATION STRUCTURAL FILL SITE

1303 BRICKYARD ROAD

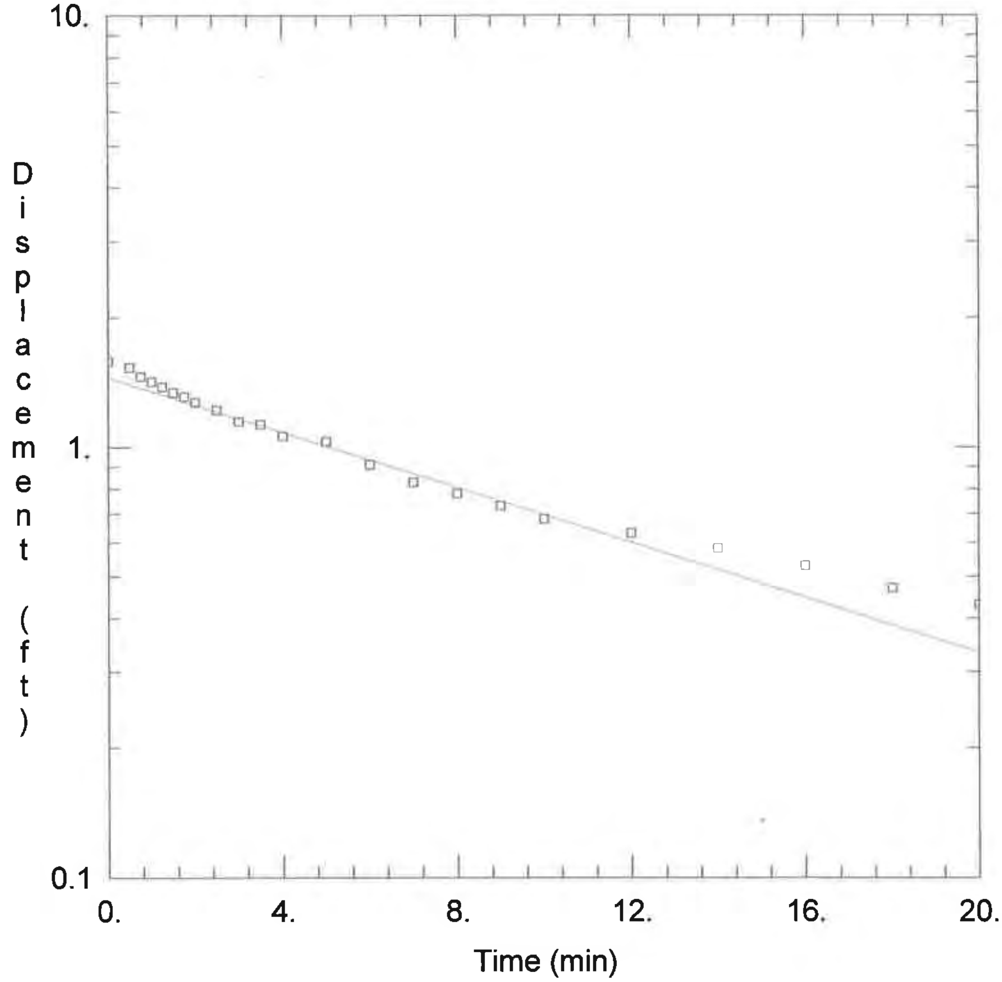
SANFORD, NORTH CAROLINA

Date: August 21, 2014
Initial Drawdown: 1.58'
Radius of Well Casing: 0.083'
Total Depth Well Below Ground Surface: 29.55'
Total Depth Well Below Top-of-Casing (BTOC): 32.00'
Static Depth-to-Water BTOC: 7.92'
Static Height of Water in Well: 24.08'
Screen Length: 10'

Elapsed Time (minutes)	***Depth-to-Water BTOC (feet)***	***Static Depth-to-Water BTOC (feet)***	***Change in Water Level (feet)***
0 (static)	7.92		
0.25	9.50	7.92	1.58
0.50	9.45	7.92	1.53
0.75	9.38	7.92	1.46
1.00	9.34	7.92	1.42
1.25	9.30	7.92	1.38
1.50	9.26	7.92	1.34
1.75	9.23	7.92	1.31
2.00	9.19	7.92	1.27
2.50	9.14	7.92	1.22
3.00	9.07	7.92	1.15
3.50	9.05	7.92	1.13
4.00	8.98	7.92	1.06
5.00	8.95	7.92	1.03
6.00	8.83	7.92	0.91
7.00	8.75	7.92	0.83
8.00	8.70	7.92	0.78
9.00	8.65	7.92	0.73
10.00	8.60	7.92	0.68
12.00	8.55	7.92	0.63
14.00	8.50	7.92	0.58
16.00	8.45	7.92	0.53
18.00	8.39	7.92	0.47
20.00	8.35	7.92	0.43

Rising head slug test conducted by Buxton Environmental, Inc. on August 21, 2014 by removing (1) bailer of water and measuring water levels with a depth-to-water electrode to the nearest 0.01 over time

rk:table:SanfordSlug.PZ-1



RISING HEAD SLUG TEST - PZ-1

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Demo 4.0\PZS-1.aqt
Date: 08/27/14
Time: 09:08:34

PROJECT INFORMATION

Company: Buxton Environmental, Inc.
Client: HDR
Project: 1
Location: Sanford Mine
Test Well: PZ-1
Test Date: 8-21-2014

AQUIFER DATA

Saturated Thickness: 24.08 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 1.58 ft
Total Well Penetration Depth: 29.55 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.08 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 5.629E-5 cm/sec
y0 = 1.449 ft

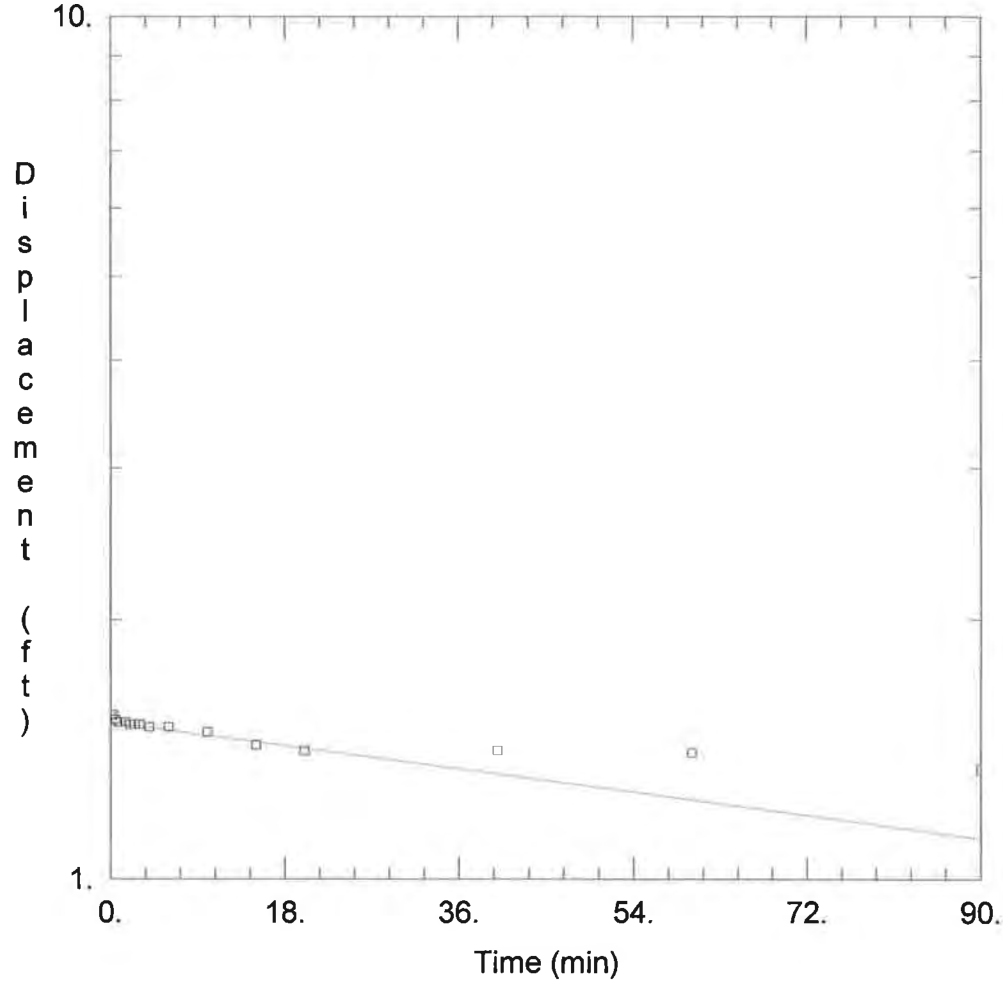
PZ-4
RISING HEAD SLUG TEST DATA
COLON MINE RECLAMATION STRUCTURAL FILL SITE
1303 BRICKYARD ROAD
SANFORD, NORTH CAROLINA

Date: August 21, 2014
Initial Drawdown: 1.55'
Radius of Well Casing: 0.083'
Total Depth Well Below Ground Surface: 36.70'
Total Depth Well Below Top-of-Casing (BTOC): 39.00'
Static Depth-to-Water BTOC: 11.85'
Static Height of Water in Well: 27.15'
Screen Length: 10'

Elapsed Time (minutes)	*Depth-to-Water BTOC (feet)*	*Static Depth-to-Water BTOC (feet)*	*Change in Water Level (feet)*
0 (static)	11.85		
0.25	13.40	11.85	1.55
0.50	13.38	11.85	1.53
0.75	13.37	11.85	1.52
1.00	13.37	11.85	1.52
1.50	13.37	11.85	1.52
2.00	13.36	11.85	1.51
2.50	13.36	11.85	1.51
3.00	13.36	11.85	1.51
4.00	13.35	11.85	1.50
6.00	13.35	11.85	1.50
10.00	13.33	11.85	1.48
15.00	13.28	11.85	1.43
20.00	13.26	11.85	1.41
40.00	13.26	11.85	1.41
60.00	13.25	11.85	1.40
90.00	13.19	11.85	1.34

Rising head slug test conducted by Buxton Environmental, Inc. on August 21, 2014 by removing (1) bailer of water and measuring water levels with a depth-to-water electrode to the nearest 0.01 over time

rk:table:SanfordSlug.PZ-4



RISING HEAD SLUG TEST - PZ-4

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Demo 4.0\PZS-4.aqt
Date: 08/27/14 Time: 10:37:49

PROJECT INFORMATION

Company: Buxton Environmental, Inc.
Client: HDR
Project: 1
Location: Sanford Mine
Test Well: PZ-4
Test Date: 8-21-2014

AQUIFER DATA

Saturated Thickness: 27.15 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 1.55 ft
Total Well Penetration Depth: 36.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.15 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.704E-6 cm/sec
y0 = 1.517 ft

PZ-4D

RISING HEAD SLUG TEST DATA

COLON MINE RECLAMATION STRUCTURAL FILL SITE

1303 BRICKYARD ROAD

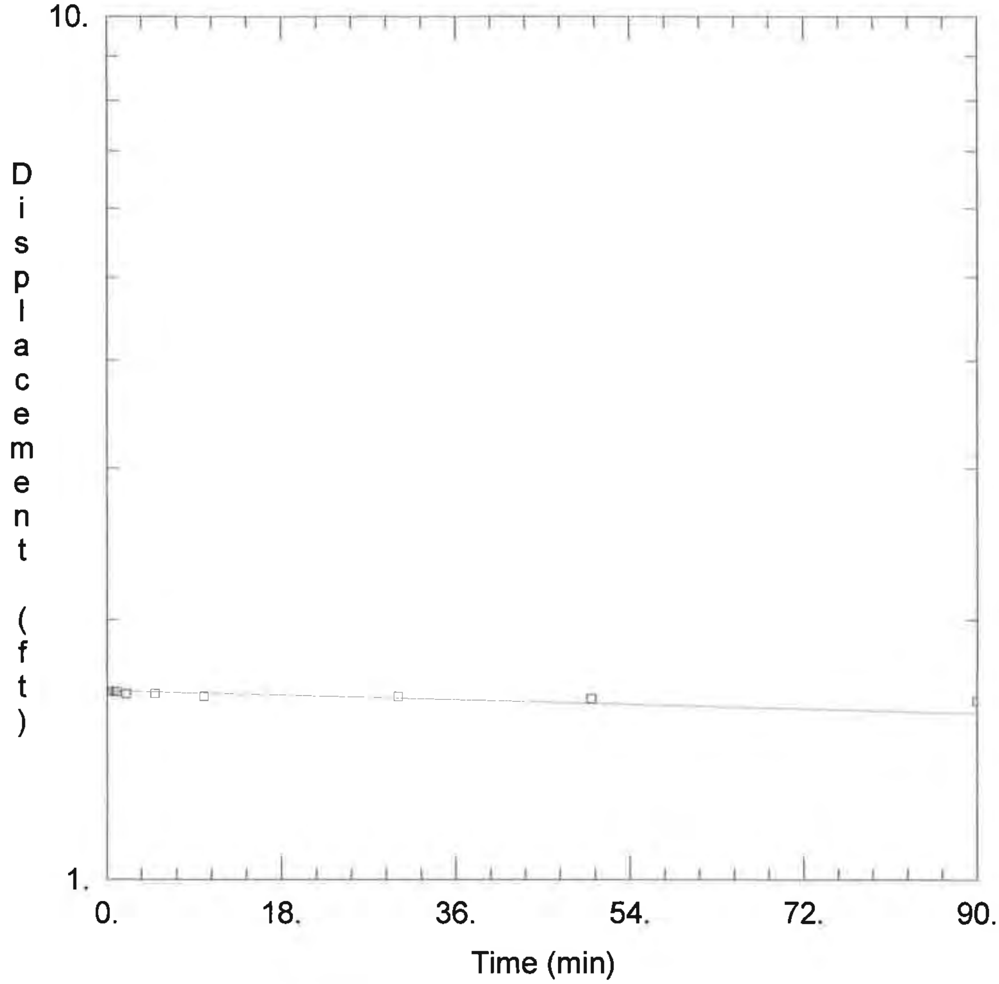
SANFORD, NORTH CAROLINA

Date: August 21, 2014
Initial Drawdown: 1.65'
Radius of Well Casing: 0.083'
Total Depth Well Below Ground Surface: 52.00'
Total Depth Well Below Top-of-Casing (BTOC): 54.51'
Static Depth-to-Water BTOC: 11.65'
Static Height of Water in Well: 42.86'
Screen Length: 5'

Elapsed Time (minutes)	***Depth-to-Water BTOC (feet)***	***Static Depth-to-Water BTOC (feet)***	***Change in Water Level (feet)***
0 (static)	11.65		
0.25	13.30	11.65	1.65
0.50	13.30	11.65	1.65
0.75	13.30	11.65	1.65
1.00	13.30	11.65	1.65
2.00	13.29	11.65	1.64
5.00	13.29	11.65	1.64
10.00	13.28	11.65	1.63
30.00	13.28	11.65	1.63
50.00	13.27	11.65	1.62
90.00	13.26	11.65	1.61

Rising head slug test conducted by Buxton Environmental, Inc. on August 21, 2014 by removing (1) bailer of water and measuring water levels with a depth-to-water electrode to the nearest 0.01 over time

rk:table:SanfordSlug.PZ-4D



RISING HEAD SLUG TEST - PZ-4D

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Demo 4.0\PZS-4D.aqt
Date: 08/27/14 Time: 10:48:58

PROJECT INFORMATION

Company: Buxton Environmental, Inc.
Client: HDR
Project: 1
Location: Sanford Mine
Test Well: PZ-4D
Test Date: 8-21-2014

AQUIFER DATA

Saturated Thickness: 42.86 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 1.65 ft
Total Well Penetration Depth: 57. ft
Casing Radius: 0.083 ft

Static Water Column Height: 42.86 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 5.523E-7 cm/sec y0 = 1.653 ft

PZ-9s

RISING HEAD SLUG TEST DATA

COLON MINE RECLAMATION STRUCTURAL FILL SITE

1303 BRICKYARD ROAD

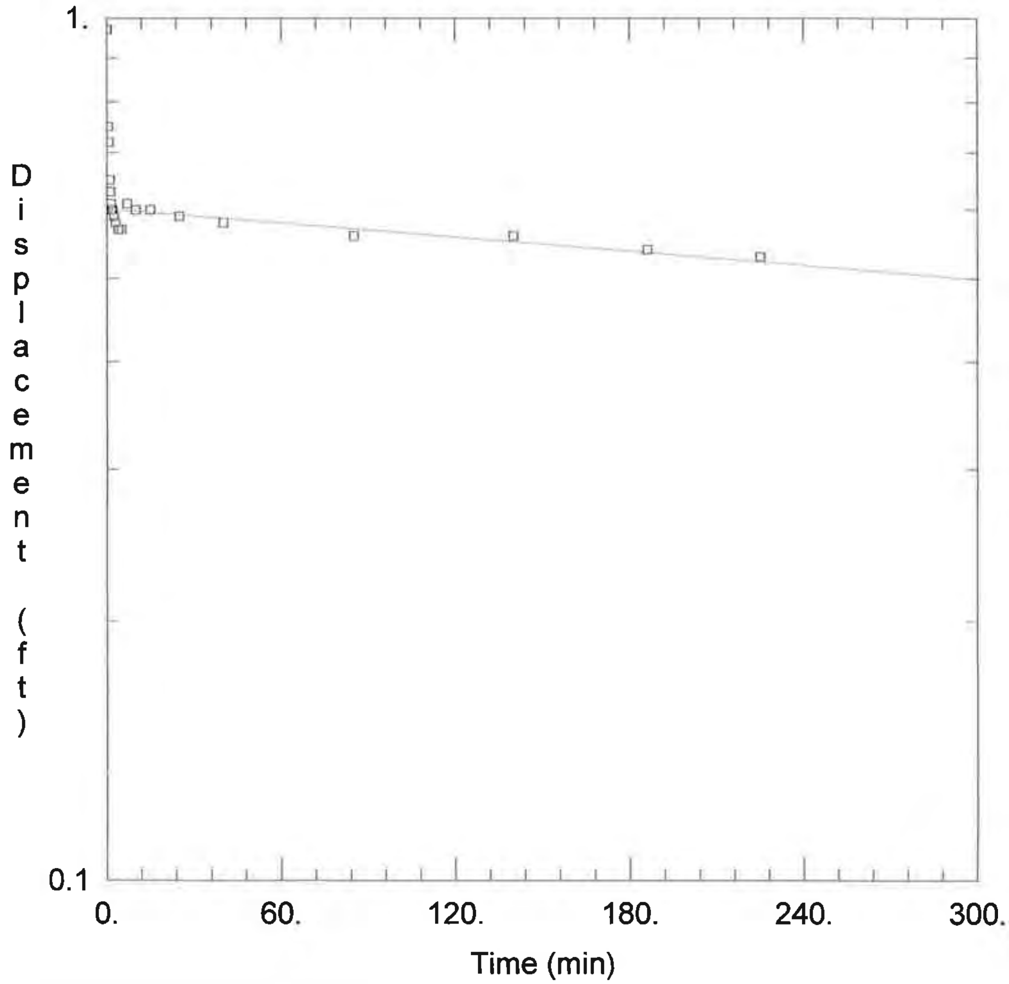
SANFORD, NORTH CAROLINA

Date: August 21, 2014
Initial Drawdown: 0.97'
Radius of Well Casing: 0.083'
Total Depth Well Below Ground Surface: 25.00'
Total Depth Well Below Top-of-Casing (BTOC): 27.55'
Static Depth-to-Water BTOC: 19.05'
Static Height of Water in Well: 8.50'
Screen Length: 10'

Elapsed Time (minutes)	***Depth-to-Water BTOC (feet)***	***Static Depth-to-Water BTOC (feet)***	***Change in Water Level (feet)***
0 (static)	19.05		
0.25	20.02	19.05	0.97
0.50	19.80	19.05	0.75
0.75	19.77	19.05	0.72
1.00	19.70	19.05	0.65
1.25	19.68	19.05	0.63
1.50	19.66	19.05	0.61
1.75	19.65	19.05	0.60
2.00	19.65	19.05	0.60
2.50	19.64	19.05	0.59
3.00	19.63	19.05	0.58
4.00	19.62	19.05	0.57
5.00	19.62	19.05	0.57
7.00	19.66	19.05	0.61
10.00	19.65	19.05	0.60
15.00	19.65	19.05	0.60
25.00	19.64	19.05	0.59
40.00	19.63	19.05	0.58
85.00	19.61	19.05	0.56
140.00	19.61	19.05	0.56
186.00	19.59	19.05	0.54
225.00	19.58	19.05	0.53

Rising head slug test conducted by Buxton Environmental, Inc. on August 21, 2014 by removing (1) bailer of water and measuring water levels with a depth-to-water electrode to the nearest 0.01 over time

rk:table:SanfordSlug.PZ-9



RISING HEAD SLUG TEST - PZ-9S

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Demo 4.0\PZS-9s.aqt
Date: 08/27/14 Time: 11:15:08

PROJECT INFORMATION

Company: Buxton Environmental, Inc.
Client: HDR
Project: 1
Location: Sanford Mine
Test Well: PZ-9s
Test Date: 8-21-2014

AQUIFER DATA

Saturated Thickness: 8.5 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 0.97 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.5 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 5.425E-7 cm/sec
y0 = 0.6015 ft

PZ-9

RISING HEAD SLUG TEST DATA

COLON MINE RECLAMATION STRUCTURAL FILL SITE

1303 BRICKYARD ROAD

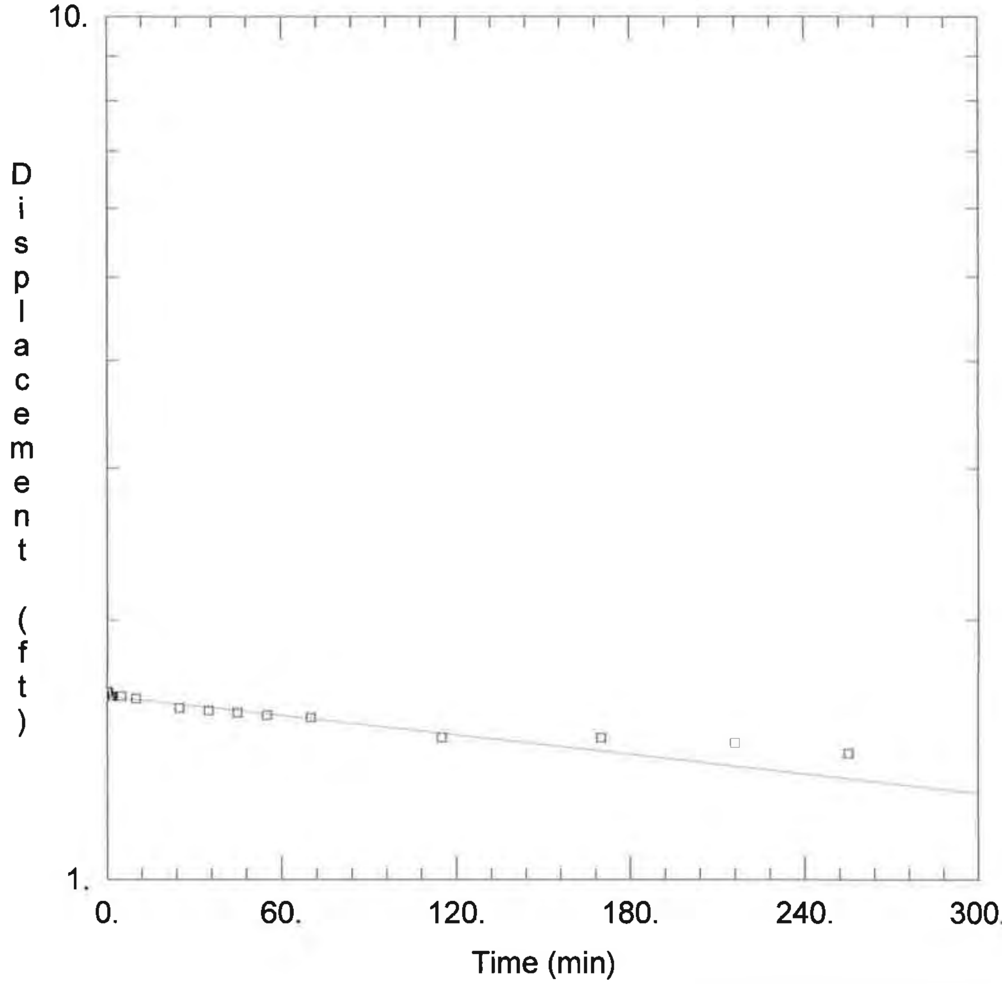
SANFORD, NORTH CAROLINA

Date: August 21, 2014
Initial Drawdown: 1.65'
Radius of Well Casing: 0.083'
Total Depth Well Below Ground Surface: 38.40'
Total Depth Well Below Top-of-Casing (BTOC): 41.35'
Static Depth-to-Water BTOC: 19.95'
Static Height of Water in Well: 21.40'
Screen Length: 10'

Elapsed Time (minutes)	***Depth-to-Water BTOC (feet)***	***Static Depth-to-Water BTOC (feet)***	***Change in Water Level (feet)***
0 (static)	19.95		
0.25	21.60	19.95	1.65
0.50	21.59	19.95	1.64
0.75	21.58	19.95	1.63
1.00	21.58	19.95	1.63
1.25	21.58	19.95	1.63
1.50	21.58	19.95	1.63
1.75	21.58	19.95	1.63
2.00	21.58	19.95	1.63
5.00	21.58	19.95	1.63
10.00	21.57	19.95	1.62
25.00	21.53	19.95	1.58
35.00	21.52	19.95	1.57
45.00	21.51	19.95	1.56
55.00	21.50	19.95	1.55
70.00	21.49	19.95	1.54
115.00	21.41	19.95	1.46
170.00	21.41	19.95	1.46
216.00	21.39	19.95	1.44
255.00	21.35	19.95	1.40

Rising head slug test conducted by Buxton Environmental, Inc. on August 21, 2014 by removing (1) bailer of water and measuring water levels with a depth-to-water electrode to the nearest 0.01 over time

rk:table:SanfordSlug.PZ-9



RISING HEAD SLUG TEST - PZ-9

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Demo 4.0\PZS-9.aqt
Date: 08/27/14 Time: 11:06:13

PROJECT INFORMATION

Company: Buxton Environmental, Inc.
Client: HDR
Project: 1
Location: Sanford Mine
Test Well: PZ-9
Test Date: 8-21-2014

AQUIFER DATA

Saturated Thickness: 21.4 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 1.65 ft
Total Well Penetration Depth: 38.4 ft
Casing Radius: 0.083 ft
Static Water Column Height: 21.4 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 6.828E-7 cm/sec
y0 = 1.63 ft

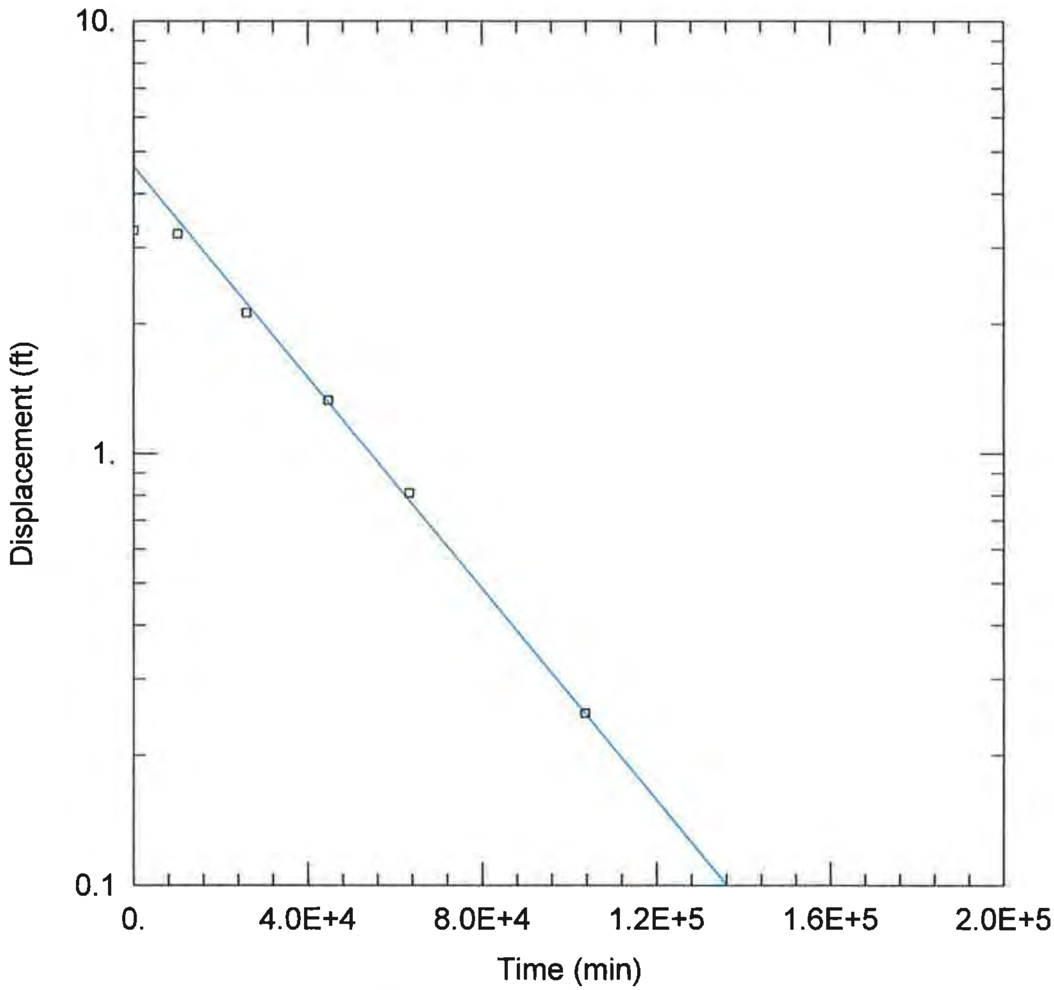
PZ-10
RISING HEAD TEST DATA
COLON MINE RECLAMATION STRUCTURAL FILL SITE
1303 BRICKYARD ROAD
SANFORD, NORTH CAROLINA

Date: July 21 through October 31, 2014
Initial Drawdown: 3.29' (test started upon installation of piezometer PZ-10 on July 21, 2014)
Radius of Well Casing: 0.083'
Total Depth Well Below Ground Surface: 27.15'
Total Depth Well Below Top-of-Casing (BTOC): 30.18'
Static Depth-to-Water BTOC: 26.89' (assumed)
Static Height of Water in Well: 3.29'
Screen Length: 10'

Elapsed Time (minutes)	***Depth-to-Water BTOC (feet)***	***Static Depth-to-Water BTOC (feet)***	***Change in Water Level (feet)***
0 (static) (PZ-10 installed 7-21-14)	26.89 (water level on 10-31-14)		
10,080 (7-28-14)	30.12	26.89	3.23
25,920 (8-8-14)	29.01	26.89	2.12
44,640 (8-21-14)	28.22	26.89	1.33
63,360 (9-3-14)	27.70	26.89	0.81
103,680 (10-1-14)	27.14	26.89	0.25
146,880 (10-31-14)	26.89	26.89	0.00

Rising head test conducted by Buxton Environmental, Inc. from July 21, 2014 (installation date of PZ-10) until October 31, 2014 by measuring water levels with a depth-to-water electrode to the nearest 0.01 over time
Water levels were still stabilizing as of October 31, 2014.
This test data was analyzed to approximate hydraulic conductivity at PZ-10 utilizing Bouwer and Rice slug test solution techniques.

rk:table:SanfordSlug.PZ-10



RISING HEAD SLUG TEST - PZ-10

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Demo 4.0\PZS-10.aqt
Date: 11/03/14 Time: 11:27:35

PROJECT INFORMATION

Company: Buxton Environmental, Inc.
Client: HDR
Project: 1
Location: Sanford Mine
Test Well: PZ-1
Test Date: 8-21-2014

AQUIFER DATA

Saturated Thickness: 3.29 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 3.29 ft
Total Well Penetration Depth: 27.15 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.29 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 6.051E-8 cm/sec
y0 = 4.627 ft

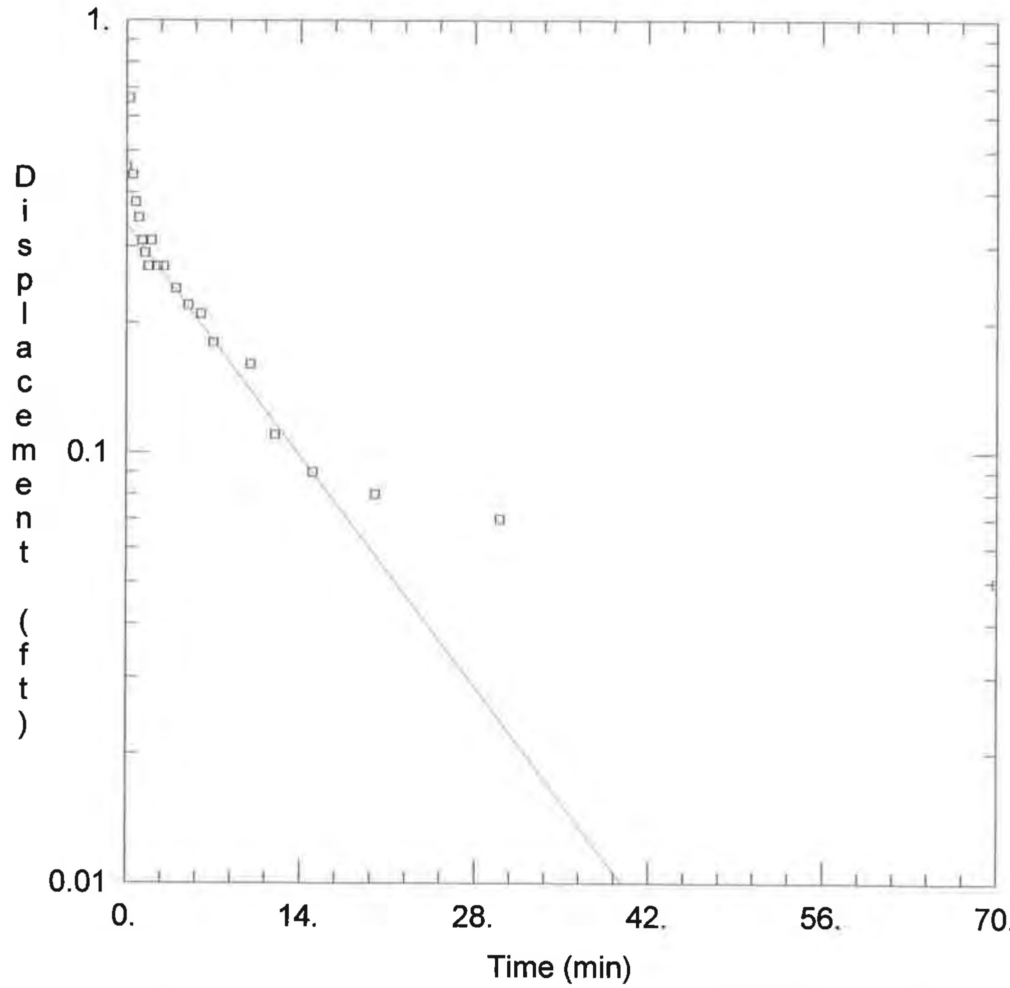
PZ-15
RISING HEAD SLUG TEST DATA
COLON MINE RECLAMATION STRUCTURAL FILL SITE
1303 BRICKYARD ROAD
SANFORD, NORTH CAROLINA

Date: August 21, 2014
Initial Drawdown: 0.66'
Radius of Well Casing: 0.083'
Total Depth Well Below Ground Surface: 28.70'
Total Depth Well Below Top-of-Casing (BTOC): 31.70'
Static Depth-to-Water BTOC: 16.24'
Static Height of Water in Well: 15.46'
Screen Length: 10'

Elapsed Time (minutes)	*Depth-to-Water BTOC (feet)*	*Static Depth-to-Water BTOC (feet)*	*Change in Water Level (feet)*
0 (static)	16.24		
0.25	16.90	16.24	0.66
0.50	16.68	16.24	0.44
0.75	16.62	16.24	0.38
1.00	16.59	16.24	0.35
1.25	16.55	16.24	0.31
1.50	16.53	16.24	0.29
1.75	16.51	16.24	0.27
2.00	16.55	16.24	0.31
2.50	16.51	16.24	0.27
3.00	16.51	16.24	0.27
4.00	16.48	16.24	0.24
5.00	16.46	16.24	0.22
6.00	16.45	16.24	0.21
7.00	16.42	16.24	0.18
10.00	16.40	16.24	0.16
12.00	16.35	16.24	0.11
15.00	16.33	16.24	0.09
20.00	16.32	16.24	0.08
30.00	16.31	16.24	0.07
70.00	16.29	16.24	0.05

Rising head slug test conducted by Buxton Environmental, Inc. on August 21, 2014 by removing (1) bailer of water and measuring water levels with a depth-to-water electrode to the nearest 0.01 over time

rk:table:SanfordSlug.PZ-15



RISING HEAD SLUG TEST - PZ-15

Data Set: C:\Program Files\HydroSOLVE\AQTESOLV Demo 4.0\PZS-15.aqt
Date: 08/27/14 Time: 11:25:35

PROJECT INFORMATION

Company: Buxton Environmental, Inc.
Client: HDR
Project: 1
Location: Sanford Mine
Test Well: PZ-15
Test Date: 8-21-2014

AQUIFER DATA

Saturated Thickness: 15.46 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 0.46 ft
Total Well Penetration Depth: 28.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 15.46 ft
Screen Length: 10. ft
Well Radius: 0.083 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 6.738E-5 cm/sec
y0 = 0.3372 ft

APPENDIX J
Historical Groundwater Level Data, USGS Wells NC-126 (Chapel Hill) and NC-194 (Marston)

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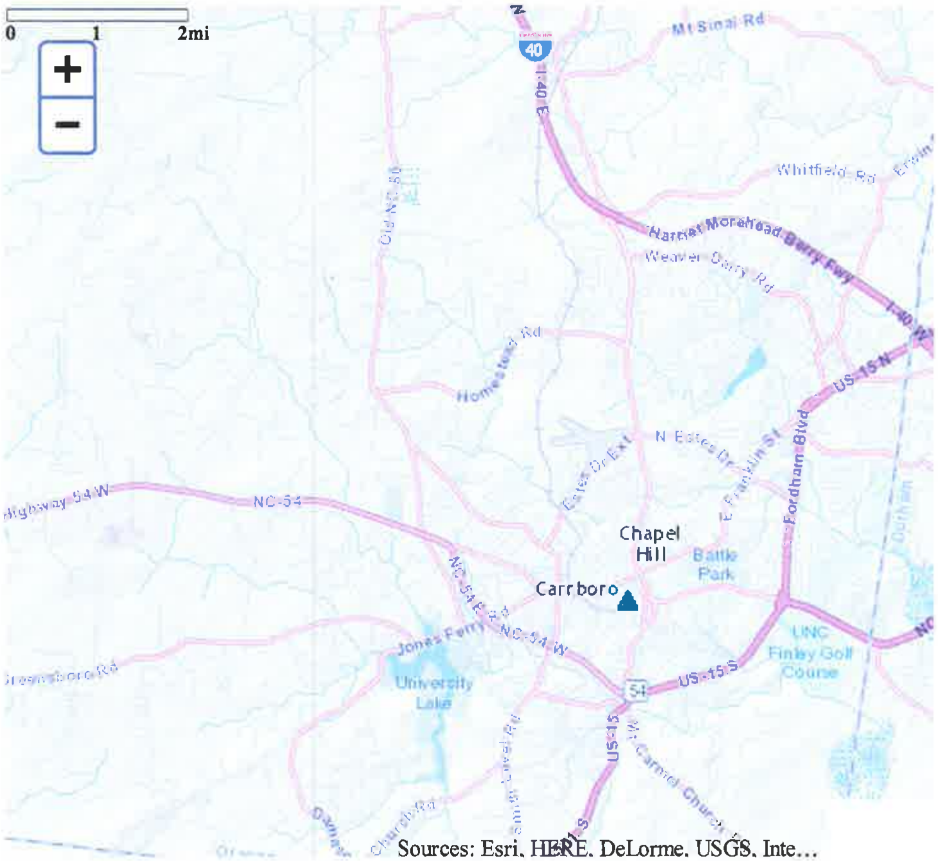
Site Number: 355522079043001 - OR-069 (NC-126) AT CHAPEL HILL, NC (REGOLITH)

26 miles North of site



DESCRIPTION:
Latitude 35°54'31", Longitude 79°03'29" NAD83
Orange County, North Carolina, Hydrologic Unit 03030002
Well depth: 48.0 feet
Hole depth: 48.0 feet
Land surface altitude: 511.50feet above NGVD29.
Well completed in "Piedmont and Blue Ridge crystalline-rock aquifers" (N400PDMBRX) national aquifer.
Well completed in "Regolith" (100RGLT) local aquifer

AVAILABLE DATA:

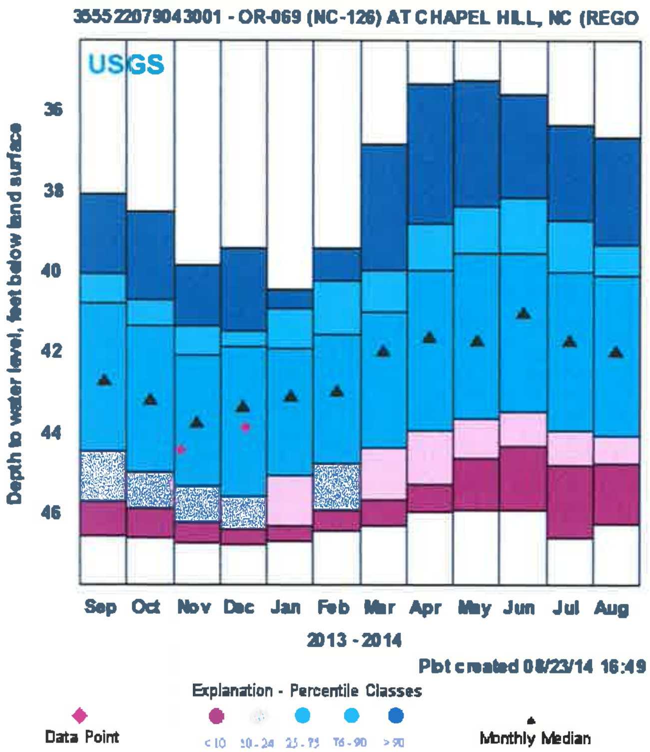
Data Type	Begin Date	End Date	Count
Field groundwater-level measurements	1948-03-22	2013-12-17	1884

Additional Data Sources	Begin Date	End Date	Count
Annual Water-Data Report (pdf) **offsite**	2006	2013	8
Groundwater Watch **offsite**	1948	2013	1884

OPERATION:
Record for this site is maintained by the USGS North Carolina Water Science Center
Email questions about this site toNorth Carolina Water Science Center Water-Data Inquiries

Groundwater Watch Help Page

Site Statistics



Most recent data value: 43.85 on 12/17/2013
Period of Record Monthly Statistics for 355522079043001
Depth to water level, feet below land surface
All Approved Continuous & Periodic Data Used In Analysis
Note: Highlighted values in the table indicate closest statistic to the most recent data value.

Month	Lowest Median	10th %ile	25th %ile	50th %ile	75th %ile	90th %ile	Highest Median	Number of Years
Jan	46.70	46.32	45.05	43.12	41.91	40.92	40.44	51
Feb	46.44	45.92	44.74	42.96	41.55	40.22	39.40	47
Mar	46.32	45.64	44.36	41.99	40.98	39.95	36.80	52
Apr	45.95	45.26	43.94	41.66	39.97	38.81	35.32	58
May	45.90	44.63	43.63	41.75	39.51	38.35	35.22	53
Jun	45.91	44.30	43.44	41.03	39.53	38.16	35.56	53
Jul	46.59	44.79	43.91	41.73	40.00	38.71	36.32	57
Aug	46.24	44.77	44.04	41.97	40.10	39.32	36.62	54
Sep	46.56	45.70	44.43	42.73	40.79	40.04	38.04	50
Oct	46.59	45.86	44.98	43.20	41.32	40.70	38.49	57
Nov	46.72	46.22	45.29	43.76	42.06	41.36	39.85	55
Dec	46.77	46.41	45.55	43.37	41.87	41.47	39.41	51

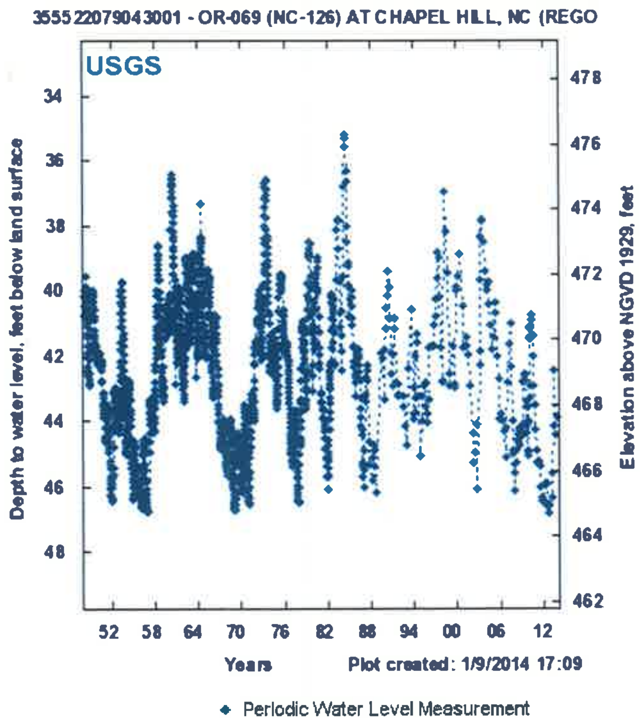
As of 8/23/2014 02:43-2

Statistics Options

View month/year statistics

* Historical monthly MEDIAN GW High

Periodic Groundwater Data



Summary for Period of Record Periodic Water Levels
Depth to water level, feet below land surface
Approved Periodic Water Level Values

Begin Date	End Date	Number of Values
03/22/48	12/17/13	1,884

Highest WL	Date of Highest WL	Lowest WL	Date of Lowest WL
35.22	05/14/84	46.77	12/03/56

Groundwater Levels Options

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*References to non-Department of the Interior (DOI) products do not constitute an endorsement by the DOI.
By viewing the Google Maps API on this web site the user agrees to these TERMS.

National Water Information System: Web Interface

USGS Water Resources

Data Category: Groundwater **Geographic Area:** United States GO

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Groundwater levels for the Nation

Search Results -- 1 sites found

Agency code = usgs
site_no list =

- 355522079043001

Minimum number of levels = 1
Save file of selected sites to local disk for future upload

USGS 355522079043001 OR-069 (NC-126) AT CHAPEL HILL, NC (REGOLITH)

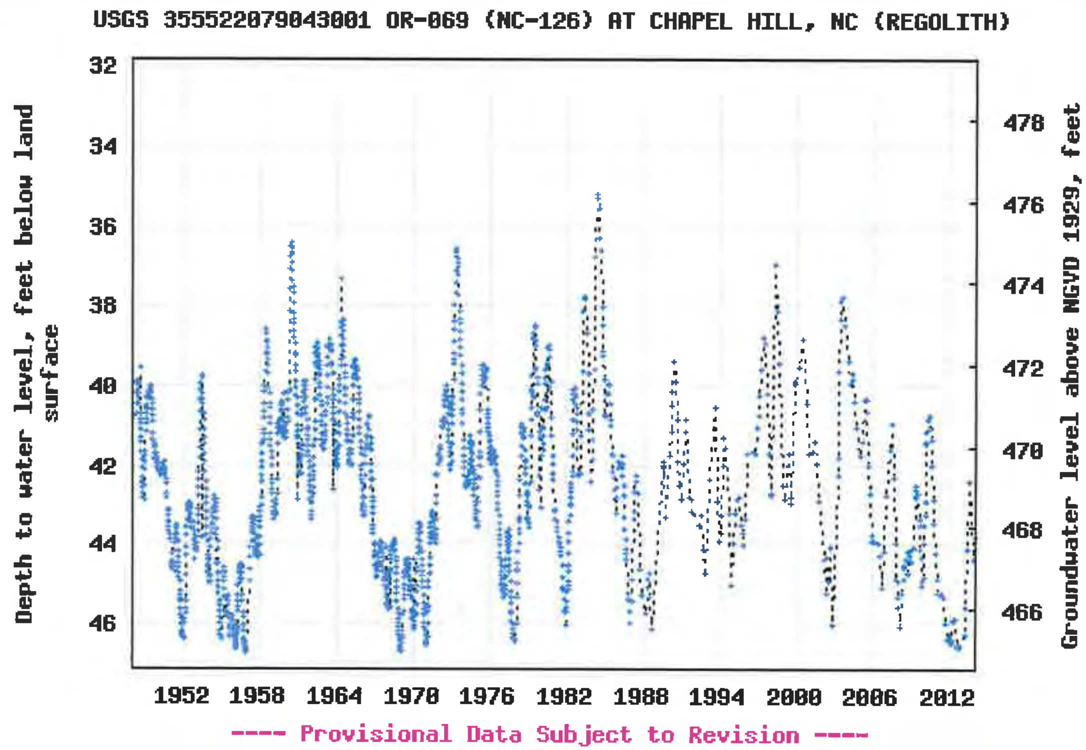
Available data for this site Groundwater: Field measurements GO

Orange County, North Carolina
Hydrologic Unit Code 03030002
Latitude 35°54'31", Longitude 79°03'29" NAD83
Land-surface elevation 511.50 feet above NGVD29
The depth of the well is 48.0 feet below land surface.

The depth of the hole is 48.0 feet below land surface.
This well is completed in the Piedmont and Blue Ridge crystalline-rock aquifers (N400PDMBRX) national aquifer.
This well is completed in the Regolith (100RGLT) local aquifer.

Output formats

Table of data
Tab-separated data
Graph of data
Reselect period



Breaks in the plot represent a gap of at least one year between field measurements.
Download a presentation-quality graph

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```
# ---------------------------------------------------------------
# U.S. Department of the Interior
# U.S. Geological Survey
# Retrieved: 8/23/2014 8:08:16 PM
#
# ------------------------ WARNING ------------------------
# Some of the data you have obtained from this automated
# U.S. Geological Survey database have not received
# Director's approval and as such are provisional
# and subject to revision. The data are released
# on the condition that neither the USGS nor the
# United States Government may be held liable for
# any damages resulting from its use.
#
# This file consists of space delimited columns of data,
# which include the following fields:
#
# column            column definition
# ------------      ----------------------------------------
# 1. agency_cd      Agency collecting or maintaining the site
# 2. site_no        USGS site identification number
# 3. parm_code      Parameter code
# 4. lev_dt         Date
# 5. lev_va         Depth to water level, feet below land surface (Missing value indicated by '-----')
# 6. sl_lev_va      Altitude of Water Level, in Feet Above Sea Level (Missing value indicated by '-----')
# 7. lev_status_cd Water level status code, defined at: http://waterdata.usgs.gov/nwis/gwlevels/?help#
#
# Note: '*' in the status field indicates a partial date.
#
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# ----- End of Data
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USGS Home
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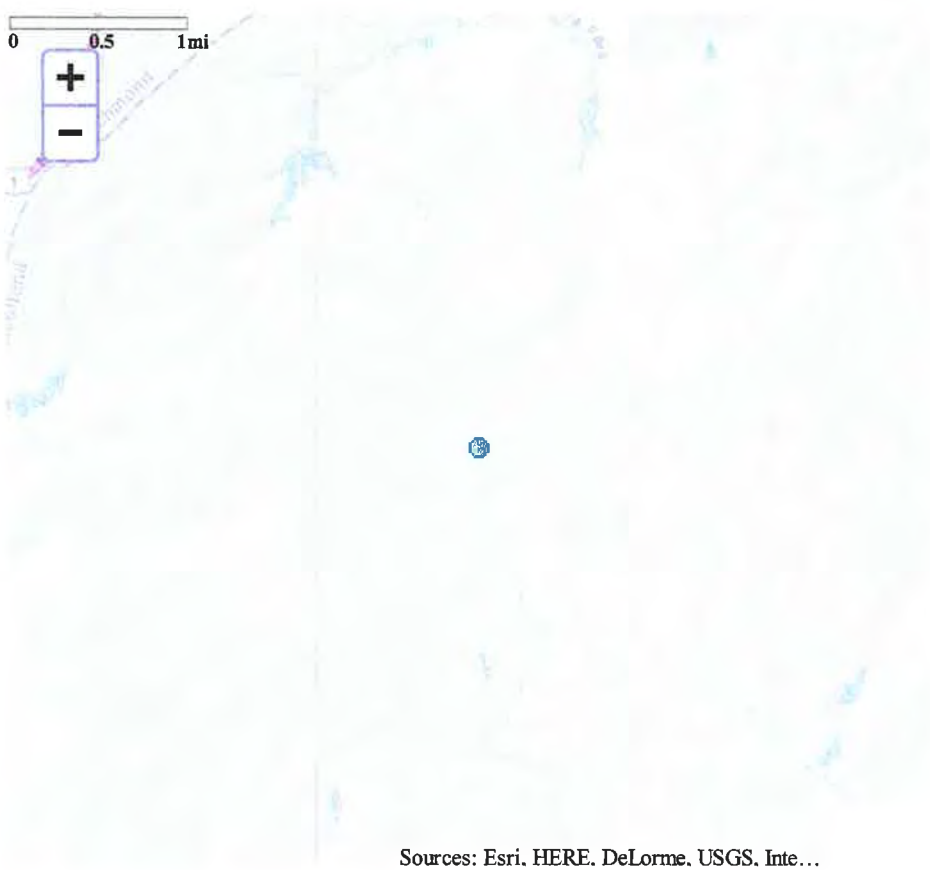
Groundwater Watch

Latest News...

NOTICE: Groundwater Watch was not refreshed this past weekend. Please read the Latest News page for important details

Site Number: 345812079313401 - SC-080 (NC-194) NR MARSTON, NC (BLACK CREEK) 45 miles S W.



Groundwater Watch Help Page

DESCRIPTION:
Latitude 34°58'14", Longitude 79°31'42" NAD83
Scotland County, North Carolina, Hydrologic Unit 03040204
Well depth: 39 feet
Hole depth: 39 feet
Land surface altitude: 433feet above NGVD29.
Well completed in "Northern Atlantic Coastal Plain aquifer system" (S100NATLCP) national aquifer.
Well completed in "Black Creek Aquifer, Upper" (211BAKCU) local aquifer

AVAILABLE DATA:

Data Type	Begin Date	End Date	Count
Current / Historical Observations	2007-10-01	2014-08-23	
Daily Data			
Precipitation, total, inches	2003-09-06	2004-10-24	385
Depth to water level, feet below land surface	1987-10-03	2014-08-22	9475
Daily Statistics			
Depth to water level, feet below land surface	1987-10-03	2014-03-11	9316
Monthly Statistics			
Depth to water level, feet below land surface	1987-10	2014-03	
Annual Statistics			
Depth to water level, feet below land surface	1988	2014	
Field groundwater-level measurements	1993-11-09	2014-04-23	129
Field/Lab water-quality samples			

Additional Data Sources	Begin Date	End Date	Count

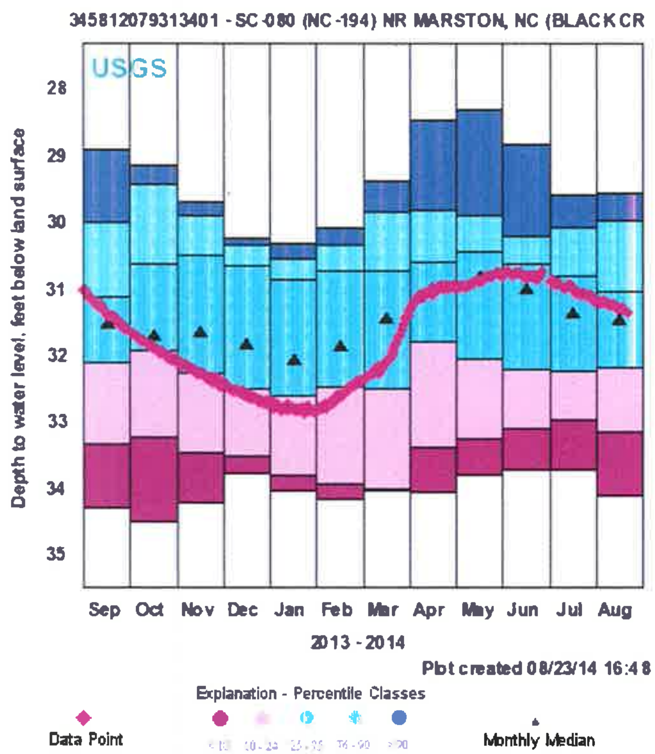
Annual Water-Data Report (pdf) **offsite**	2006	2013	8
Groundwater Watch **offsite**	1987	2014	9596

OPERATION:

Record for this site is maintained by the USGS North Carolina Water Science Center

Email questions about this site toNorth Carolina Water Science Center Water-Data Inquiries

Site Statistics



Most recent data value: 31.34 on 8/21/2014
Period of Record Monthly Statistics for 345812079313401
Depth to water level, feet below land surface
All Approved Continuous & Periodic Data Used In Analysis

Note: Highlighted values in the table indicate closest statistic to the most recent data value.

Month	Lowest Median	10th %ile	25th %ile	50th %ile	75th %ile	90th %ile	Highest Median	Number of Years
Jan	34.02	33.79	32.61	32.08	30.85	30.54	30.31	27
Feb	34.17	33.93	32.48	31.86	30.73	30.33	30.06	27
Mar	34.02	34.00	32.49	31.45	30.72	29.84	29.38	27
Apr	34.07	33.39	31.78	31.02	30.58	29.81	28.45	27
May	33.80	33.24	32.06	30.83	30.44	29.89	28.31	25
Jun	33.72	33.09	32.22	31.00	30.63	30.20	28.82	26
Jul	33.73	32.96	32.23	31.37	30.79	30.07	29.57	26
Aug	34.10	33.15	32.17	31.49	31.03	29.96	29.56	26
Sep	34.30	33.33	32.10	31.52	31.11	29.99	28.90	25
Oct	34.49	33.23	31.91	31.70	30.63	29.43	29.13	27
Nov	34.22	33.46	32.26	31.67	30.50	29.90	29.69	27
Dec	33.77	33.52	32.49	31.84	30.64	30.32	30.22	26

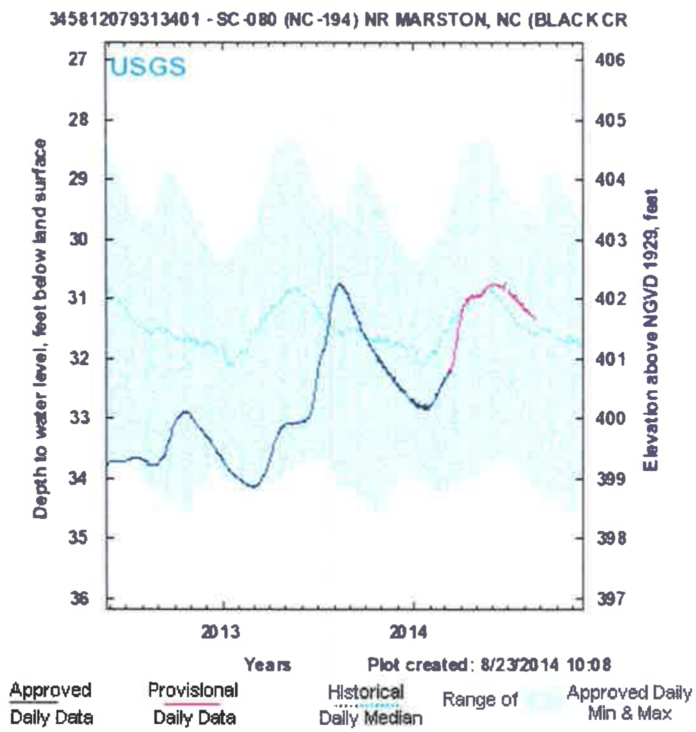
As of 8/23/2014 02:39-2

Statistics Options

View month/year statistics

* Historical monthly median GW High

Daily Groundwater Data



Most recent Provisional daily data value: 31.34 on 08/21/14

Summary for Period of Continuous Record

Depth to water level, feet below land surface

Daily Mean Values Data Used in Analysis

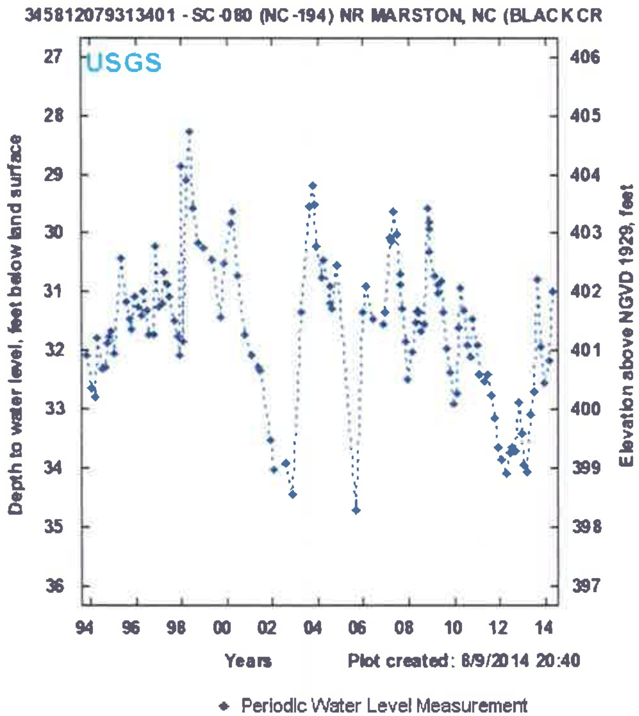
Begin Date	End Date	Days	% Complete
10/03/87	03/11/14	9,316	96

Lowest Level	5th %ile	10th %ile	25th %ile	50th %ile	75th %ile	90th %ile	95th %ile	Highest Level
34.60	33.78	33.22	32.33	31.48	30.73	30.16	29.75	28.28

Daily Data Options

- View latest data on NWISWeb
- View data in calendar format
- Download data in text format
- View daily medians
- View Daily Value Moving Averages

Periodic Groundwater Data



Summary for Period of Record Periodic Water Levels

Depth to water level, feet below land surface

Approved Periodic Water Level Values

Begin Date	End Date	Number of Values
11/09/93	04/23/14	129

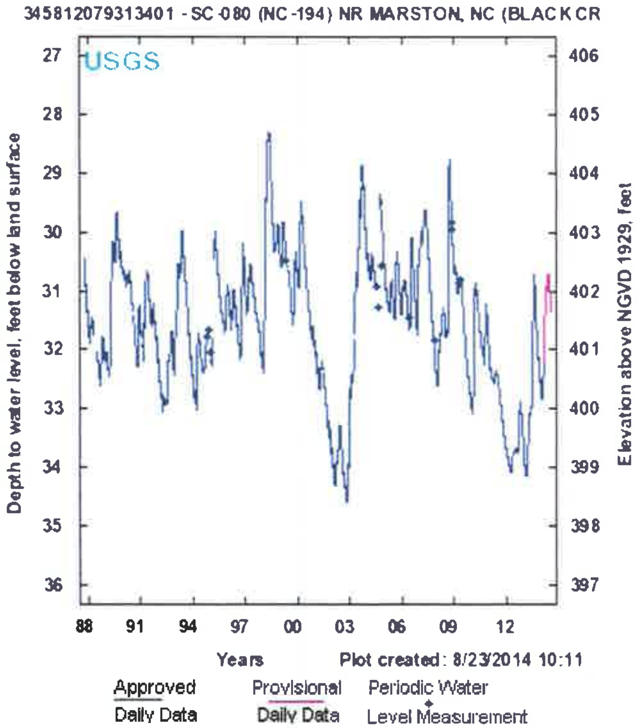
Highest WL	Date of Highest WL	Lowest WL	Date of Lowest WL
28.29	05/14/98	34.72	08/22/05

Groundwater Levels Options

USGS View latest data on NWISWeb

Download Groundwater levels in text format

Period of Record - All Data Types



Summary for Period of Record - All Data Types

Depth to water level, feet below land surface

Begin Date	End Date	Number of Values
10/03/87	08/21/14	10,329

Highest WL	Date of Highest WL	Lowest WL	Date of Lowest WL
28.28	05/08/98	34.72	08/22/05

Period of Record Options

USGS View latest data on NWISWeb for all data types

View annual monthly statistics for all data types

Download Groundwater levels in text format of all data types

Return to Groundwater Watch | Return to County Page | Return to State Page

*References to non-Department of the Interior (DOI) products do not constitute an endorsement by the DOI.
By viewing the Google Maps API on this web site the user agrees to these TERMS.

Groundwater Watch


```
# -----------------------------------------------------------------
# U.S. Department of the Interior
# U.S. Geological Survey
# Retrieved: 8/23/2014 8:55:37 PM
#
# ----------------------- WARNING -----------------------
# Some of the data you have obtained from this automated
# U.S. Geological Survey database have not received
# Director's approval and as such are provisional
# and subject to revision. The data are released
# on the condition that neither the USGS nor the
# United States Government may be held liable for
# any damages resulting from its use.
#
# This file consists of space delimited columns of data,
# which include the following fields:
#
# column            column definition
# ------------      -----------------------------------------
# 1. agency_cd      Agency collecting or maintaining the site
# 2. site_no        USGS site identification number
# 3. parm_code      Parameter code
# 4. lev_dt         Date
# 5. lev_va         Depth to water level, feet below land surface (Missing value indicated by '-----')
# 6. sl_lev_va      Altitude of Water Level, in Feet Above Sea Level (Missing value indicated by '-----')
# 7. lev_status_cd Water level status code, defined at: http://waterdata.usgs.gov/nwis/gwlevels/?help#
#
# Note: '*' in the status field indicates a partial date.
#
# ----- Agency Code: US GEOLOGICAL SURVEY
# -----  Station ID: 345812079313401, Station Name: SC-080 (NC-194) NR MARSTON, NC (BLACK CREEK)
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USGS 345812079313401 72019 12/04/1995 31.08 ----- J
USGS 345812079313401 72019 01/25/1996 31.24 ----- -
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# ----- End of Data
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Return To Station Page Return to County Page Return to State Page Return To National Page

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APPENDIX K
Historical Rainfall Totals for North Carolina and Raleigh-Durham Airport

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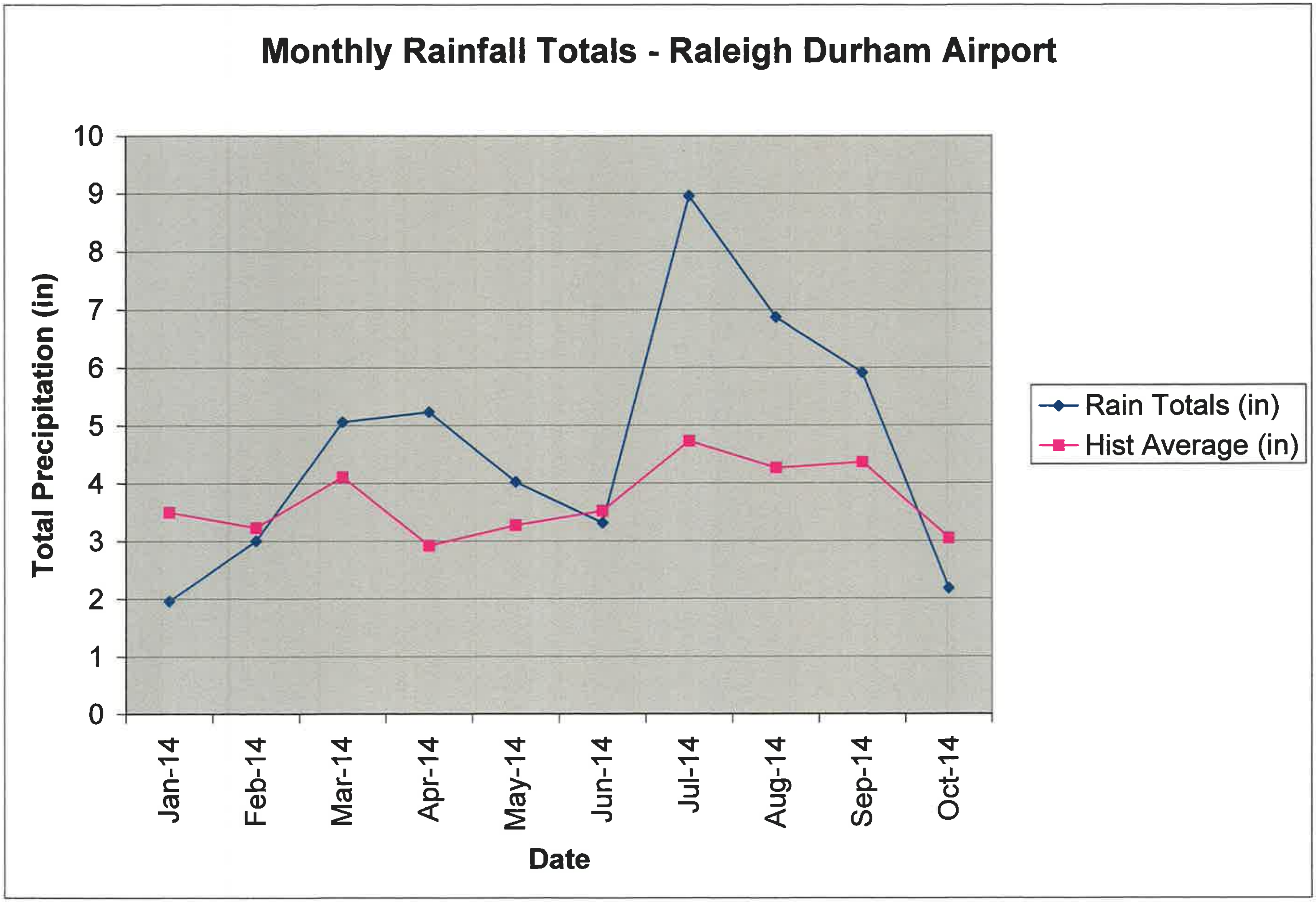

Monthly Rainfall Totals - Raleigh Durham Airport
Total Precipitation (in)
10
9
8
7
6
5
4
3
2
1
0
Jan-14
Feb-14
Mar-14
Apr-14
May-14
Jun-14
Jul-14
Aug-14
Sep-14
Oct-14
Date
Rain Totals (in)
Hist Average (in)

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

```
000
CXUS52 KRAH 011452
CLMRDU


CLIMATE REPORT
NATIONAL WEATHER SERVICE RALEIGH NC
941 AM EST SAT FEB 1 2014

...................................

...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF JANUARY 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
..............................................................
TEMPERATURE (F)
RECORD
 HIGH                80   01/30/2002
 LOW                 -9   01/21/1985
HIGHEST              69   01/11                        75
LOWEST                7   01/30                        18
AVG. MAXIMUM       48.1             50.9   -2.8      53.9
AVG. MINIMUM       25.2             31.0   -5.8      34.8
MEAN               36.7             41.0   -4.3      44.4
DAYS MAX >= 90        0                                 0
DAYS MAX <= 32        4                                 1
DAYS MIN <= 32       22                                15
DAYS MIN <= 0         0                                 0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM           7.52   1954
TOTALS             1.96             3.50  -1.54      3.10
DAYS >= .01           8
DAYS >= .10           7
DAYS >= .50           1
DAYS >= 1.00          0
GREATEST
 24 HR. TOTAL      0.73   01/10 TO 01/11

SNOWFALL (INCHES)
RECORDS
 TOTAL             25.8   2000
TOTALS              1.9              2.9   -1.0       1.0
SINCE 7/1           1.9
```

SNOWDEPTH AVG.	0			
DAYS >= TRACE	5			
DAYS >= 1.0	1	0.8	0.2	0

DEGREE_DAYS				
HEATING TOTAL	872	746	126	634
SINCE 7/1	2104	1997	107	1811
COOLING TOTAL	0	0	0	2
SINCE 1/1	0	0	0	

WIND (MPH)			
AVERAGE WIND SPEED	6.0		
HIGHEST WIND SPEED/DIRECTION	60/230	DATE	01/11
HIGHEST GUST SPEED/DIRECTION	86/220	DATE	01/11

SKY COVER	
POSSIBLE SUNSHINE (PERCENT)	MM
AVERAGE SKY COVER	0.50
NUMBER OF DAYS FAIR	8
NUMBER OF DAYS PC	15
NUMBER OF DAYS CLOUDY	8

AVERAGE RH (PERCENT) 56

WEATHER CONDITIONS. NUMBER OF DAYS WITH

THUNDERSTORM	0	MIXED PRECIP	1
HEAVY RAIN	0	RAIN	2
LIGHT RAIN	8	FREEZING RAIN	0
LT FREEZING RAIN	0	HAIL	0
HEAVY SNOW	0	SNOW	2
LIGHT SNOW	5	SLEET	1
FOG	12	FOG W/VIS <= 1/4 MILE	3
HAZE	1		

- INDICATES NEGATIVE NUMBERS.
R INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T INDICATES TRACE AMOUNT.

&&

A RECORD LOW TEMPERATURE OF 7 DEGREES WAS TIED AT RALEIGH-DURHAM INTL AIRPORT NC THURSDAY JANUARY 30TH. THIS TIES THE OLD RECORD OF 7 SET IN 1977.

A RECORD LOW MAXIMUM TEMPERATURE OF 27 WAS TIED AT THE RALEIGH-DURHAM INTL AIRPORT ON FRIDAY JANUARY 24TH. THIS TIES THE OLD RECORD DAILY LOW MAXIMUM TEMPERATURE SET IN 1963.

A RECORD LOW TEMPERATURE OF 9 DEGREES WAS SET RALEIGH-DURHAM INTL AIRPORT ON TUESDAY JANUARY 7TH. THIS BREAKS THE OLD RECORD OF 15 SET IN 1988.

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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000
CXUS52 KRAH 090731 CCA
CLMRDU

CLIMATE REPORT...CORRECTED
NATIONAL WEATHER SERVICE RALEIGH NC
855 AM EST SAT MAR 1 2014

...................................

...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF FEBRUARY 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
.............................................................
TEMPERATURE (F)
RECORD
 HIGH                84   02/26/1977
 LOW                 -2   02/14/1899
HIGHEST              73   02/21                         63
LOWEST               23   02/12                         18
AVG. MAXIMUM       53.5                55.2    -1.7   51.8
AVG. MINIMUM       33.4                33.8    -0.4   32.5
MEAN               43.4                44.5    -1.1   42.1
DAYS MAX >= 90        0                                  0
DAYS MAX <= 32        1                                  0
DAYS MIN <= 32       14                                 15
DAYS MIN <= 0         0                                  0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM           9.73   1939
TOTALS             3.00                3.23   -0.23   4.08
DAYS >= .01           9
DAYS >= .10           7
DAYS >= .50           2
DAYS >= 1.00          0
GREATEST
 24 HR. TOTAL      0.98   02/12 TO 02/13

SNOWFALL (INCHES)
RECORDS
 TOTAL             21.0   1948


 SNOW DEPTH          10   1979
```

```
TOTALS              3.7                1.9     1.8      0.7
SINCE 7/1           5.6
SNOWDEPTH AVG.        0
DAYS >= TRACE         4
DAYS >= 1.0           1                0.6     0.4        0

DEGREE_DAYS
HEATING TOTAL       597                575      22      635
 SINCE 7/1         2701               2572     129     2446
COOLING TOTAL         0                  1      -1        0
 SINCE 1/1            0                  1      -1
.............................................................

WIND (MPH)
AVERAGE WIND SPEED              5.9
HIGHEST WIND SPEED/DIRECTION    32/250    DATE  02/21
HIGHEST GUST SPEED/DIRECTION    41/250    DATE  02/21

SKY COVER
POSSIBLE SUNSHINE (PERCENT)   MM
AVERAGE SKY COVER           0.70
NUMBER OF DAYS FAIR            3
NUMBER OF DAYS PC             14
NUMBER OF DAYS CLOUDY         11

AVERAGE RH (PERCENT)     62

WEATHER CONDITIONS. NUMBER OF DAYS WITH
THUNDERSTORM              2     MIXED PRECIP              0
HEAVY RAIN                1     RAIN                      3
LIGHT RAIN               10     FREEZING RAIN             1
LT FREEZING RAIN          2     HAIL                      0
HEAVY SNOW                1     SNOW                      2
LIGHT SNOW                4     SLEET                     2
FOG                      15     FOG W/VIS <= 1/4 MILE     3
HAZE                      1

-  INDICATES NEGATIVE NUMBERS.
R  INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T  INDICATES TRACE AMOUNT.

&&

NO CLIMATE RECORDS WERE TIED OR BROKEN AT RALEIGH DURHAM INTERNATIONAL AIRPORT
FOR THE MONTH OF FEBRUARY.
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These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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CXUS52 KRAH 020729
CLMRDU

CLIMATE REPORT...CORRECTED
NATIONAL WEATHER SERVICE RALEIGH NC
1026 AM EDT TUE APR 1 2014

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...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF MARCH 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
.............................................................
TEMPERATURE (F)
RECORD
 HIGH               94   03/29/1907
 LOW                11   03/02/1980
                         03/06/1960
HIGHEST             79   03/11                          78
LOWEST              16   03/04                          23
AVG. MAXIMUM      57.9              63.4    -5.5      55.9
AVG. MINIMUM      34.0              39.9    -5.9      33.9
MEAN              46.0              51.6    -5.6      44.9
DAYS MAX >= 90       0                                   0
DAYS MAX <= 32       0                                   0
DAYS MIN <= 32      15                                  14
DAYS MIN <= 0        0                                   0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM          7.78   1973
TOTALS            5.06              4.11    0.95      2.95
DAYS >= .01         12
DAYS >= .10          9
DAYS >= .50          2
DAYS >= 1.00         1
GREATEST
 24 HR. TOTAL     1.72   03/07 TO 03/07

SNOWFALL (INCHES)
RECORDS
 TOTAL            17.8   1927

 SNOW DEPTH         11   1980
```

```
TOTALS              0.2                0.5    -0.3      0.0
SINCE 7/1           5.8
SNOWDEPTH AVG.        0
DAYS >= TRACE         4
DAYS >= 1.0           0                0.1    -0.1        0

DEGREE_DAYS
HEATING TOTAL       583                424     159      615
 SINCE 7/1         3284               2996     288     3061
COOLING TOTAL         0                 11     -11        0
 SINCE 1/1            0                 12     -12
..............................................................

WIND (MPH)
AVERAGE WIND SPEED              7.1
HIGHEST WIND SPEED/DIRECTION    29/220    DATE  03/12
HIGHEST GUST SPEED/DIRECTION    37/270    DATE  03/30

SKY COVER
POSSIBLE SUNSHINE (PERCENT)   MM
AVERAGE SKY COVER           0.60
NUMBER OF DAYS FAIR            6
NUMBER OF DAYS PC             12
NUMBER OF DAYS CLOUDY         13

AVERAGE RH (PERCENT)     61

WEATHER CONDITIONS. NUMBER OF DAYS WITH
THUNDERSTORM              1     MIXED PRECIP            0
HEAVY RAIN                3     RAIN                    8
LIGHT RAIN               12     FREEZING RAIN           0
LT FREEZING RAIN          3     HAIL                    0
HEAVY SNOW                0     SNOW                    2
LIGHT SNOW                2     SLEET                   5
FOG                      16     FOG W/VIS <= 1/4 MILE   3
HAZE                      1

-  INDICATES NEGATIVE NUMBERS.
R  INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T  INDICATES TRACE AMOUNT.

&&

MARCH 7TH: RECORD RAINFALL OF 1.72 INCHES WAS SET AT THE RALEIGH DURHAM
INTERNATIONAL AIRPORT BREAKING THE OLD RECORD OF 1.63 INCHES SET IN 1941.
```

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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CXUS52 KRAH 021124 CCA
CLMRDU

CLIMATE REPORT...CORRECTED
NATIONAL WEATHER SERVICE RALEIGH NC
1037 AM EDT THU MAY 1 2014

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...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF APRIL 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER           OBSERVED          NORMAL  DEPART  LAST YEAR`S
                   VALUE   DATE(S)  VALUE   FROM    VALUE
                                            NORMAL
..............................................................
TEMPERATURE (F)
RECORD
 HIGH               95   04/23/1980
                         04/18/1896
 LOW                23   04/10/1985
                         04/09/1972
HIGHEST             86   04/02                          85
LOWEST              31   04/17                          35
AVG. MAXIMUM      72.3              72.4    -0.1      71.0
AVG. MINIMUM      48.0              48.0     0.0      49.9
MEAN              60.2              60.2     0.0      60.5
DAYS MAX >= 90      0                                    0
DAYS MAX <= 32      0                                    0
DAYS MIN <= 32      1                                    0
DAYS MIN <= 0       0                                    0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM          6.10   1978
TOTALS            5.23              2.92     2.31     4.38
DAYS >= .01        10
DAYS >= .10         6
DAYS >= .50         4
DAYS >= 1.00        3
GREATEST
 24 HR. TOTAL     1.42   04/07 TO 04/07
                         04/06 TO 04/07
                         04/07 TO 04/07

SNOWFALL (INCHES)
```

```
TOTALS            0.0               0.1    -0.1        T
SINCE 7/1         5.8
SNOWDEPTH AVG.      0
DAYS >= TRACE       0
DAYS >= 1.0         0               0.0     0.0        0

DEGREE_DAYS
HEATING TOTAL     167               193     -26      175
 SINCE 7/1       3451              3189     262     3236
COOLING TOTAL      31                49     -18       48
 SINCE 1/1         31                61     -30
..............................................................

WIND (MPH)
AVERAGE WIND SPEED              7.4
HIGHEST WIND SPEED/DIRECTION    32/230    DATE  04/04
HIGHEST GUST SPEED/DIRECTION    38/160    DATE  04/30

SKY COVER
POSSIBLE SUNSHINE (PERCENT)   MM
AVERAGE SKY COVER           0.60
NUMBER OF DAYS FAIR            7
NUMBER OF DAYS PC             12
NUMBER OF DAYS CLOUDY         11

AVERAGE RH (PERCENT)     59

WEATHER CONDITIONS. NUMBER OF DAYS WITH
THUNDERSTORM              4     MIXED PRECIP               0
HEAVY RAIN                4     RAIN                       4
LIGHT RAIN               12     FREEZING RAIN              0
LT FREEZING RAIN          0     HAIL                       0
HEAVY SNOW                0     SNOW                       0
LIGHT SNOW                0     SLEET                      0
FOG                      11     FOG W/VIS <= 1/4 MILE      0
HAZE                      2

-  INDICATES NEGATIVE NUMBERS.
R  INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T  INDICATES TRACE AMOUNT.
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These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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CXUS52 KRAH 011326
CLMRDU


CLIMATE REPORT
NATIONAL WEATHER SERVICE RALEIGH NC
924 AM EDT SUN JUN 1 2014

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...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF MAY 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
..............................................................
TEMPERATURE (F)
RECORD
 HIGH               97   05/31/1953
 LOW                29   05/02/1963
HIGHEST             92   05/13                          87
LOWEST              45   05/19                          39
AVG. MAXIMUM      81.4              79.6    1.8       76.1
AVG. MINIMUM      58.3              56.5    1.8       56.3
MEAN              69.9              68.0    1.9       66.2
DAYS MAX >= 90       4                                   0
DAYS MAX <= 32       0                                   0
DAYS MIN <= 32       0                                   0
DAYS MIN <= 0        0                                   0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM          7.76   1974
TOTALS            4.02              3.27    0.75      4.52
DAYS >= .01          6
DAYS >= .10          3
DAYS >= .50          1
DAYS >= 1.00         1
GREATEST
 24 HR. TOTAL     3.56   05/15 TO 05/16

DEGREE_DAYS
HEATING TOTAL       27                54     -27        84
 SINCE 7/1        3478              3243     235      3320
COOLING TOTAL      182               148      34       128
 SINCE 1/1         213               209       4
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WIND (MPH)
AVERAGE WIND SPEED               5.7
HIGHEST WIND SPEED/DIRECTION     28/230     DATE  05/01
HIGHEST GUST SPEED/DIRECTION     41/280     DATE  05/27

SKY COVER
POSSIBLE SUNSHINE (PERCENT)    MM
AVERAGE SKY COVER            0.50
NUMBER OF DAYS FAIR             7
NUMBER OF DAYS PC              19
NUMBER OF DAYS CLOUDY           5

AVERAGE RH (PERCENT)      65

WEATHER CONDITIONS. NUMBER OF DAYS WITH
THUNDERSTORM              2     MIXED PRECIP              0
HEAVY RAIN                1     RAIN                      2
LIGHT RAIN                5     FREEZING RAIN             0
LT FREEZING RAIN          0     HAIL                      0
HEAVY SNOW                0     SNOW                      0
LIGHT SNOW                0     SLEET                     0
FOG                      12     FOG W/VIS <= 1/4 MILE     0
HAZE                      0

-  INDICATES NEGATIVE NUMBERS.
R  INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T  INDICATES TRACE AMOUNT.

&&

RECORDS

MAY 15TH: RECORD RAINFALL OF 3.38 INCHES...BREAKING THE OLD RECORD
OF 2.19 INCHES SET IN 1934.
```

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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CXUS52 KRAH 280600
CLMRDU


CLIMATE REPORT
NATIONAL WEATHER SERVICE RALEIGH NC
200 AM EDT MON JUL 28 2014

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...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF JUNE 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
..............................................................
TEMPERATURE (F)
RECORD
 HIGH              105   06/30/2012
                         06/29/2012
                         06/27/1954
 LOW                38   06/08/1977
HIGHEST             97   06/19                          94
                         06/18
LOWEST              52   06/02                          55
AVG. MAXIMUM      88.8              87.1     1.7      85.4
AVG. MINIMUM      65.8              65.8     0.0      66.2
MEAN              77.3              76.4     0.9      75.8
DAYS MAX >= 90      14                                   5
DAYS MAX <= 32       0                                   0
DAYS MIN <= 32       0                                   0
DAYS MIN <= 0        0                                   0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM         10.45   2006
TOTALS            3.31              3.52   -0.21     10.08
DAYS >= .01         10
DAYS >= .10          6
DAYS >= .50          3
DAYS >= 1.00         0
GREATEST
 24 HR. TOTAL     0.88   06/27 TO 06/27
                         06/26 TO 06/27
                         06/27 TO 06/27
```

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DEGREE_DAYS
HEATING TOTAL        0                  4      -4       0
 SINCE 7/1        3478               3247     231    3320
COOLING TOTAL      377                347      30     331
 SINCE 1/1         590                556      34
..............................................................

WIND (MPH)
AVERAGE WIND SPEED               4.9
HIGHEST WIND SPEED/DIRECTION     32/200    DATE  06/11
HIGHEST GUST SPEED/DIRECTION     47/280    DATE  06/19

SKY COVER
POSSIBLE SUNSHINE (PERCENT)   MM
AVERAGE SKY COVER           0.60
NUMBER OF DAYS FAIR            1
NUMBER OF DAYS PC             24
NUMBER OF DAYS CLOUDY          5

AVERAGE RH (PERCENT)     67

WEATHER CONDITIONS. NUMBER OF DAYS WITH
THUNDERSTORM              0     MIXED PRECIP               0
HEAVY RAIN                5     RAIN                       5
LIGHT RAIN               13     FREEZING RAIN              0
LT FREEZING RAIN          0     HAIL                       0
HEAVY SNOW                0     SNOW                       0
LIGHT SNOW                0     SLEET                      0
FOG                      19     FOG W/VIS <= 1/4 MILE      3
HAZE                      5

-  INDICATES NEGATIVE NUMBERS.
R  INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T  INDICATES TRACE AMOUNT.
```

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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CXUS52 KRAH 011300
CLMRDU


CLIMATE REPORT
NATIONAL WEATHER SERVICE RALEIGH NC
847 AM EDT FRI AUG 1 2014

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...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF JULY 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
.............................................................
TEMPERATURE (F)
RECORD
 HIGH              105   07/08/2012
                         07/23/1952
                         07/14/1954
 LOW                48   07/02/1975
HIGHEST             98   07/14                          96
                         07/08
LOWEST              60   07/17                          62
AVG. MAXIMUM      88.1              90.2    -2.1      87.5
AVG. MINIMUM      68.7              69.9    -1.2      70.7
MEAN              78.4              80.0    -1.6      79.1
DAYS MAX >= 90      13                                  11
DAYS MAX <= 32       0                                   0
DAYS MIN <= 32       0                                   0
DAYS MIN <= 0        0                                   0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM         10.27   1991
TOTALS            8.96              4.73    4.23      3.48
DAYS >= .01          8
DAYS >= .10          6
DAYS >= .50          5
DAYS >= 1.00         3
GREATEST
 24 HR. TOTAL     4.21   07/15 TO 07/15

DEGREE_DAYS
HEATING TOTAL        0                 0       0         0
```

SINCE 7/1	0	0	0	0
COOLING TOTAL	423	466	-43	446
SINCE 1/1	1013	1022	-9	

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WIND (MPH)

AVERAGE WIND SPEED	5.5		
HIGHEST WIND SPEED/DIRECTION	29/150	DATE	07/03
HIGHEST GUST SPEED/DIRECTION	37/150	DATE	07/03

SKY COVER

POSSIBLE SUNSHINE (PERCENT)	MM
AVERAGE SKY COVER	0.70
NUMBER OF DAYS FAIR	1
NUMBER OF DAYS PC	19
NUMBER OF DAYS CLOUDY	10

AVERAGE RH (PERCENT) 68

WEATHER CONDITIONS. NUMBER OF DAYS WITH

THUNDERSTORM	8	MIXED PRECIP	0
HEAVY RAIN	5	RAIN	6
LIGHT RAIN	11	FREEZING RAIN	0
LT FREEZING RAIN	0	HAIL	0
HEAVY SNOW	0	SNOW	0
LIGHT SNOW	0	SLEET	0
FOG	17	FOG W/VIS <= 1/4 MILE	3
HAZE	4		

\- INDICATES NEGATIVE NUMBERS.
R INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T INDICATES TRACE AMOUNT.

&&

THE HIGH MINIMUM TEMPERATURE OF 74 DEGREES ON THE 31ST TIED THE RECORD FOR THE DATE SET IN 1999.

RAINFALL ON THE 15TH TOTALED 4.21 INCHES...BREAKING THE PREVIOUS RECORD FOR THE DATE OF 2.80 INCHES SET IN 1954.

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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CXUS52 KRAH 011353
CLMRDU


CLIMATE REPORT
NATIONAL WEATHER SERVICE RALEIGH NC
948 AM EDT MON SEP 1 2014

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...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF AUGUST 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
..............................................................
TEMPERATURE (F)
RECORD
 HIGH              105   08/21/2007
                         08/18/1988
                         00/00/2068
 LOW                46   08/30/1965
HIGHEST             92   08/28                       94
                         08/22
LOWEST              58   08/27                       55
                         08/14
AVG. MAXIMUM      84.6             88.4    -3.8    85.1
AVG. MINIMUM      67.1             68.6    -1.5    67.0
MEAN              75.9             78.5    -2.6    76.0
DAYS MAX >= 90       6                                8
DAYS MAX <= 32       0                                0
DAYS MIN <= 32       0                                0
DAYS MIN <= 0        0                                0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM         12.18   1986
TOTALS            6.87             4.26    2.61    4.88
DAYS >= .01         10
DAYS >= .10          7
DAYS >= .50          6
DAYS >= 1.00         3
GREATEST
 24 HR. TOTAL     2.61   08/11 TO 08/12

DEGREE_DAYS
```

HEATING TOTAL	0	1	-1	0
SINCE 7/1	0	1	-1	0
COOLING TOTAL	345	419	-74	351
SINCE 1/1	1358	1441	-83	

....

WIND (MPH)
AVERAGE WIND SPEED 4.1
HIGHEST WIND SPEED/DIRECTION 31/300 DATE 08/20
HIGHEST GUST SPEED/DIRECTION 58/320 DATE 08/20

SKY COVER
POSSIBLE SUNSHINE (PERCENT) MM
AVERAGE SKY COVER 0.70
NUMBER OF DAYS FAIR 2
NUMBER OF DAYS PC 18
NUMBER OF DAYS CLOUDY 11

AVERAGE RH (PERCENT) 74

WEATHER CONDITIONS. NUMBER OF DAYS WITH

THUNDERSTORM	5	MIXED PRECIP	0
HEAVY RAIN	6	RAIN	5
LIGHT RAIN	10	FREEZING RAIN	0
LT FREEZING RAIN	0	HAIL	0
HEAVY SNOW	0	SNOW	0
LIGHT SNOW	0	SLEET	0
FOG	23	FOG W/VIS <= 1/4 MILE	4
HAZE	8		

\- INDICATES NEGATIVE NUMBERS.
R INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T INDICATES TRACE AMOUNT.

&&

RECORDS:

AUGUST 2ND: A RECORD LOW MAXIMUM TEMPERATURE OF 70 DEGREES WAS SET AT THE RALEIGH-DURHAM INTERNATIONAL AIRPORT. THIS BROKE THE PREVIOUS RECORD OF 71 DEGREES SET IN 1916.

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

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CXUS52 KRAH 011351
CLMRDU


CLIMATE REPORT
NATIONAL WEATHER SERVICE RALEIGH NC
949 AM EDT WED OCT 1 2014

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...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF SEPTEMBER 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
..............................................................
TEMPERATURE (F)
RECORD
 HIGH              104   09/06/1954
 LOW                37   09/23/1983
                         09/26/1950
HIGHEST             96   09/02                          91
LOWEST              54   09/28                          50
AVG. MAXIMUM      79.9              82.1    -2.2      81.0
AVG. MINIMUM      64.4              61.7     2.7      60.4
MEAN              72.2              71.9     0.3      70.7
DAYS MAX >= 90       6                                   4
DAYS MAX <= 32       0                                   0
DAYS MIN <= 32       0                                   0
DAYS MIN <= 0        0                                   0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM         21.79   1999
TOTALS            5.91              4.36    1.55      2.91
DAYS >= .01         14
DAYS >= .10          5
DAYS >= .50          3
DAYS >= 1.00         3
GREATEST
 24 HR. TOTAL     3.30   09/23 TO 09/24

DEGREE_DAYS
HEATING TOTAL       10                20     -10        11
 SINCE 7/1          10                21     -11        11
COOLING TOTAL      234               227       7       189
```

```
 SINCE 1/1       1592              1668     -76
..............................................................

WIND (MPH)
AVERAGE WIND SPEED              5.0
HIGHEST WIND SPEED/DIRECTION    24/220    DATE  09/04
HIGHEST GUST SPEED/DIRECTION    33/200    DATE  09/02

SKY COVER
POSSIBLE SUNSHINE (PERCENT)   MM
AVERAGE SKY COVER           0.70
NUMBER OF DAYS FAIR            1
NUMBER OF DAYS PC             15
NUMBER OF DAYS CLOUDY         14

AVERAGE RH (PERCENT)     75

WEATHER CONDITIONS. NUMBER OF DAYS WITH
THUNDERSTORM             4     MIXED PRECIP                0
HEAVY RAIN               4     RAIN                        5
LIGHT RAIN              17     FREEZING RAIN               0
LT FREEZING RAIN         0     HAIL                        0
HEAVY SNOW               0     SNOW                        0
LIGHT SNOW               0     SLEET                       0
FOG                     22     FOG W/VIS <= 1/4 MILE       2
HAZE                     3

-  INDICATES NEGATIVE NUMBERS.
R  INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T  INDICATES TRACE AMOUNT.

&&

A RECORD RAINFALL OF 3.18 INCHES WAS SET AT RALEIGH-DURHAM INTL
AIRPORT NC ON SEPTEMBER 24TH. THIS BREAKS THE OLD RECORD OF 1.63 SET IN 1947.
```

These data are preliminary and have not undergone final quality control by the National Climatic Data Center (NCDC). Therefore, these data are subject to revision. Final and certified climate data can be accessed at the NCDC - http://www.ncdc.noaa.gov.

Climatological Report (Monthly)

```
000
CXUS52 KRAH 011334
CLMRDU


CLIMATE REPORT
NATIONAL WEATHER SERVICE RALEIGH NC
929 AM EDT SAT NOV 1 2014

...................................

...THE RALEIGH-DURHAM INTL AIRPORT CLIMATE SUMMARY FOR THE MONTH OF OCTOBER 2014...

CLIMATE NORMAL PERIOD 1981 TO 2010
CLIMATE RECORD PERIOD 1887 TO 2014

WEATHER          OBSERVED          NORMAL  DEPART  LAST YEAR`S
                  VALUE   DATE(S)  VALUE   FROM    VALUE
                                           NORMAL
.............................................................
TEMPERATURE (F)
RECORD
 HIGH              98   10/06/1954
 LOW               19   10/27/1962
HIGHEST            86   10/11                          89
LOWEST             39   10/25                          29
AVG. MAXIMUM     75.0               72.7     2.3     70.8
AVG. MINIMUM     51.0               49.8     1.2     52.6
MEAN             63.0               61.2     1.8     61.7
DAYS MAX >= 90      0                                   0
DAYS MAX <= 32      0                                   0
DAYS MIN <= 32      0                                   1
DAYS MIN <= 0       0                                   0

PRECIPITATION (INCHES)
RECORD
 MAXIMUM         9.35   2002
TOTALS           2.18               3.25   -1.07     1.41
DAYS >= .01         7
DAYS >= .10         5
DAYS >= .50         2
DAYS >= 1.00        0
GREATEST
 24 HR. TOTAL    0.85   10/10 TO 10/11

DEGREE_DAYS
HEATING TOTAL     118                168     -50      148
 SINCE 7/1        128                189     -61      159
COOLING TOTAL      64                 52      12       55
 SINCE 1/1       1656               1720     -64
..............................................................

WIND (MPH)
AVERAGE WIND SPEED              5.1
HIGHEST WIND SPEED/DIRECTION    24/140     DATE  10/14
```

HIGHEST GUST SPEED/DIRECTION 30/150 DATE 10/14

SKY COVER

POSSIBLE SUNSHINE (PERCENT)	MM
AVERAGE SKY COVER	0.50
NUMBER OF DAYS FAIR	10
NUMBER OF DAYS PC	17
NUMBER OF DAYS CLOUDY	4

AVERAGE RH (PERCENT) 67

WEATHER CONDITIONS. NUMBER OF DAYS WITH

THUNDERSTORM	3	MIXED PRECIP	0
HEAVY RAIN	3	RAIN	5
LIGHT RAIN	8	FREEZING RAIN	0
LT FREEZING RAIN	0	HAIL	0
HEAVY SNOW	0	SNOW	0
LIGHT SNOW	0	SLEET	0
FOG	11	FOG W/VIS <= 1/4 MILE	1
HAZE	3		

\- INDICATES NEGATIVE NUMBERS.
R INDICATES RECORD WAS SET OR TIED.
MM INDICATES DATA IS MISSING.
T INDICATES TRACE AMOUNT.

&&

A RECORD HIGH MINIMUM OF 70 DEGREES ON THE 14TH BROKE THE OLD RECORD FROM 1954.

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APPENDIX L

Historical Groundwater Level Data and Boring Logs, Lee County Landfill

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HISTORICAL GROUNDWATER ELEVATION DATA W/ ESTIMATED LONG-TERM HIGH CORRECTION FACTOR
LEE COUNTY LANDFILL
331 LANDFILL ROAD
LEMON SPRINGS, NORTH CAROLINA
PERMIT NO.: 53-01

Monitor Well ID	***MW-4***	***MW-5***	***MW-6***	***MW-7***	***MW-9***	***MW-10***	***MW-11***	***MW-12***	***MW-13***	***MW-14***
Well Depth (feet bgs)	19.00	19.50	40.40	22.17	22.85	22.80	22.75	13.30	24.25	18.25
Top-of Casing Elevation (feet)	345.90	351.10	402.10	360.30	384.20	377.00	399.60	337.40	363.93	358.61
Date:	***Groundwater Elevation (feet)***									
09/12/95	--	--	--	347.56	375.43	369.09	380.22	329.87	--	--
05/13/96	--	--	--	351.77	375.06	369.98	388.73	329.26	--	--
10/09/97	334.21	344.23	391.86	350.33	374.41	368.95	386.72	333.04	--	--
04/15/98	337.89	344.96	394.21	**352.94**	**377.82**	370.15	392.18	333.69	--	--
10/14/98	333.58	344.13	390.99	350.30	374.89	368.98	385.52	333.10	--	--
10/19/99	**338.40**	**345.35**	**395.24**	**352.91**	370.70	**370.27**	392.63	**334.06**	--	--
05/04/00	336.0	344.6	392.3	352.0	375.6	369.7	388.8	333.2	355.5	352.7
10/17/00	334.60	341.30	392.80	350.20	375.10	368.90	386.60	333.10	**356.50**	351.50
04/17/01	336.6	344.6	392.7	351.9	375.0	369.8	389.8	333.2	355.5	352.6
04/22/02	335.3	344.4	392.4	351.4	375.5	368.1	388.7	333.1	355.2	352.4
10/21/02	--	**345.53**	392.56	--	375.55	--	--	**334.45**	355.76	352.64
10/30/03	**338.10**	344.93	**394.77**	352.62	377.07	369.86	**393.25**	333.89	356.18	**353.51**
04/21/04	335.1	344.5	392.2	351.5	374.0	369.7	388.7	333.2	355.1	352.5
10/28/04	334.5	344.5	393.4	350.9	374.0	369.4	388.3	333.3	354.3	351.8
04/18/05	337.11	344.99	394.73	352.35	**377.76**	**370.19**	**392.74**	333.50	356.35	**353.34**
10/31/05	333.6	344.3	393.0	350.5	372.9	369.2	388.4	333.1	354.6	351.9
04/10/06	334.8	344.4	392.0	351.4	374.0	369.7	388.5	333.2	355.2	352.4
10/20/06	331.2	343.9	392.1	349.9	372.1	367.3	387.9	332.1	347.5	350.1
04/23/07	336.0	344.6	--	351.7	375.6	370.0	390.2	333.3	355.7	352.8
10/31/07	332.0	344.5	391.8	349.5	374.5	368.4	388.8	333.1	354.45	350.64
04/09/08	338.0	345.0	393.5	352.5	377.4	370.1	392.1	333.5	**356.4**	353.1
10/21/08	335.1	344.6	394.0	351.0	376.7	369.3	389.3	333.6	354.9	352.1
04/24/09	336.60	--	393.46	351.82	377.27	369.77	390.44	333.59	355.87	352.89
11/24/09	335.10	344.85	393.15	351.45	375.05	369.05	389.05	333.75	354.69	351.83
04/09/10	337.10	344.90	392.68	351.75	376.44	369.67	390.30	333.85	355.98	352.91
10/04/10	330.59	344.55	392.16	349.24	374.82	367.84	388.54	332.98	353.38	350.52
10/10/11	dry	341.64	391.18	347.76	370.56	363.44	383.59	328.87	348.94	347.68
10/18/12	331.62	344.35	392.48	349.73	374.91	367.55	387.62	332.50	353.19	350.71
04/17/13	335.45	344.80	392.55	351.87	375.92	369.61	389.65	333.62	356.24	352.48
10/1/2013*	330.32	344.24	392.48	349.23	374.09	366.60	386.83	331.55	352.92	350.35
04/10/14	336.95	344.76	393.35	351.90	377.45	369.76	391.04	333.57	**356.40**	352.82
Groundwater High - 10/1/2013 Levels*	8.08'	1.29'	2.76'	3.71'	3.73'	3.67'	6.42'	2.90'	3.58'	3.16'
Geometric Mean (Correction Factor)*	*+3.5'*									

Notes:

Lee County Landfill is located 11.5 miles south southwest of the Colon Mine site.

Lee County Landfill is located in the upper Coastal Plain Province within the Middendorf Formation (Cretaceous) consisting of sand, sandstone and mudstone according to 1985 Geologic Map of North Carolina; boring logs for MW-4, MW-5 and MW-6 indicated a primarily sandy clay and clayey sand formation.

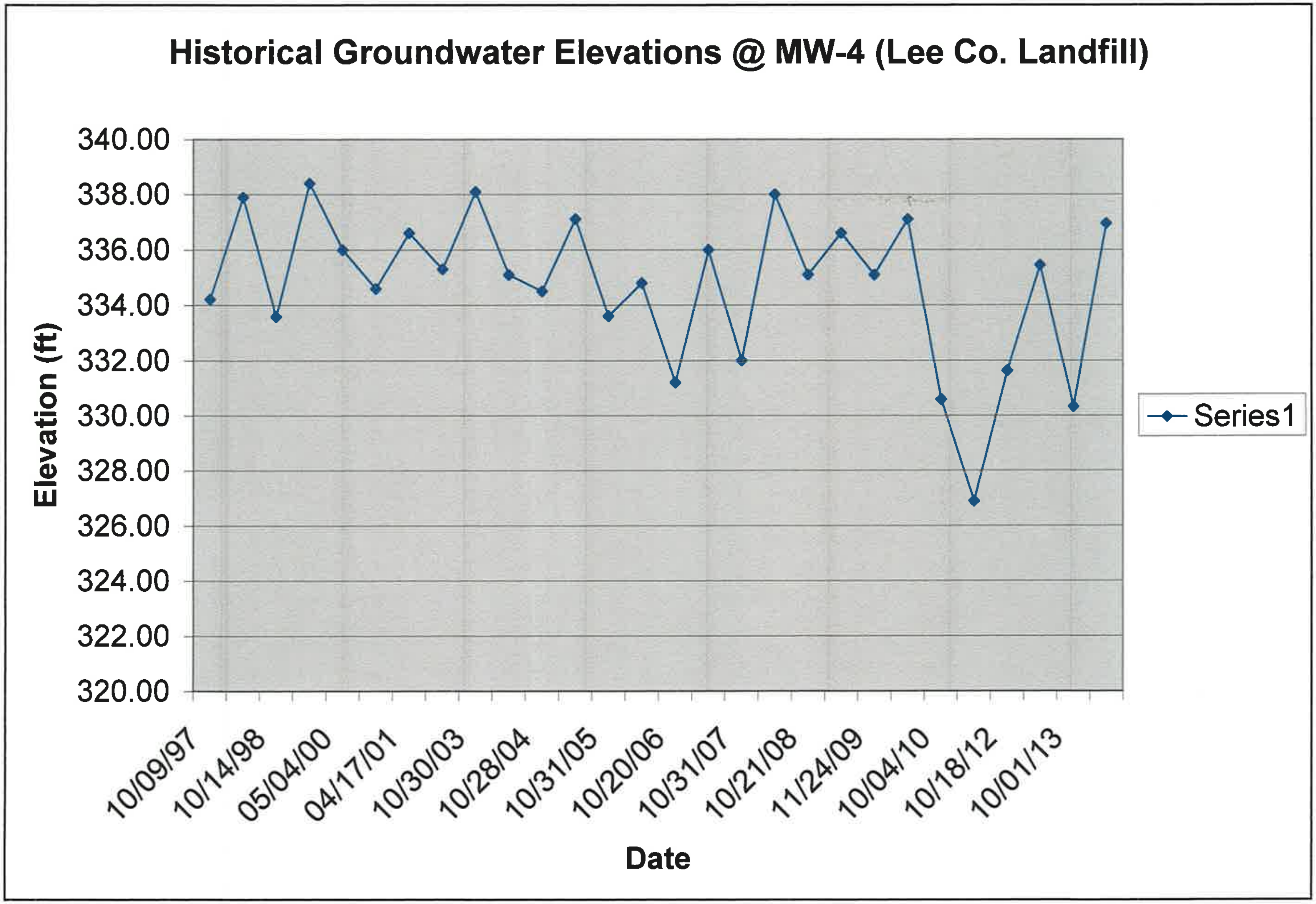
Groundwater gauging information obtained from monitoring reports (listed below), which were provided on the NCDENR-Solid Waste Section website and historical database.

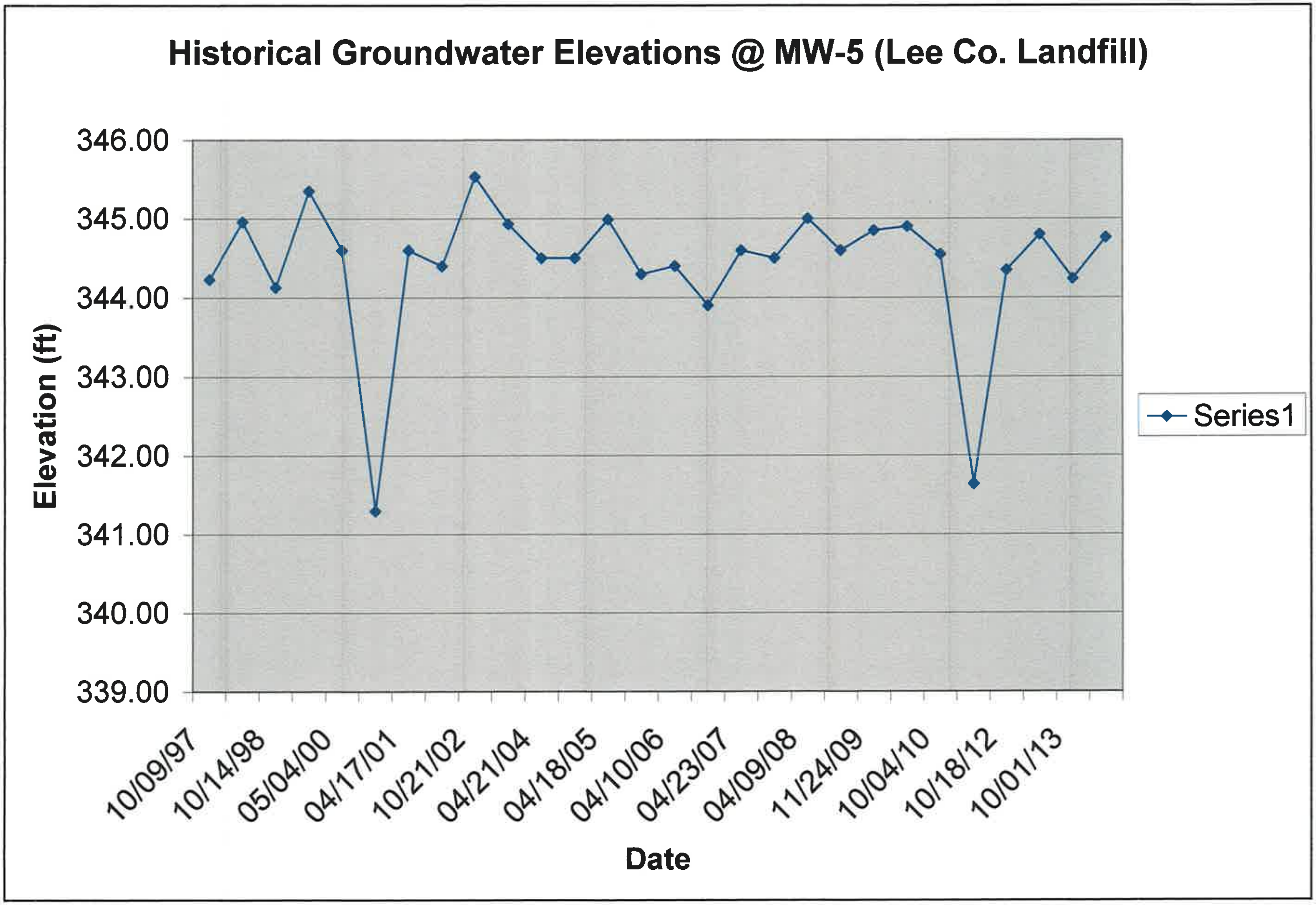
bold and shade denotes historical groundwater high; which occurred between 1998 and 2003

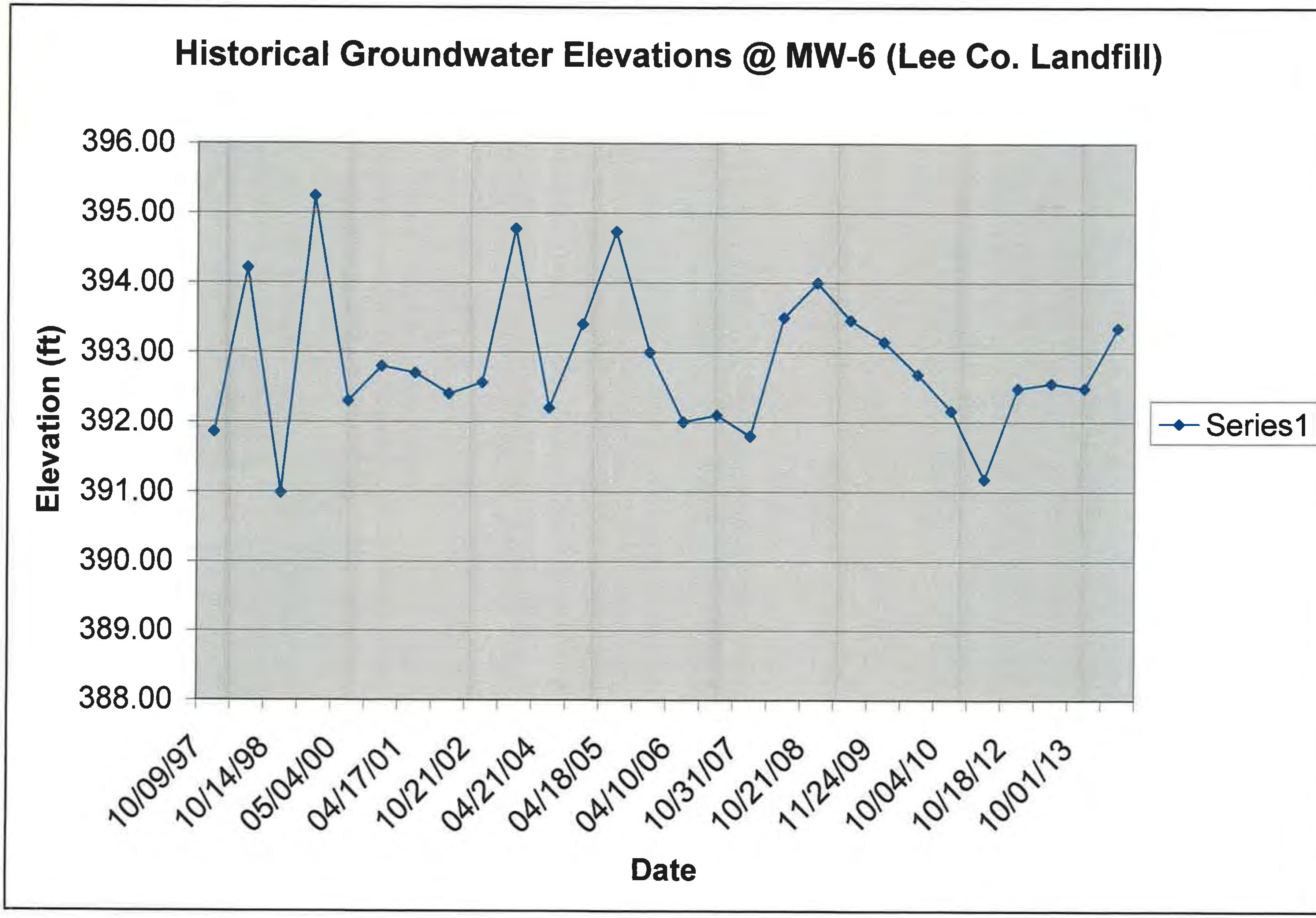
bold denotes second most historical groundwater high

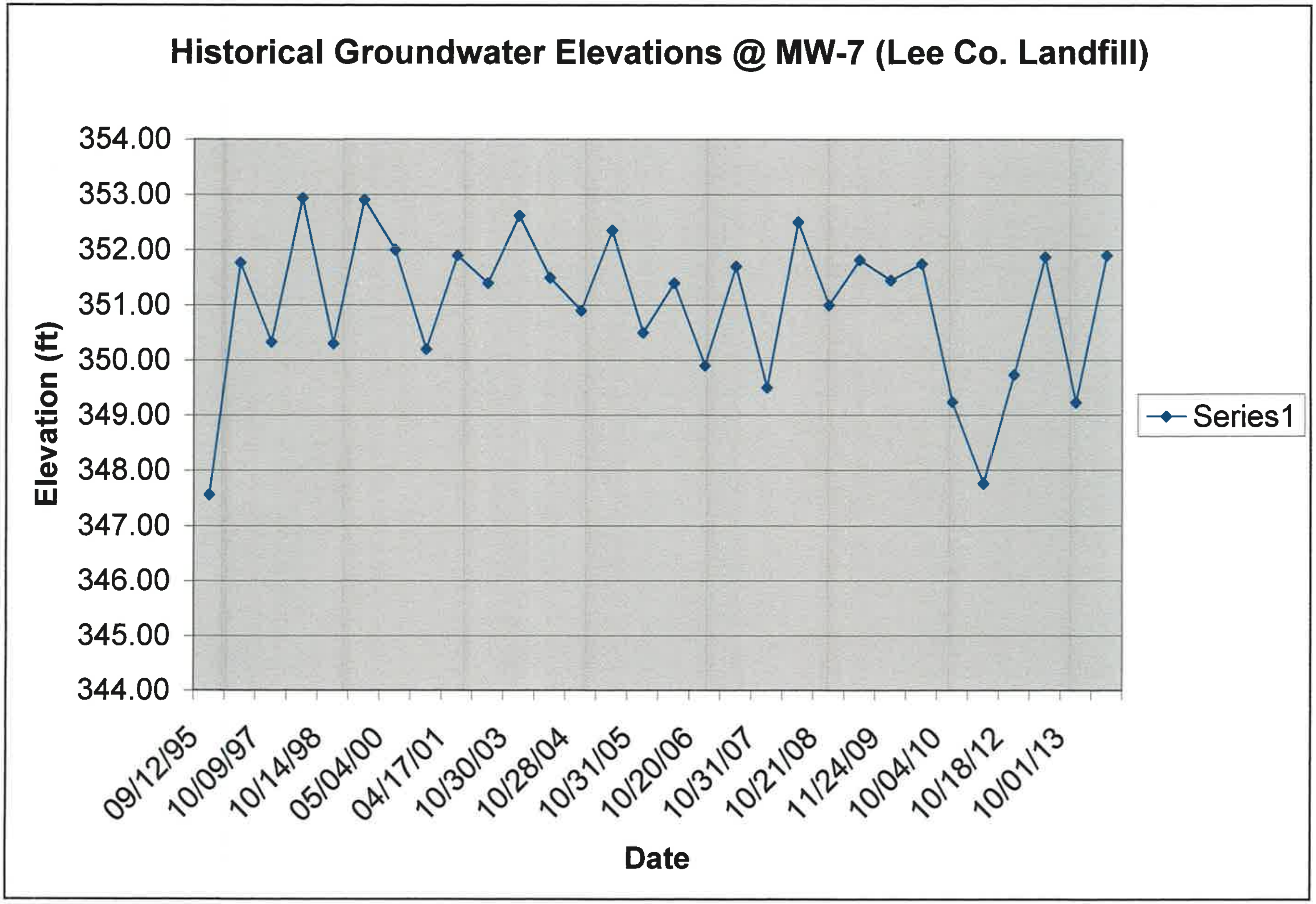
light stipple* = a reasonable conservative "Estimated Long-Term Groundwater High" correction factor for the Colon Mine site was determined by subtracting historical groundwater high elevations from groundwater elevations on 10/1/2013, and then calculating the geometric mean of the 10 differences.

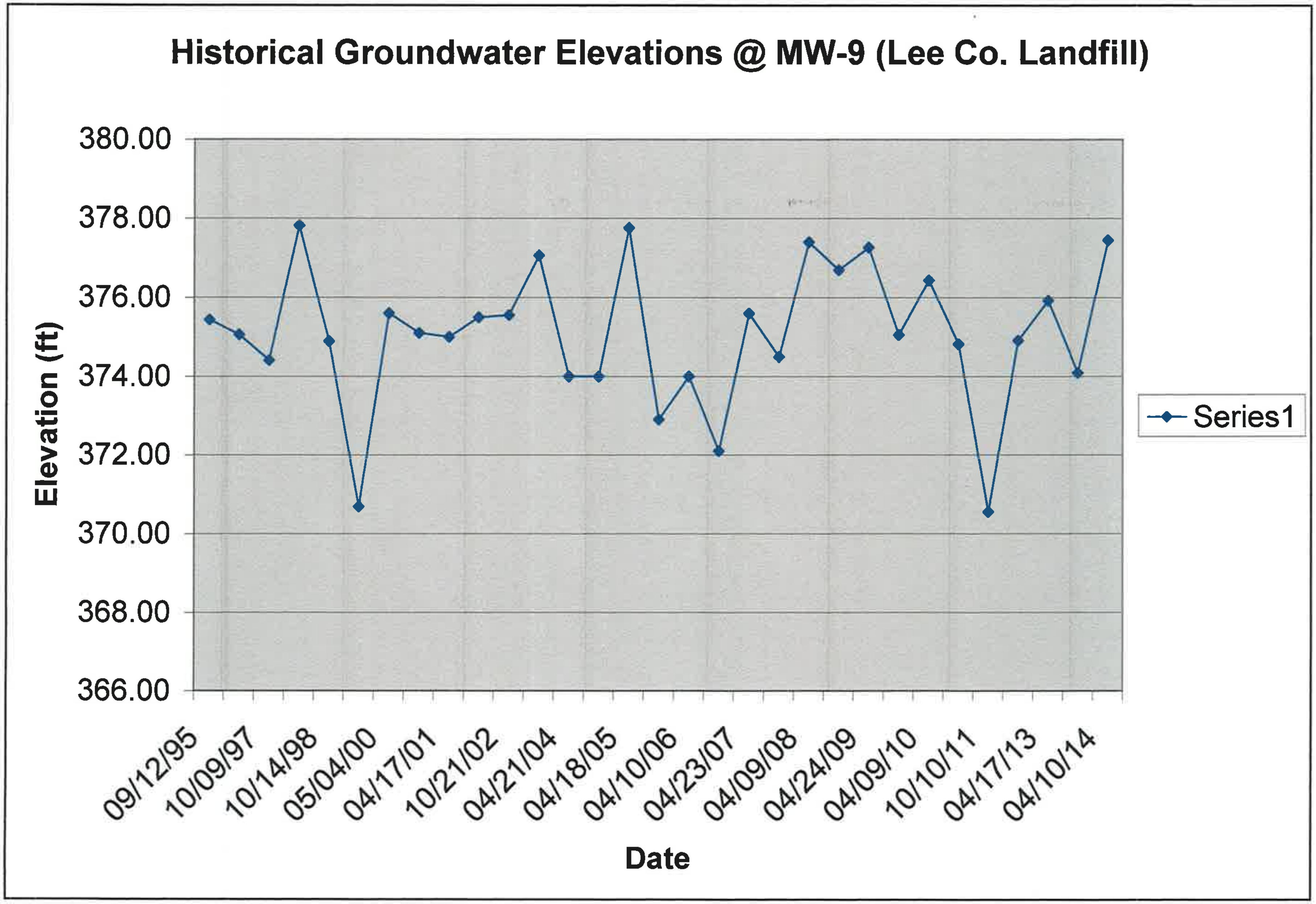
"--" = no data

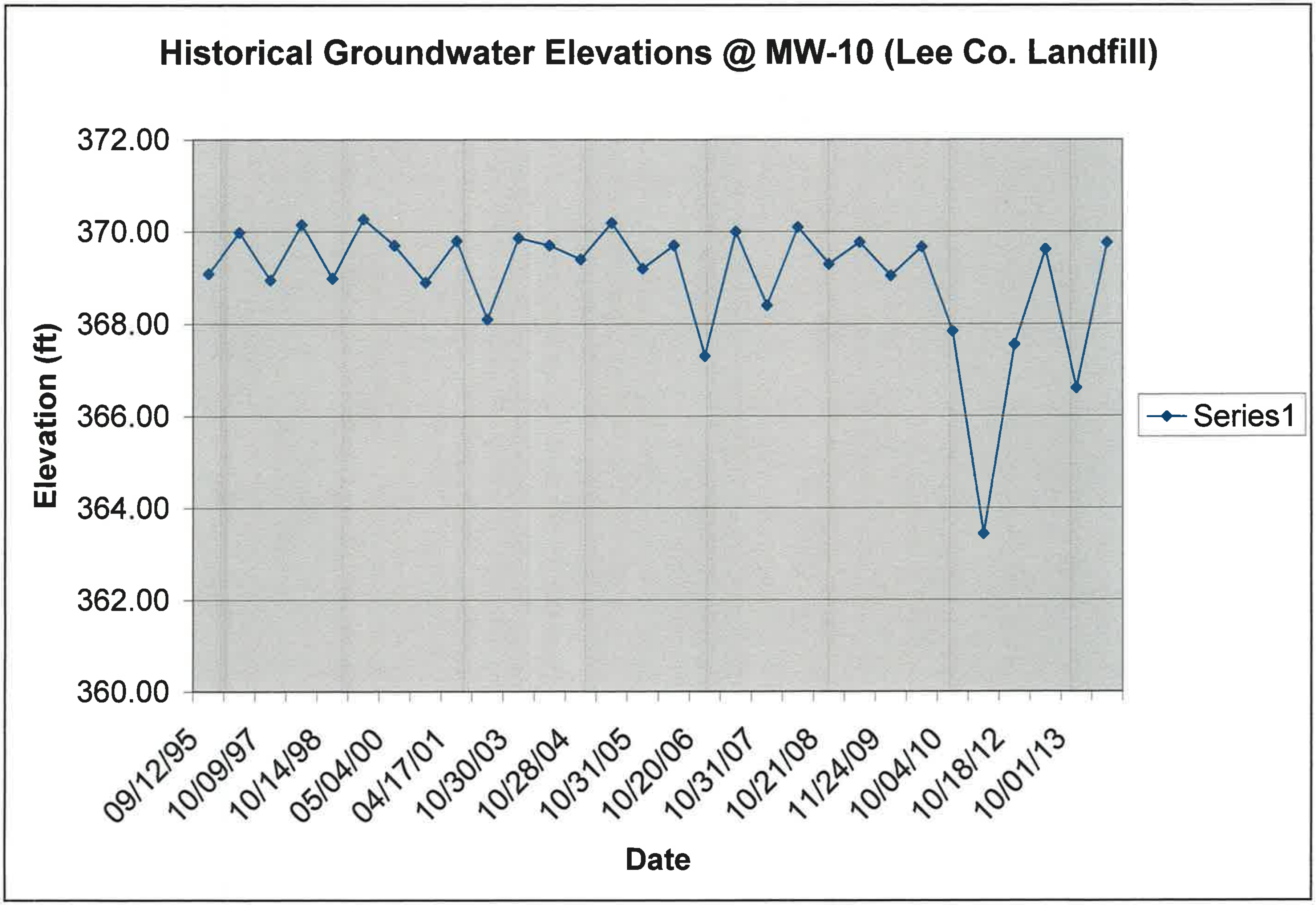

Historical Groundwater Elevations @ MW-4 (Lee Co. Landfill)
Elevation (ft)
340.00
338.00
336.00
334.00
332.00
330.00
328.00
326.00
324.00
322.00
320.00
10/09/97
10/14/98
05/04/00
04/17/01
10/30/03
10/28/04
10/31/05
10/20/06
10/31/07
10/21/08
11/24/09
10/04/10
10/18/12
10/01/13
Date
Series1

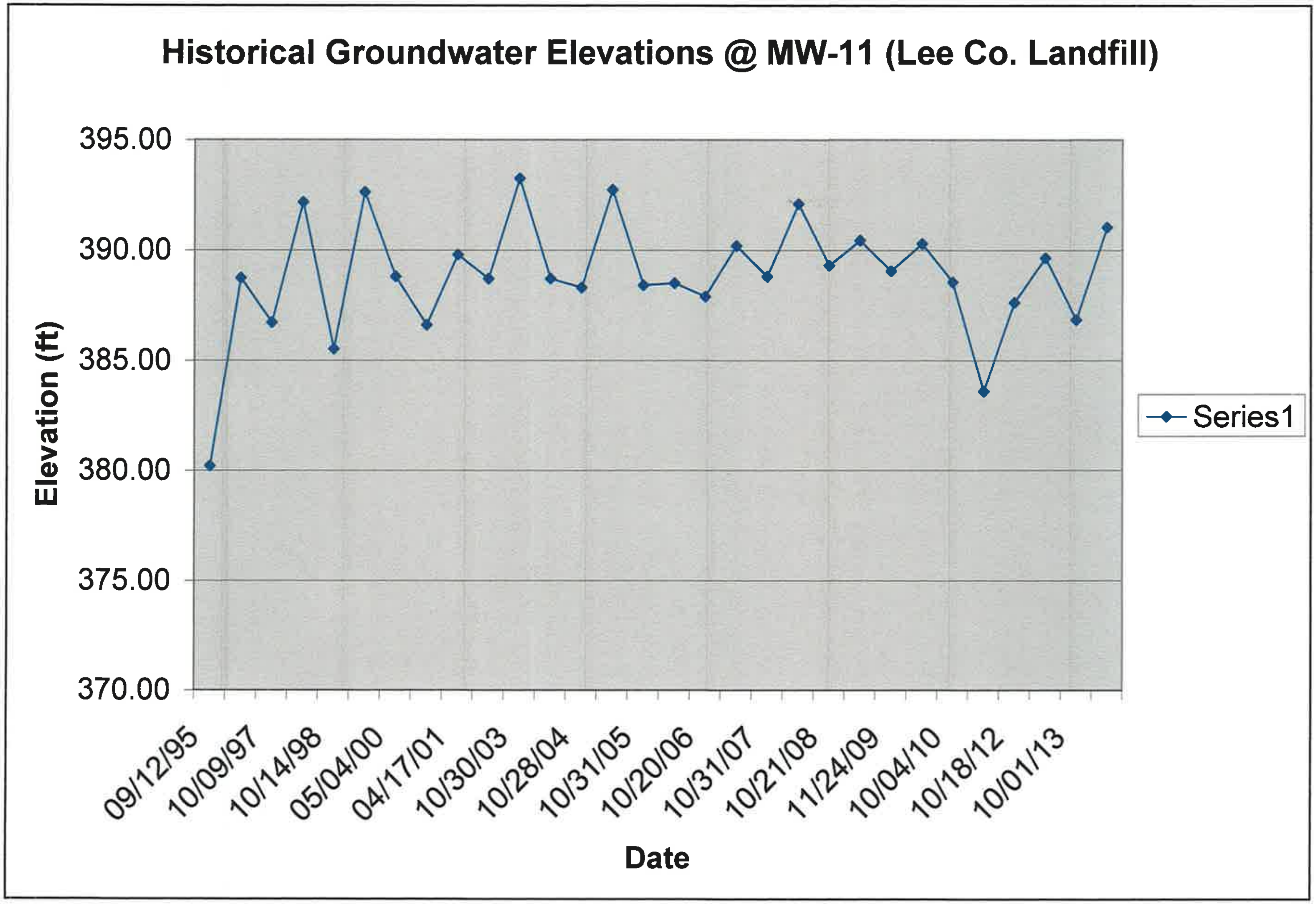

Historical Groundwater Elevations @ MW-5 (Lee Co. Landfill)
346.00
345.00
344.00
343.00
342.00
341.00
340.00
339.00
Elevation (ft)
10/09/97
10/14/98
05/04/00
04/17/01
10/21/02
04/21/04
04/18/05
04/10/06
04/23/07
04/09/08
11/24/09
10/04/10
10/18/12
10/01/13
Date
Series1

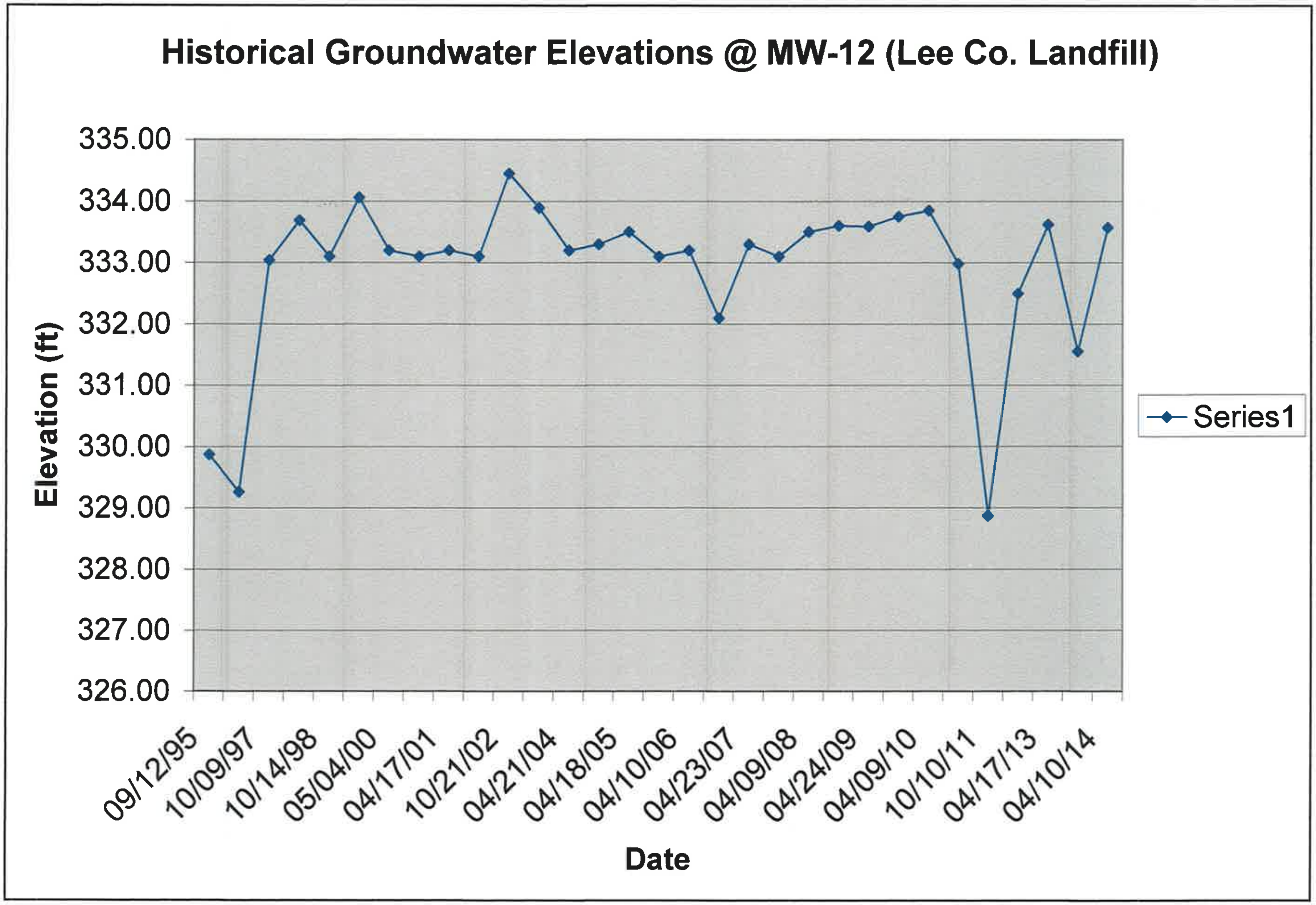

Historical Groundwater Elevations @ MW-6 (Lee Co. Landfill)
Elevation (ft)
396.00
395.00
394.00
393.00
392.00
391.00
390.00
389.00
388.00
10/09/97
10/14/98
05/04/00
04/17/01
10/21/02
04/21/04
04/18/05
04/10/06
10/31/07
10/21/08
11/24/09
10/04/10
10/18/12
10/01/13
Date
Series1

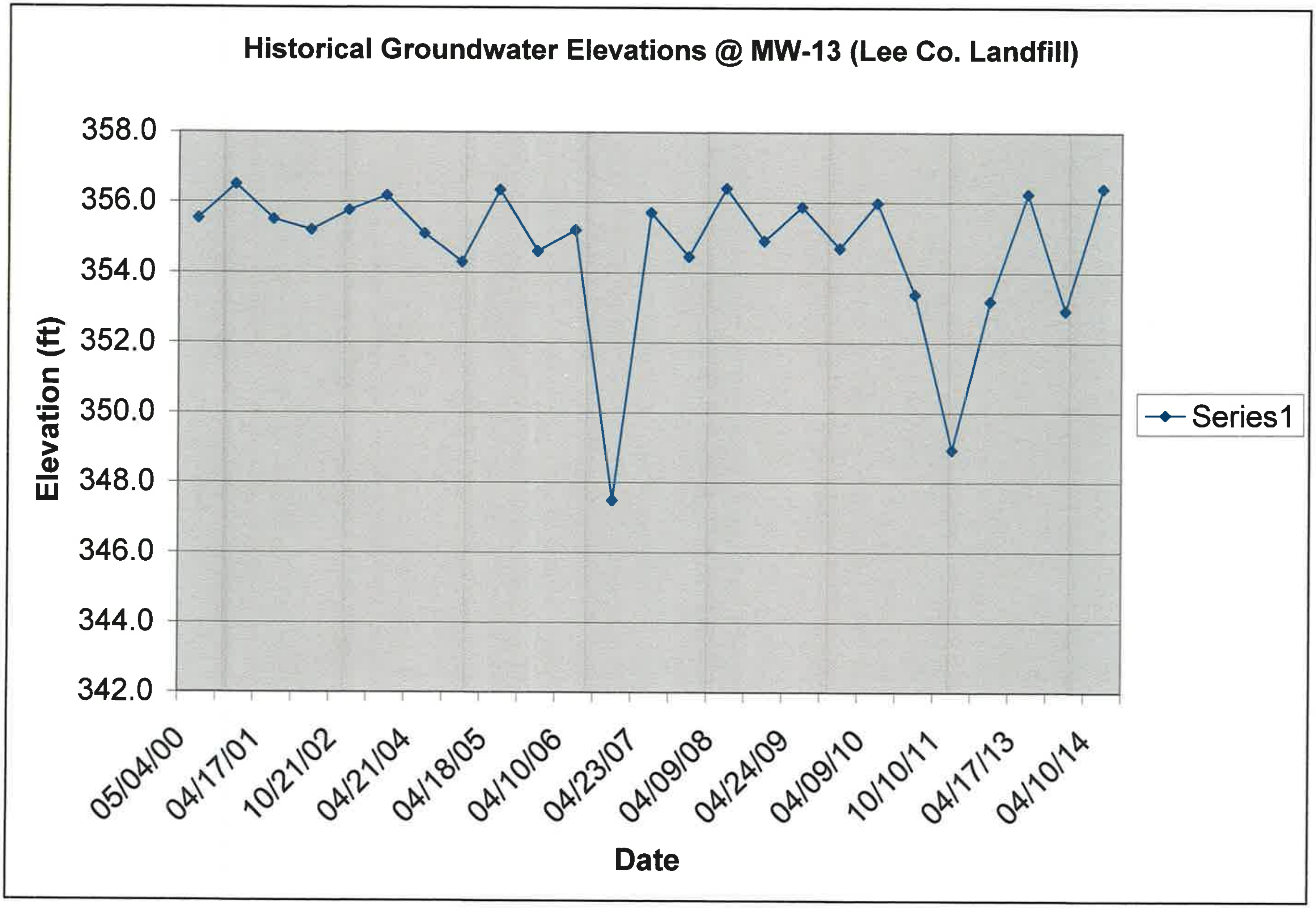

Historical Groundwater Elevations @ MW-7 (Lee Co. Landfill)
Elevation (ft)
354.00
353.00
352.00
351.00
350.00
349.00
348.00
347.00
346.00
345.00
344.00
09/12/95
10/09/97
10/14/98
05/04/00
04/17/01
10/30/03
10/28/04
10/31/05
10/20/06
10/31/07
10/21/08
11/24/09
10/04/10
10/18/12
10/01/13
Date
Series1


Historical Groundwater Elevations @ MW-9 (Lee Co. Landfill)
Elevation (ft)
380.00
378.00
376.00
374.00
372.00
370.00
368.00
366.00
09/12/95
10/09/97
10/14/98
05/04/00
04/17/01
10/21/02
04/21/04
04/18/05
04/10/06
04/23/07
04/09/08
04/24/09
04/09/10
10/10/11
04/17/13
04/10/14
Date
Series1

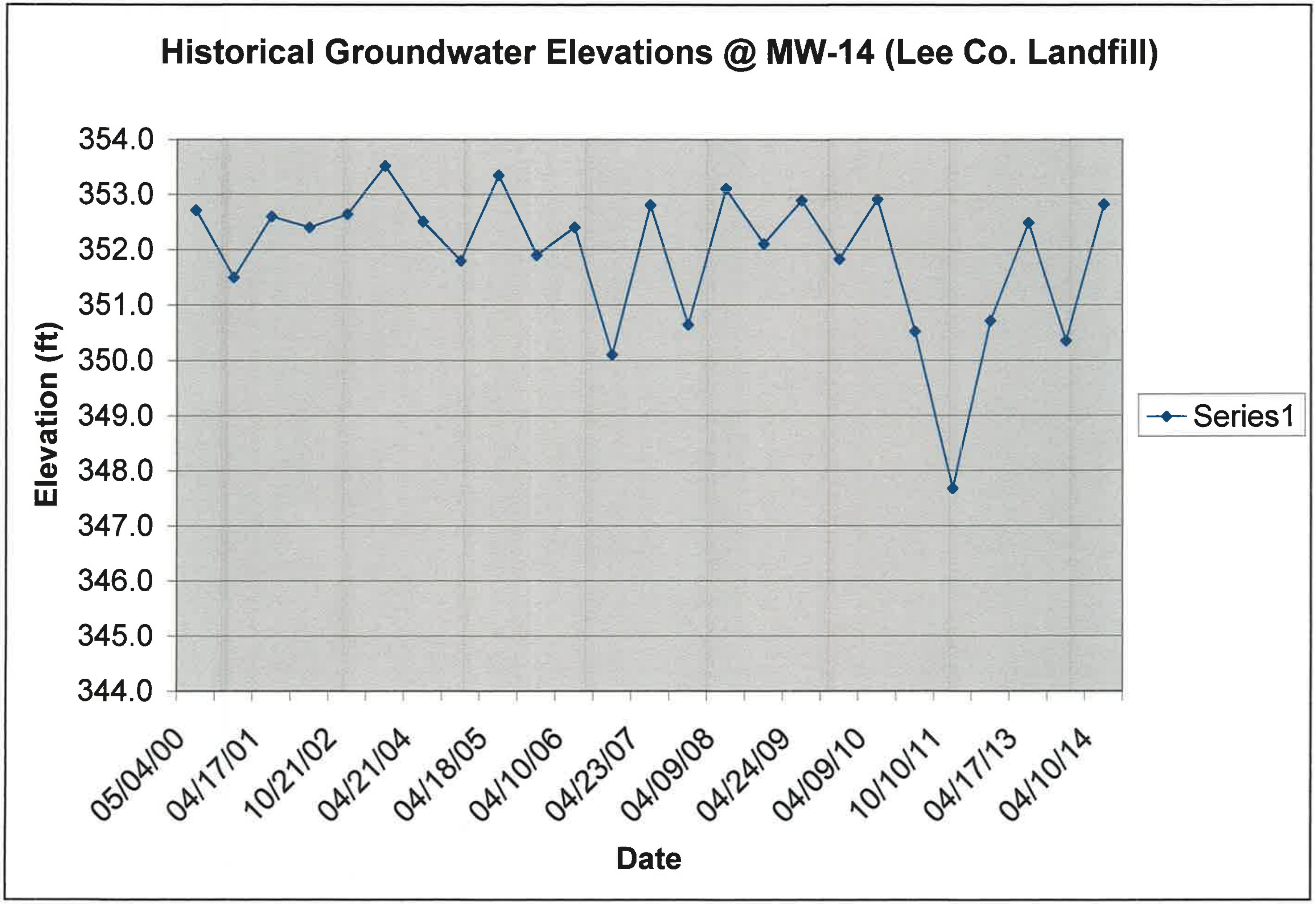

Historical Groundwater Elevations @ MW-10 (Lee Co. Landfill)
Elevation (ft)
372.00
370.00
368.00
366.00
364.00
362.00
360.00
09/12/95
10/09/97
10/14/98
05/04/00
04/17/01
10/30/03
10/28/04
10/31/05
10/20/06
10/31/07
10/21/08
11/24/09
10/04/10
10/18/12
10/01/13
Date
Series1


Historical Groundwater Elevations @ MW-11 (Lee Co. Landfill)
395.00
390.00
385.00
380.00
375.00
370.00
Elevation (ft)
09/12/95
10/09/97
10/14/98
05/04/00
04/17/01
10/30/03
10/28/04
10/31/05
10/20/06
10/31/07
10/21/08
11/24/09
10/04/10
10/18/12
10/01/13
Date
Series1


Historical Groundwater Elevations @ MW-12 (Lee Co. Landfill)
Elevation (ft)
335.00
334.00
333.00
332.00
331.00
330.00
329.00
328.00
327.00
326.00
09/12/95
10/09/97
10/14/98
05/04/00
04/17/01
10/21/02
04/21/04
04/18/05
04/10/06
04/23/07
04/09/08
04/24/09
04/09/10
10/10/11
04/17/13
04/10/14
Date
Series1



Historical Groundwater Elevations @ MW-13 (Lee Co. Landfill)
Elevation (ft)
358.0
356.0
354.0
352.0
350.0
348.0
346.0
344.0
342.0
05/04/00
04/17/01
10/21/02
04/21/04
04/18/05
04/10/06
04/23/07
04/09/08
04/24/09
04/09/10
10/10/11
04/17/13
04/10/14
Date
Series1



Historical Groundwater Elevations @ MW-14 (Lee Co. Landfill)
354.0
353.0
352.0
351.0
350.0
349.0
348.0
347.0
346.0
345.0
344.0
Elevation (ft)
05/04/00
04/17/01
10/21/02
04/21/04
04/18/05
04/10/06
04/23/07
04/09/08
04/24/09
04/09/10
10/10/11
04/17/13
04/10/14
Date
Series1

TABLE 1
Groundwater Elevations - April 2014
Lee County Landfill, (#53-01)
Sanford, NC

MONITORING LOCATION	DATE	MEASURING POINT ELEVATION[1] (feet AMSL)	DEPTH TO WATER (feet TOC)	WATER ELEVATION (feet AMSL)
MW-4	04/10/14	345.90	8.95	336.95
MW-5	04/10/14	351.10	6.34	344.76
MW-6	04/10/14	402.10	8.75	393.35
MW-7	04/10/14	360.30	8.4	351.90
MW-9	04/10/14	384.20	6.75	377.45
MW-10	04/10/14	377.00	7.24	369.76
MW-11	04/10/14	399.60	8.56	391.04
MW-12	04/10/14	337.40	3.83	333.57
MW-13	04/10/14	363.93	7.53	356.40
MW-14	04/10/14	358.61	5.79	352.82

NOTES:

[1] Measuring point elevations obtained from First Semi-Annual Groundwater Monitoring Report 2013, East Coast Environmental, P.A., May 9, 2013

AMSL - Above Mean Sea Level

TOC - Top of PVC Casing

TABLE 1
Groundwater Elevations - October 2013
Lee County Landfill, (#53-01)
Sanford, NC

MONITORING LOCATION	DATE	MEASURING POINT ELEVATION[1] (feet AMSL)	DEPTH TO WATER (feet TOC)	WATER ELEVATION (feet AMSL)
MW-4	10/10/13	345.90	15.58	330.32
MW-5	10/10/13	351.10	6.86	344.24
MW-6	10/10/13	402.10	9.62	392.48
MW-7	10/10/13	360.30	11.07	349.23
MW-9	10/10/13	384.20	10.11	374.09
MW-10	10/10/13	377.00	10.40	366.6
MW-11	10/10/13	399.60	12.77	386.83
MW-12	10/10/13	337.40	5.85	331.55
MW-13	10/10/13	363.93	11.01	352.92
MW-14	10/10/13	358.61	8.26	350.35

NOTES:
[1] Measuring point elevations obtained from First Semi-Annual Groundwater Monitoring Report 2013, East Coast Environmental, P.A., May 9, 2013
AMSL - Above Mean Sea Level
TOC - Top of PVC Casing

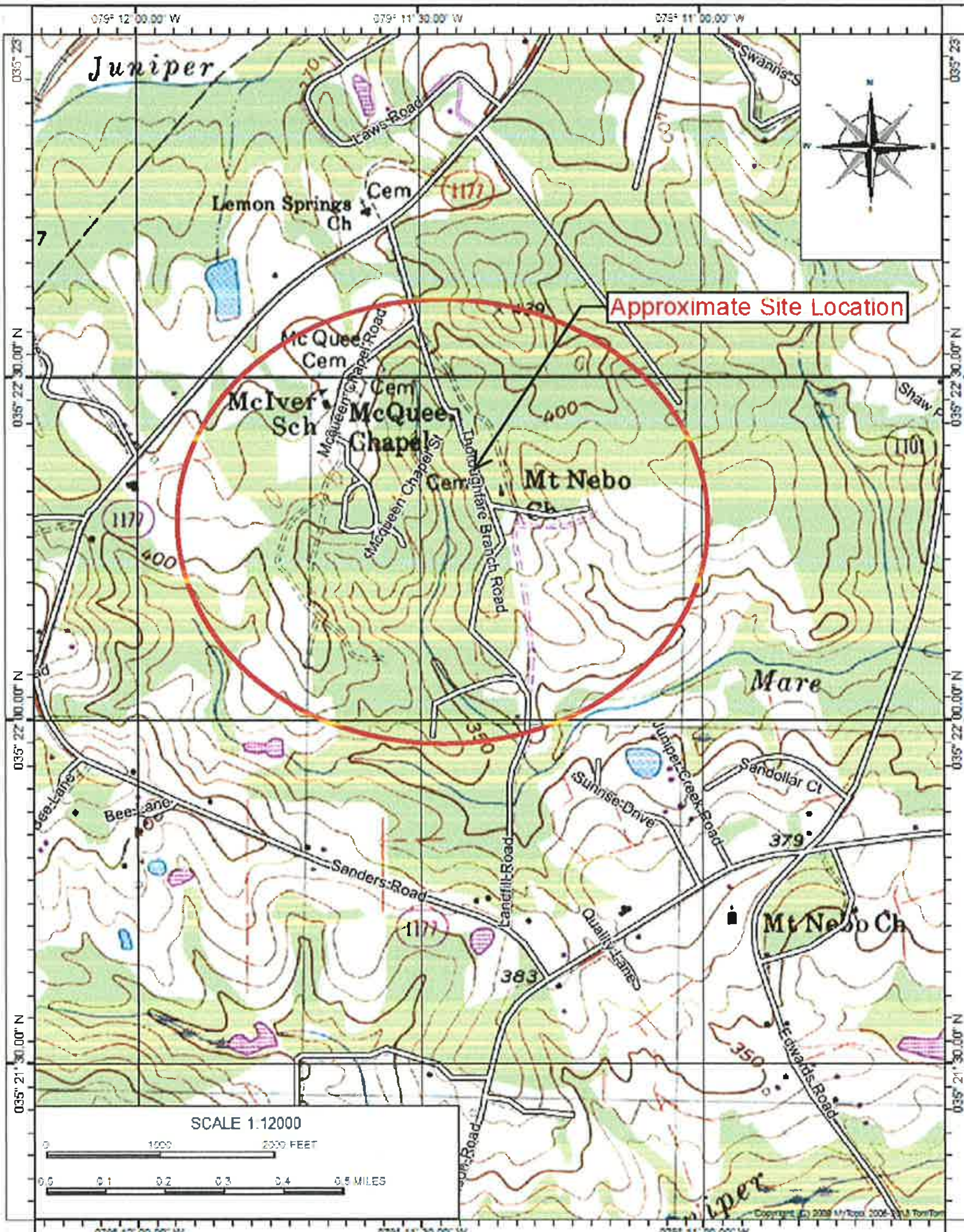
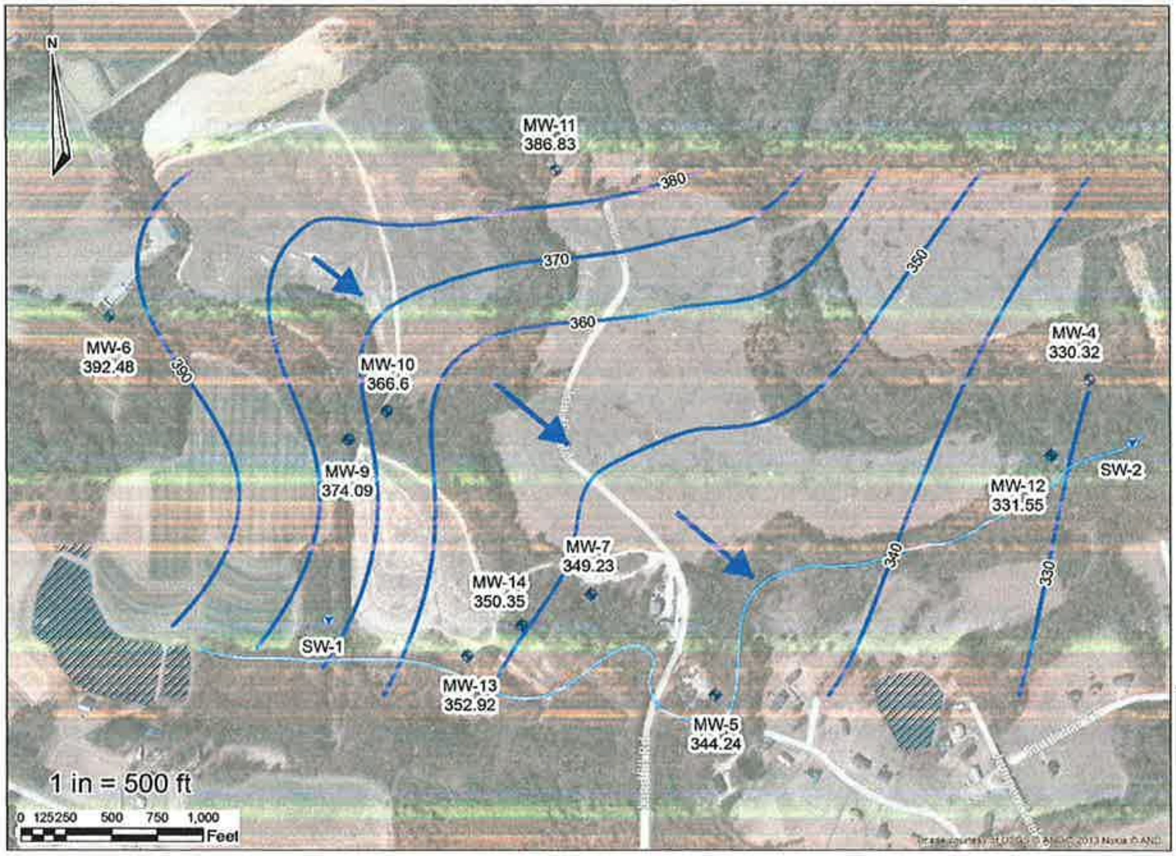


FIGURE 1
SITE LOCATION MAP
Lee County Landfill
331 Landfill Road
Sanford, NC
HRP #: LEE7000.GW

COMPILED: October 29, 2013

HRP Associates, Inc.
Environmental/Civil Engineering and Hydrogeology
Creating the Right Solutions Together
CT – NY – MA – SC – FL – TX
1327 Miller Road, Suite D
Greenville, SC 29607
Ph: (864) 289-0311 Fax: (864) 281-9846
http://www.hrpassociates.com



Legend

- Surface Water Sample
- Monitoring Wells
- Mare Branch Creek
- Groundwater Contours
- GW Flow Direction
- Pond

- Surface water sample and monitoring well locations are approximate and based on 2008 Site Layout Map.

Figure 2
Groundwater Elevation Map
October 2013
Lee County Landfill
Sanford, NC
HRP # LEE7000.GW

HRP Associates, Inc.
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Offices in CT, SC, NY, FL, MA, TX and PA
1327 Miller Road, Suite D
Greenville, SC 29607
Ph:(864)289-0311 Fax:(864)281-9846
www.hrpassociates.com

East Coast Environmental, P.A.
3815 Junction Boulevard Raleigh, NC 27603
(919) 772-0268 F (919) 772-0468

May 9, 2013

Ms. Jaclynne Drummond
Compliance Hydrogeologist
NC Department of Environment and Natural Resources Division of Waste Management - Solid Waste Section 1646 Mail Service Center
Raleigh, North Carolina 27699-1646

RE: First Semi-annual Groundwater Monitoring Report of 2013 Lee County Landfill, Permit No. 53-01
Lee County, North Carolina

Dear Ms. Drummond:

On behalf of Lee County, East Coast Environmental, P.A. (ECE) is submitting the enclosed *First Semiannual Groundwater Monitoring Report of 2013* in electronic format. This completes the first semiannual compliance monitoring event of 2013 for the closed Lee County Landfill, Permit No. 53-01, as required by the North Carolina Division of Waste Management, Solid Waste Section. Please contact me at (919) 772-0268 if you have any questions regarding this submittal.

Sincerely,

Thomas R. Will

Thomas R. Will, North Carolina Licensed Geologist 1164
Project Manager
East Coast Environmental, P.A.

Enclosures

C: Joseph Cherry - Lee County, Solid Waste Superintendent

DENR USE ONLY: ☐Paper Report ☐Electronic Data - Email CD (data loaded: Yes / No) Doc/Event #:

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

- **Prepare one form for each individually monitored unit**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.)
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

East Coast Environmental, P.A.

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: Thomas Will Phone: (919) 772-0268

E-mail: ecoaste@bellsouth.net

Facility name	Facility Address	Facility Permit #	NC Landfill Rule (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)
Lee County Landfill	330 Landfill Road	53-01	0.0500	April 17, 2013

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☒ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Type of data submitted: (Check all that apply)

☒ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☒ Surface water monitoring data
☐ Methane gas monitoring data
☐ Corrective action data (specify)
☐ Other(specify)

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.
☒ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Thomas Will | Project Manager | (919) 772-0268
Facility Representative Name (Print) | Title | (Area Code) Telephone Number

Affix NC Licensed/ Professional Geologist Seal

5-9-13
Signature | Date

5-9-13

3815 Junction Bouevard, Raleigh, NC 27603
Facility Representative Address

NC PE Firm License Number (if applicable effective May 1, 2009)

Revised 6/2009

East Coast Environmental, P.A.
3815 Junction Boulevard Raleigh, NC 27603
(919) 772-0268 F (919) 772-0468

FIRST SEMI-ANNUAL GROUNDWATER MONITORING REPORT OF 2013

PREPARED FOR:
LEE COUNTY GENERAL SERVICES
805 S. FIFTH STREET SANFORD, NORTH CAROLINA 27330
LEE COUNTY LANDFILL PERMIT No. 53-01

Prepared by:

East Coast Environmental, P.A.
3815 Junction Boulevard
Raleigh, North Carolina
(919) 772-0268

First Semiannual Groundwater Monitoring Report of 2013
Lee County Landfill
Lee County, North Carolina

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1.0 INTRODUCTION

1.1 Site Information

The Lee County Landfill is a closed, unlined municipal solid waste (MSW) and construction & demolition (C&D) landfill located on approximately 254.6 acres in Lee County, NC, approximately 6.5 miles south of Sanford. The six MSW and one C&D waste disposal areas comprise approximately 100.8 acres. The property boundary is indicated on an excerpt from the 7.5 minutes USGS topographic map for Muchison & Sanford, North Carolina (Figure 1). The MSW portion of the facility ceased accepting waste prior to October 9, 1993, and a letter of closure was issued on December 20, 1996. The C&D portion of the facility was issued a Permit to Operate on July 25, 1995 and ceased accepting waste June 30, 2008.

1.2 Site Geology and Hydrogeology

The Lee County Landfill is located near the edge of the Coastal Plain Physiographic Province. The facility is underlain by the Middendorf Fonnation consisting of sand, sandstone, and mudstone. The Middendorf Formation is underlain by metavolcanic rocks of the Eastern Slate Belt. The uppermost aquifer is unconfined. The groundwater level measurements taken in April 2013 were used to construct the potentiometric surface contours shown in Figure 2. Historical static water levels are provided in Table 1. Groundwater flow at the site is generally to the southeast.

1.3 Regulatory Status

The Lee County Landfill is currently monitoring groundwater in accordance with criteria set forth in Rule .0500 of the North Carolina Solid Waste Management Rules (NCSWMR) for MSW landfills closed prior to October 9, 1993 and C&D landfills closed prior to July 1, 2008.

2.0 FACILITY MONITORING PROGRAM

2.1 Groundwater Monitoring Program

The current groundwater compliance monitoring network includes 6 monitoring wells. In addition, there are 4 monitoring wells used only for water level measurements. These wells are summarized below, along with their current monitoring program status. The locations of the monitoring wells are shown on Figure 2.

Groundwater samples are collected semiannually in April and October. Samples are analyzed for RCRA metals and the NC Appendix I list of volatile organic constituents during the first and second semiannual events.

Monitoring Well	Classification	.Monitoring Program	Total Depth From TOC (ft)
MW-4	Observation	Water Levels Only	10.45
MW-5	Compliance	Detection (.0500)	6.30
MW-6	Compliance	Detection (.0500)	9.55
MW-7	Observation	Water Levels Only	8.43
MW-9	Compliance	Detection (.0500)	8.28
MW-10	Compliance	Detection (.0500)	7.39
MW-11	Observation	Water Levels Only	9.95
MW-12	Compliance	Detection (.0500)	3.78
MW-13	Observation	Water Levels Only	7.69
MW-14	Compliance	Detection (.0500)	6.13

*TOC = Top of casing.

2.2 Surface Water Monitoring Program

Surface water at the Lee County Landfill is monitored semiannually in conjunction with the groundwater sampling events. Samples are collected from one surface water monitoring point (SW-2). Samples are not collected from SW-l. The location of the surface water monitoring point is shown on Figure 2.

Surface water samples will be collected and analyzed for RCRA metals and the NC Appendix I list of volatile organic constituents during both semiannual monitoring events. These surface water monitoring point are summarized below, along with their current monitoring program status.

Surface Point	Classification	Monitoring Program
SW-1	Not Monitored	Surface Water
SW-2	Compliance	Surface Water

3.0 FIELD WORK AND LABORATORY ANALYSIS

In order to detect potential releases of leachate and/or landfill gas migration in a timely manner, a visual inspection program has been implemented at the Lee County Landfill. This inspection program involves field personnel making the following observations:

- Observation of stress induced on the biological community (e.g., dead or dying vegetation),
- Indications of leachate impact (e.g., seeps, impacted surface water),
- Observations of erosion; and
- Negative changes around the waste facility.

On April 17, 2013 ECE personnel visited the facility to purge and sample the facility's monitoring wells MW-5, MW-6, MW-9, MW-10, MW-12, and MW-14. Prior to purging, the depth to static water level was measured for all monitoring wells with an electronic water level indicator, accurate to 0.01 foot. MW-4, MW-7, MW-11, and MW-13 were measured for static water levels only.

Monitoring wells were purged and sampled using disposable bailers. Measurements of temperature, pH, specific conductivity, and turbidity were recorded in the site specific log book prior to purging, after each purge volume, and during sampling. Prior to sampling, laboratory-supplied containers were prepared with the following information:

- Monitoring well number (completed by field personnel),
- Date and time of sample collection (completed by field personnel),
- Initials of sampling personnel (completed by field personnel),
- Project name and number (completed by the laboratory),
- Chemical preservative (completed by the laboratory); and
- Requested chemical analysis (completed by the laboratory).

Groundwater samples from each monitoring well were collected directly from the disposable bailers in the provided laboratory containers immediately after purging. Immediately after collection, the samples were placed in a laboratory provided cooler and chilled on ice.

Surface water samples are collected directly from stream flow, by lowering the prepared sample containers into the stream flow with the opening facing into the current flow. Care is taken not to overflow the sample containers (which could lead to preservative loss) and avoid sample induced turbidity. At the time of sampling, surface water is also measured for temperature, pH, specific conductivity, and turbidity. After sample collection, the samples are placed in a laboratory provided cooler and chilled on ice.

The April 2013 groundwater and surface water samples were submitted to Environmental Conservation Laboratories (ENCO) of Cary, North Carolina under chain-of-custody control for analysis. As presented earlier, the groundwater samples were analyzed for RCRA metals and the NC Appendix I list of volatile organic constituents. ECE requested a Level II data report for the final laboratory report. The samples were received by the laboratory on April 18, 2013 in good condition, properly preserved, and within analysis hold times.

In addition to samples collected for compliance monitoring at the Lee County Landfill, a Field Blank was collected by ECE personnel as part of the April 2013 sampling event. Also, a Trip Blank was prepared by the laboratory to accompany the volatile sampling containers during shipment to and from the laboratory. The April 2013 Field Blank was analyzed for RCRA metals and the NC Appendix I list of volatile organic constituents while the April 2013 Trip Blanks was analyzed for the NCSWMR Appendix I volatile organic constituent only.

4.0 DATA ANALYSIS AND COMPARISONS TO STANDARDS

Results from the April 2013 sampling event were received May 3, 2013 from ENCO and are attached. Analytical results from monitoring wells were compared directly to the NC 2L Groundwater Standards or Groundwater Protection Standards. Analytical results from the surface water monitoring point are also compared to the NC 2B Surface Water Standards. A summary of the April 2013 detected constituents can be found in Table 2.

5.0 CONCLUSIONS

Based on historical water quality data, constituents detected in groundwater and surface water samples collected during the April 2013 monitoring event are consistent with previous events. The Lee County Landfill will remain in Detection Monitoring and the next semiannual sampling event is scheduled for the October 2013.

6.0 REFERENCES

Brown, Philip M., Chief Geologist, 1985, *Geologic Map of North Carolina,* The North Carolina Geologic Survey, scale 1:500,000.

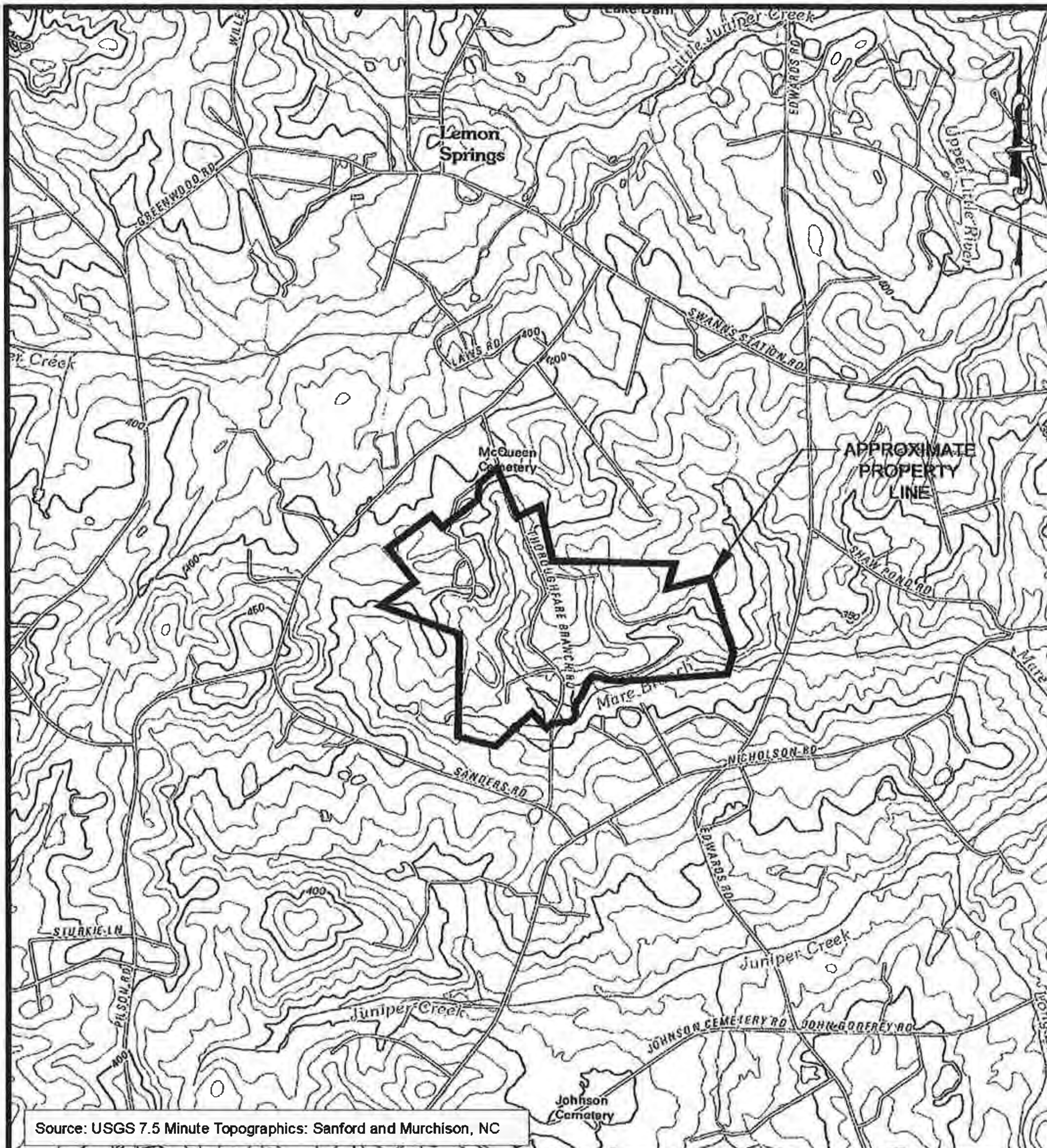
North Carolina Department of Environment and Natural Resources, 1990-2011, *Solid Waste Management Regulations.*

USEPA, 1986, *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (TEGD).

USEPA, 1992, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance,* Chapter 2, July.

Second Semiannual Groundwater Monitoring Report of 2011. January 2012. Prepared by Joyce Engineering

Figures



Source: USGS 7.5 Minute Topographics: Sanford and Murchison, NC

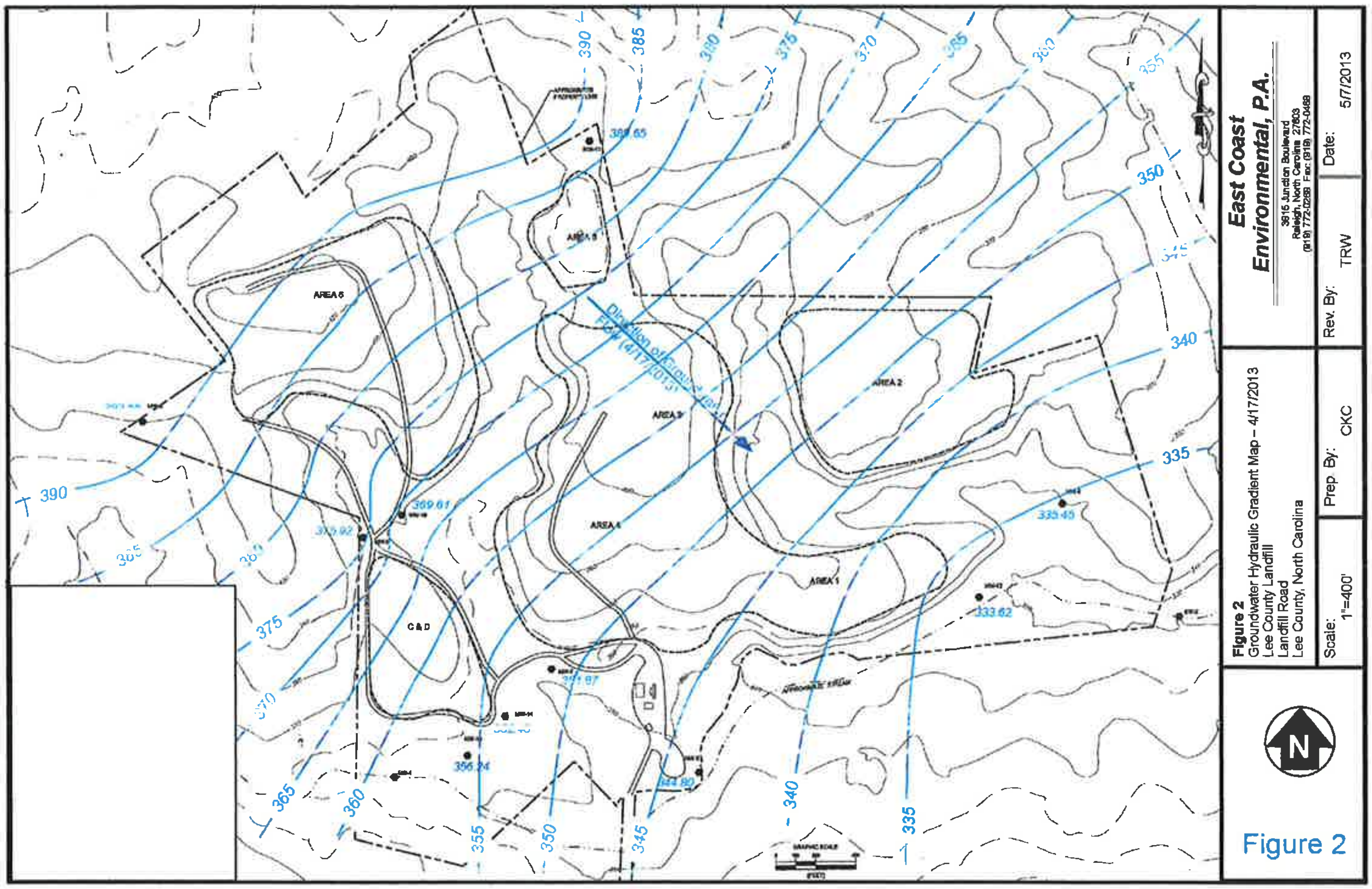
Figure 1
Site Location Map
Lee County Landfill
331 Landfill Road
Lee County, North Carolina

N

East Coast Environmental, P.A.

3815 Junction Boulevard
Raleigh, North Carolina 27603
(919) 772-0268 Fax: (919) 772-0468

Scale:	Prep. By:	Rev. By:	Date:
1"=2000'	CKC	TRW	11/12/2012


East Coast Environmental, P.A.
3816 Junction Boulevard
Raleigh, North Carolina 27603
Figure 2
Groundwater Hydraulic Gradient Map – 4/17/2013
Lee County Landfill
Landfill Road
Lee County, North Carolina
Scale:
1"=400'
Prep. By:
CKC
Rev. By:
TRW
Date:
5/7/2013
Figure 2
AREA 6
AREA 5
AREA 2
AREA 3
AREA 4
AREA 1
C&D
390
385
380
375
370
365
360
355
350
345
340
335
369.65
369.61
375.92
335.45
333.62
356.24
344.80

Tables

TABLE 1

SUMMARY OF GROUNDWATER ELEVATIONS

Location	MW-4	MW-5	MW-6	MW-7	MW-9	MW-1O	MW-l1	MW-12	MW-13	MW-14
TOC Elevation	345.90	351.10	402. 10	360.30	384.20	377.00	399.60	337.40	363.93	358.61
Well Depth	19.00	19.50	40.40	22.17	22.85	22.80	22.75	13.30	24.25	18.25
24-Apr-09	336.60	NM	393.46	351.82	377.27	369.77	390.44	333.59	355.87	352.89
24-Nov-09	335.10	344.85	393.15	351.45	375.05	369.05	389.05	333.75	354.69	351.83
09-Apr-10	337.10	344.90	392.68	351. 75	376.44	369.67	390.30	333.85	355.98	352.91
04-0ct-10	330.59	344.55	392.16	349.24	374.82	367.84	388.54	332.98	353.38	350.52
15-Apr-11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10-Oct-l1	DRY	341.64	391.18	347.76	370.56	363.44	383.59	328.87	348.94	347.68
18-Oct-12	331.62	344.35	392.48	349.73	374.91	367.55	387.62	332.50	353.19	350.71
17-Apr-13	335.45	344.80	392.55	351.87	375.92	369.61	389.65	333.62	356.24	352.48

Notes:
1. Water levels are measured from top of casing (TOC).
2. NM = Not monitored.
2. NA = Not available.
4. DRY = Monitoring well was dry

Division of Health Services

WELL COMPLETION RECORD

Note: This well is down gradient

COMPLETE ALL INFORMATION REQUESTED BELOW FOR EACH WELL INSTALLED, AND RETURN FORM TO THE N.C. DEPARTMENT OF HUMAN RESOURCES, SOLID AND HAZARDOUS WASTE MANAGEMENT BRANCH, P. O. BOX 2091, RALEIGH, N.C. 27602

NAME OF SITE: Lee County Public Works MW-4	PERMIT NO.: Landfill 53-01
ADDRESS: Po Box 89, Lemon Springs N.C. 28355	OWNER (print): Lee County
DRILLING CONTRACTOR: Benny J. Phillips, Geological Investigations, Inc.	REGISTRATION NO.: 1022

Casing Type: Sch 40 PVC dia. 2 in.
Casing Depth: from 0 to 8 ft. - dia. 2 in.
Screen Type: Sch 40 PVC .020 dia. 2 in.
Screen Depth: from 8 to 18 ft. - dia. 2 in.

Grout Depth: from 0 to 6 ft. - dia. 5 in.
Bentonite Seal: from 6 to 7 ft. - dia. 5 in.
Sand/~~Gravel~~ PK: from 7 to 19 ft. - dia. 5 in.
Total Well Depth: from 0 to 18 ft. - dia. 5 in.

Static Water Level: 9.2' feet from top of casing Date Measured 9/24/88

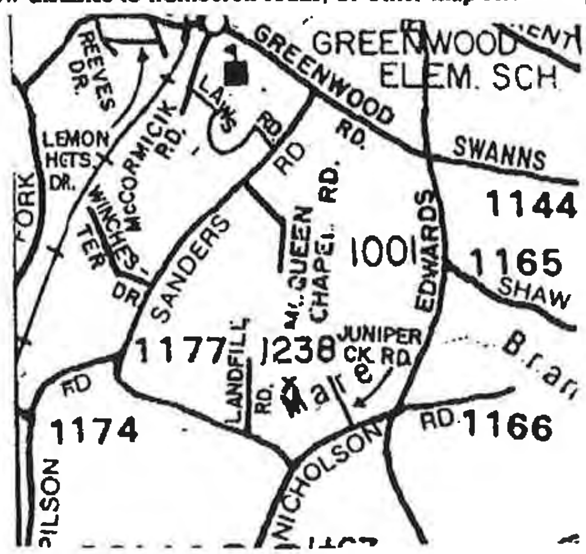
Yield (gpm): 1 Method of Testing: BAIL & measure Casing is 2 feet above land surface

DRILLING LOG

DEPTH FROM	TO	FORMATION DESCRIPTION
0	1/2	sandy TopsoiL
1/2	3	Light Tan Fine sand
3	7	orange-tan sandy clay
7	17	Light tan clayey silt, dry, metamorphic 15-17 Damp to moist
17	19	hard weathered rock, saprolite, wet
	19	refusal

LOCATION SKETCH

(show distance to numbered roads, or other map reference points)



REMARKS: Installed 21 Sept, water level : 9.4' From Top of casing
22 sept : 9.3'
24 sept : 9.2'

DATE: 27 Sept 88 SIGNATURE: Bobby B. Johnson, Dir Public Works

DHS 3342 (6/85)
Solid & Hazardous Waste Management Branch

N. C. Department of Human Resources
Division of Health Services

WELL COMPLETION RECORD

COMPLETE ALL INFORMATION REQUESTED BELOW FOR EACH WELL INSTALLED, AND RETURN FORM TO THE N.C DEPARTMENT OF HUMAN RESOURCES, SOLID AND HAZARDOUS WASTE MANAGEMENT BRANCH. P. O. BOX 2091, RALEIGH, N.C. 27602

NAME OF SITE: Lee County Public Works MW-5
PERMIT NO.: Landfill 53-01
ADDRESS: PO Box 89, Lemen Springs N.C. 28355
OWNER (print): Lee County
DRILLING CONTRACTOR: Benny J. Phillips, Geological Investigations, INC.
REGISTRATION NO.: 1022

Casing Type: Sch 40 PVC dia. 2 in.
Casing Depth: from 0 to 8 ft. - dia. 2 in.
Screen Type: Sch 40 PVC .020 dia. 2 in.
Screen Depth: from 8 to 18 ft. - dia. 2 in.

Grout Depth: from 0 to 5 ft. - dia. 5 in.
Bentonite Seal: from 5 to 7 ft. - dia. 5 in.
Sand/~~Gravel~~ PK: from 7 to 20 ft. - dia. 5 in.
Total Well Depth: from 0 to 20 ft. - dia. 5 in.

Static Water Level: 6.1 feet from top of casing
Date Measured 9/23/88
Yield (gpm): ~~[illegible]~~ .5 Method of Testing: BAIL & MEASURE Casing is 2 feet above land surface

DRILLING LOG

DEPTH FROM	TO	FORMATION DESCRIPTION
0	1/2	sandy topsoil
1/2	2 1/2	Tan fine to medium sand, damp
2 1/2	7	orange clayey medium sand, damp
7	8	Tan sandy clay, moist
8	17	gray sandy clay, wet
17	20	tan & gray sandy clay

LOCATION SKETCH
(show distance to numbered roads, or other map reference points)

REMARKS: Installed 20 Sept, water level: 8.7' from top of casing
21 Sept: 8.3'
23 Sept: 6.1'

DATE: 27 Sept 88 SIGNATURE: Bobby B. [illegible], Dir Public Works

DHS 3342 (6/85)
Solid & Hazardous Waste Management Branch

Fac/Perm/Co ID #	Date	Doc ID#
W	01, 03, 8	DIN

Division of Health Services

WELL COMPLETION RECORD

Note: This well is upgradient

COMPLETE ALL INFORMATION REQUESTED BELOW FOR EACH WELL INSTALLED, AND RETURN FORM TO THE N.C. DEPARTMENT OF HUMAN RESOURCES, SOLID AND HAZARDOUS WASTE MANAGEMENT BRANCH, P. O. BOX 2091, RALEIGH, N.C. 27602

NAME OF SITE: Lee County Public Works MW-6

PERMIT NO.: Landfill 53-01

ADDRESS: PO Box 89, Lemon Springs NC 28355

OWNER (print): Lee County

DRILLING CONTRACTOR: Benny J. Phillips, Geological Investigations, Inc.

REGISTRATION NO.: 1022

Casing Type: Sch 40 PVC dia. 2 in.
Casing Depth: from 0 to 28 ft. - dia. 2 in.
Screen Type: Sch 40 PVC, .020 dia. 2 in.
Screen Depth: from 28 to 38 ft. - dia. 2 in.

Grout Depth: from 0 to 26 ft. - dia. 5 in.
Bentonite Seal: from 26 to 27 ft. - dia. 5 in.
Sand/~~Gravel~~ PK: from 27 to 40 ft. - dia. 5 in.
Total Well Depth: from 0 to 40 ft. - dia. 5 in.

Static Water Level: 10.1 feet from top of casing

Date Measured 9 / 23 / 88

Yield (gpm): .05 Method of Testing: Bail & measure

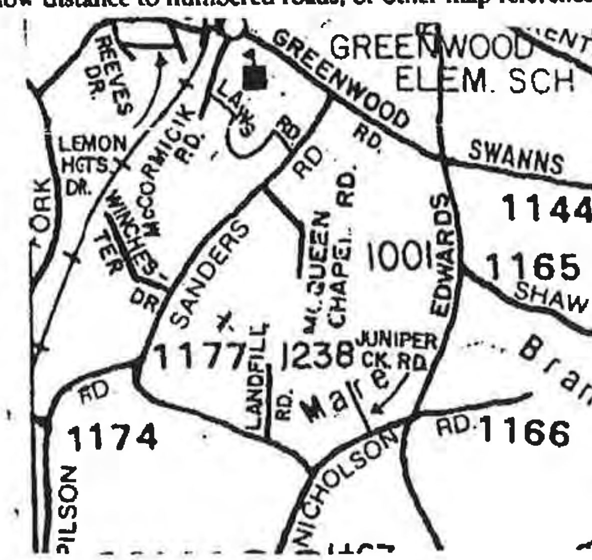
Casing is 2 feet above land surface

DRILLING LOG

DEPTH FROM	TO	FORMATION DESCRIPTION
0	½	clayey Topsoil
½	5	tan sandy clay
5	8	gray clay
8	9	red sandy clay, Damp
9	20	Tan sandy clay, Damp
20	40	Tan clayey sand
		20 - 30 moist
		30 - 40 wet

LOCATION SKETCH

(show distance to numbered roads, or other map reference points)

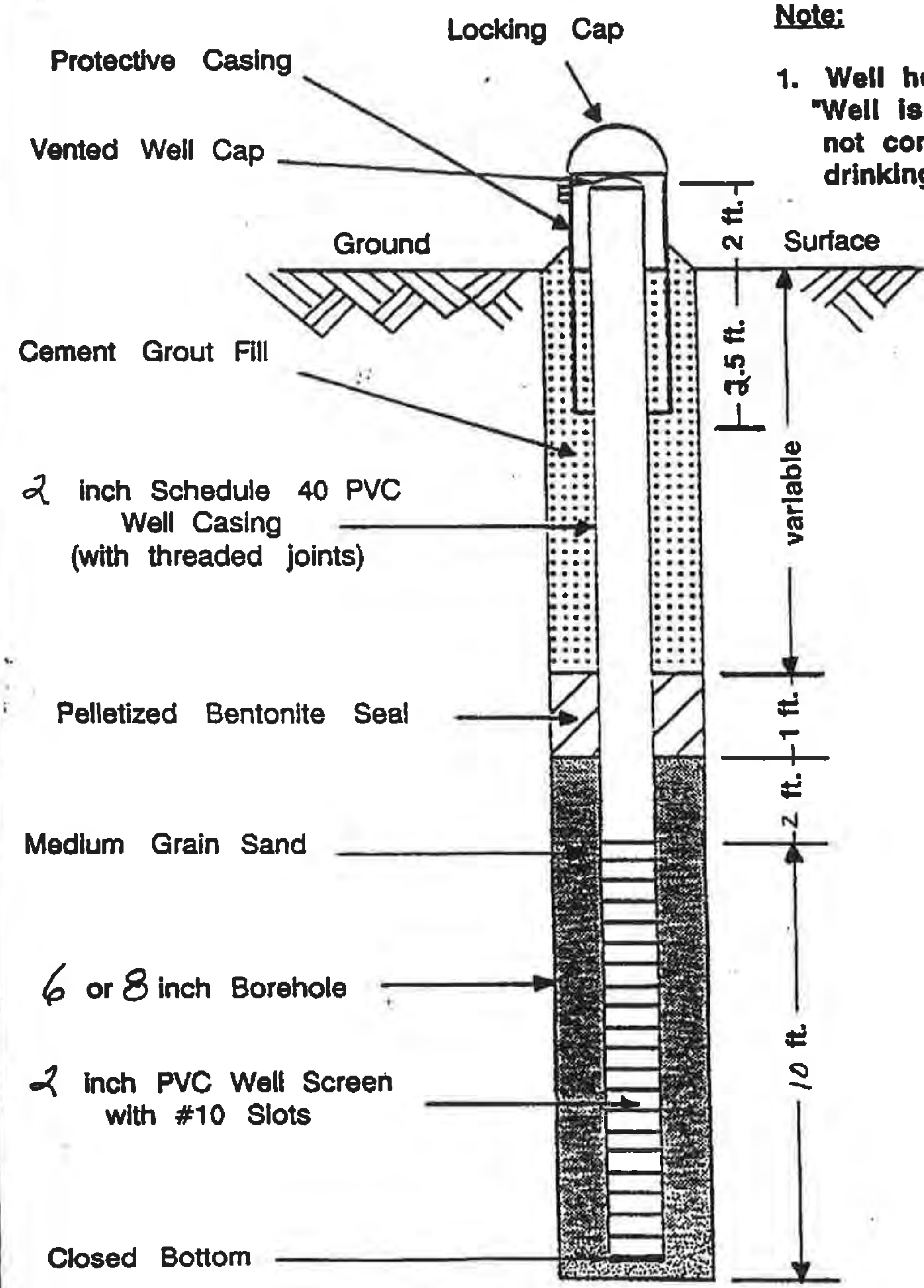


REMARKS: Installed 20 Sept, water level: 24.4' from top of casing
21 Sept: 11.4'
23 Sept: 10.1'

DATE: 27 Sept 88 SIGNATURE: Bobby B. Johnson, Dir Public Works

DHS 3342 (6/85)
Solid & Hazardous Waste Management Branch

MONITORING WELL CONSTRUCTION



Note:

1. Well head to be labeled: "Well is for monitoring and not considered safe for drinking."

PATTERSON EXPLORATION SERVICES

Well No. 7

MONITOR WELL CONSTRUCTION LOG

Protective Enclosure
- [ ] Curb Box
- [x] Guard Pipe

elev. 3.0 ft

elev. LAND SURFACE

8" inch diameter drilled hole

Well casing, 2 inch diameter, PVC

- [ ] Backfill
- [x] Grout cement

6.0 ft*

Bentonite
- [ ] slurry
- [x] pellets

8.0 ft*

10.0 ft*

Well Screen 2 inch diameter PVC, 10 slot

- [ ] Gravel Pack
- [x] Sand Pack
- [ ] Formation Collapse

20.0 ft*

20.0' ft*

*Depth below land surface.

Project Number 95SI-21 (95SI-25)

Project Name Sanford Landfill

Well No. 7 Boring No.

Town/City Sanford

County Lee State NC

Installation Date(s) 9/5 – 9/7

Drilling Contractor Special Inc.

Drilling Method 4¼" HSA.

Water Depth From Top of Riser NA ft. Date

Drilling Inspector Present

Notes: Drilled to 20.0' set well (No samples)

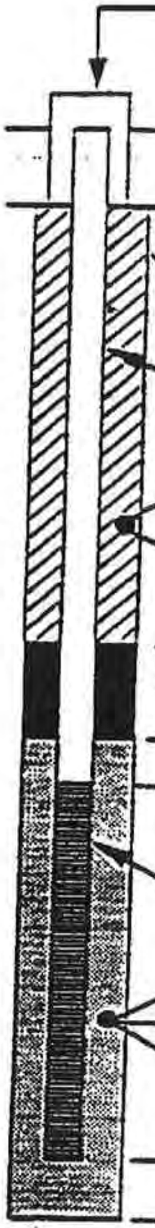
~~Ato~~

Difficult Drilling from 5.0 - 20.0'

file copy

Well No. 8

MONITOR WELL CONSTRUCTION LOG



Protective Enclosure
☐ Curb Box
☑ Guard Pipe

elev.

3.0 ft

elev. LAND SURFACE

8" inch diameter drilled hole

Well casing, 2 inch diameter, PVC

☐ Backfill
☑ Grout cement

6.0 ft*

Bentonite ☐ slurry ☑ pellets

8.0 ft*

10.0 ft*

Well Screen 2 inch diameter PVC, ____ slot

☐ Gravel Pack
☑ Sand Pack
☐ Formation Collapse

20.0 ft*

20.0 ft*

*Depth below land surface.

Project Number 95SI-2P (95SI-25)

Project Name Sanford Landfill

Well No. 8 Boring No. ____

Town/City Sanford

County Lee State NC.

Installation Date(s) 9/5-9/7

Drilling Contractor Special Inc.

Drilling Method 4 1/4" HSA.

Water Depth From Top of Riser N/A. ft. ____ Date

Drilling Inspector Present ____

Notes: Drilled to 20.0'
Set well (No samples)
Difficult Drilling from
5.0 - 20.0'

~~Joe Copy~~

Well No. 9

MONITOR WELL CONSTRUCTION LOG

Protective Enclosure
☐ Curb-Box
☑ Guard Pipe

elev.

3.0 ft

elev. LAND SURFACE

8" inch diameter drilled hole

Well casing, 2.0 inch diameter, PVC

☐ Backfill
☑ Grout cement

6.0 ft*

Bentonite ☐ slurry ☑ pellets

8.0 ft*

10.0 ft*

Well Screen
2.0 PVC inch diameter, 10 slot

☐ Gravel Pack
☑ Sand Pack
☐ Formation Collapse

20.0 ft*

20.0 ft*

*Depth below land surface.

Project Number 95SI-2P (95SI-25)

Project Name SANFORD LANDFILL

Well No. 9 Boring No.

Town/City SANFORD

County LEE State NC.

Installation Date(s) 9/5 - 9/7

Drilling Contractor Special Inc.

Drilling Method 4 1/4" HSA

Water Depth From Top of Riser NA ft. Date

Drilling Inspector Present

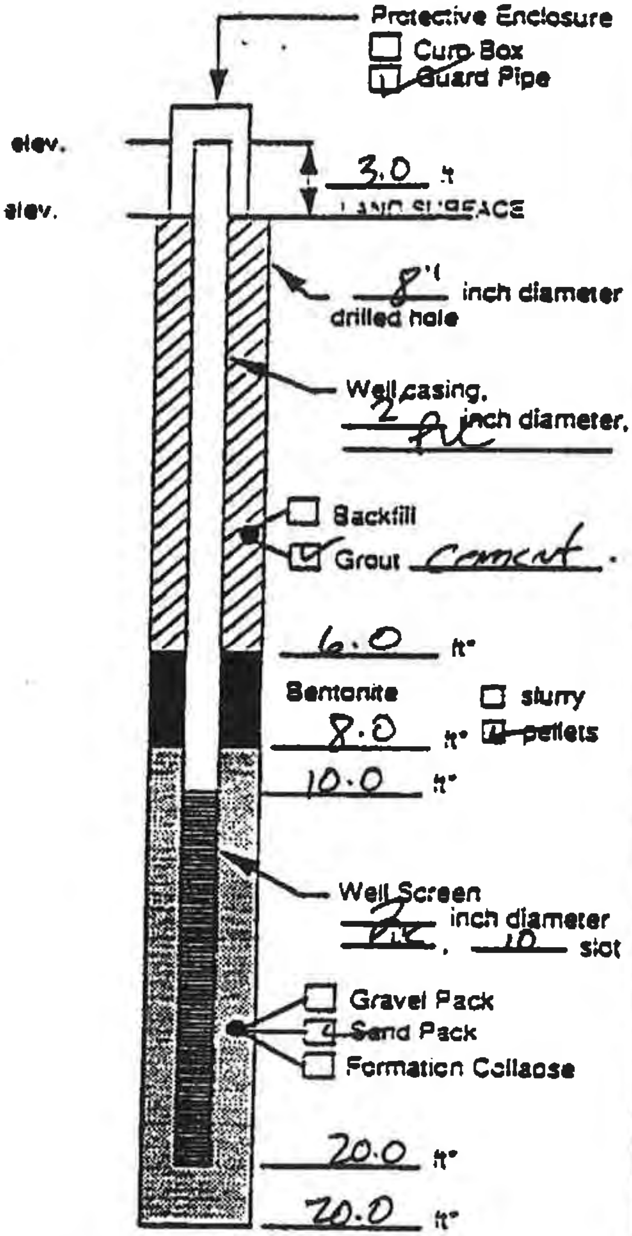
Notes: Drilled to 20.0'
Set well (no samples)
Difficult Drilling
From 5.0 - 20.0'

File Copy

Well No. 10

MONITOR WELL CONSTRUCTION LOG

(955I-2S



*Depth below land surface.

Project Number 955I-2P

Project Name Sanford Landfill

Well No. 10 Boring No.

Town/City Sanford

County Lee State NC.

Installation Date(s) 9/5-9/7

Drilling Contractor Special INC.

Drilling Method 4 1/4" HSA

Water Depth From Top of Riser NA. ft. Date

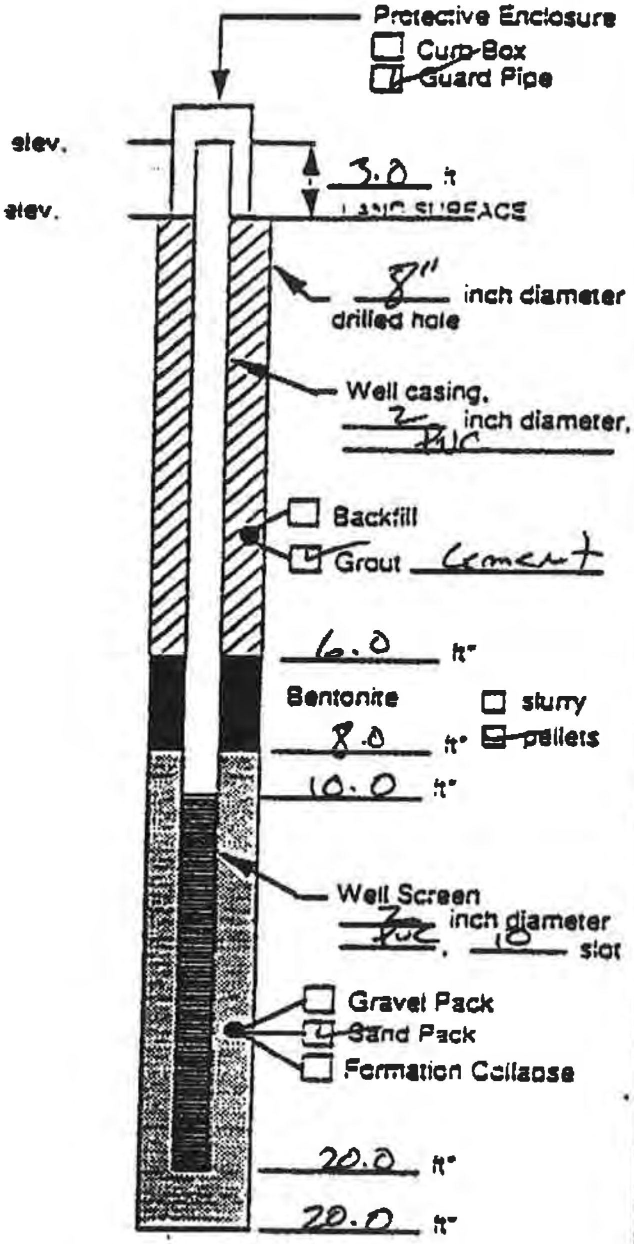
Drilling Inspector Present

Notes: Drilled to 20.0 set well from 20.0 to .0 (no samples) Difficult Drilling from 5.0 - 20.0

File Copy

Well No. 11

MONITOR WELL CONSTRUCTION LOG



*Depth below land surface.

Project Number 95SI-27 (95SI-25)

Project Name SANford

Well No. 11 Boring No. [illegible]

Town/City Sanford.

County Lee State NC.

Installation Date(s) 9/5-9/7

Drilling Contractor Special Inc.

Drilling Method 4 1/4" HSA

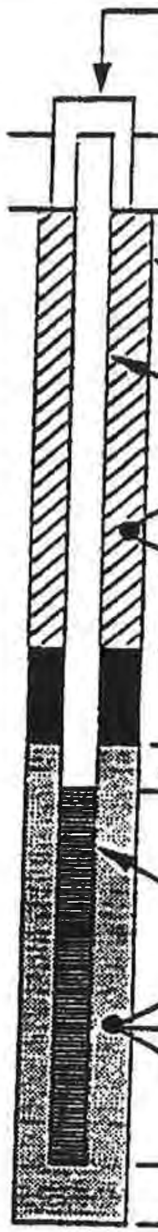
Water Depth From Top of Riser NA. ft. ______ Date

Drilling Inspector Present ______

Notes: Drilled to 20.0' set well Difficult Drilling from 5.0-20.0

Well No. 12

MONITOR WELL CONSTRUCTION LOG



Protective Enclosure
☐ Curb Box
☑ Guard Pipe

elev.
3.0 ft
elev. LAND SURFACE

8" inch diameter drilled hole

Well casing, 2 inch diameter, PVC

☐ Backfill
☑ Grout cement

1.0 ft*

Bentonite ☐ slurry ☑ pellets

~~7.0~~ ft*

5.0 ~~8.0~~ ft*

Well Screen 2 inch diameter PVC, 10 slot

☐ Gravel Pack
☑ Sand Pack
☐ Formation Collapse

15.0 ft*

15.0 ft*

*Depth below land surface.

(95SI-25)

Project Number 95SI-27

Project Name Sanford Landfill

Well No. 12 Boring No.

Town/City Sanford

County Lee State N.C.

Installation Date(s) 9/5-9/7 year ?

Drilling Contractor Special Inc.

Drilling Method 4 1/4 HSA.

Water Depth From Top of Riser N.M. ft. Date

Drilling Inspector Present

Notes: Drilled to 15.0 Auger Refusal At 15.0 (No samples) Difficult Drilling from 5.0-15.0

North Carolina Department Of Natural Resources and Community Development
Division of Environmental Management - Groundwater Section
Post Office Box 27687 • Raleigh • North Carolina • 27611
Phone (919) 733-5083

WELL CONSTRUCTION RECORD

FOR OFFICE USE ONLY
Quad. No.______ Serial No.______
Lat.______ Long.______ PC______
Minor Basin______
Basin Code______
Header Ent.______ GW-1 Ent.______

DRILLING CONTRACTOR Patterson Exploration Services

DRILLER REGISTRATION NUMBER 351

STATE WELL CONSTRUCTION PERMIT NUMBER N/A

1. **Well Location:** *(show sketch of the location below {on right})*

Nearest Town Lemon Springs, North Carolina
Sanders Road
(Road, Community, or Subdivision and Lot Number)

County Lee

2. **Owner** County of Lee
Address Post Office Box 1968, Sanford, NC 27331
(Street or Route #) (City/Town) (State) (Zip Code)

3. **Date Drilled** September 20, 1996 **Use of Well** Monitoring

4. **Total Depth** 13' **Cuttings Collected** ( )Yes (X)No

5. **Does Well Replace Existing Well?** ( )Yes (X)No

6. **Static Water Level:** 5.0 **Feet** ( )Above ( )Below **Top of Casing**
Top of Casing is 2 **Feet Above Land Surface.**

7. **Yield** *(gpm)* < 1 gpm **Method of Test** Bailer

8. **Water Zones** *(depth)* N/A

9. **Chlorination →** **Type** N/A **Amount** ______

Depth From	To	Drilling Log Formation Description
0' -	13'	Greenish-gray silty sandy CLAY (Weathered saprolite of slate belt rock) Encountered ground water @ 8 feet below ground surface.

If Additional Space Is Needed Use Back Of Form

10. CASING

Depth	Diameter	Wall Thickness or weight/feet	Material
3' - +2'	2-inch	Sch. 40	PVC

11. GROUT

Depth	Material	Method
1' - 0'	Cement	Tremie

12. SCREEN

Depth	Diameter	Slot Size	Material
13' - 3'	2-inch	.010	PVC

13. GRAVEL PACK

Depth	Size	Material
13' - 2'	Medium-grained	Torpedo Sand

Show

Mr Jim Bateson

This is the replacement for MW-12 at the Lee County Landfill as per your request. It finally dried enough for us to get it in.

Bobby Jo[illegible]

14. **REMARKS**______

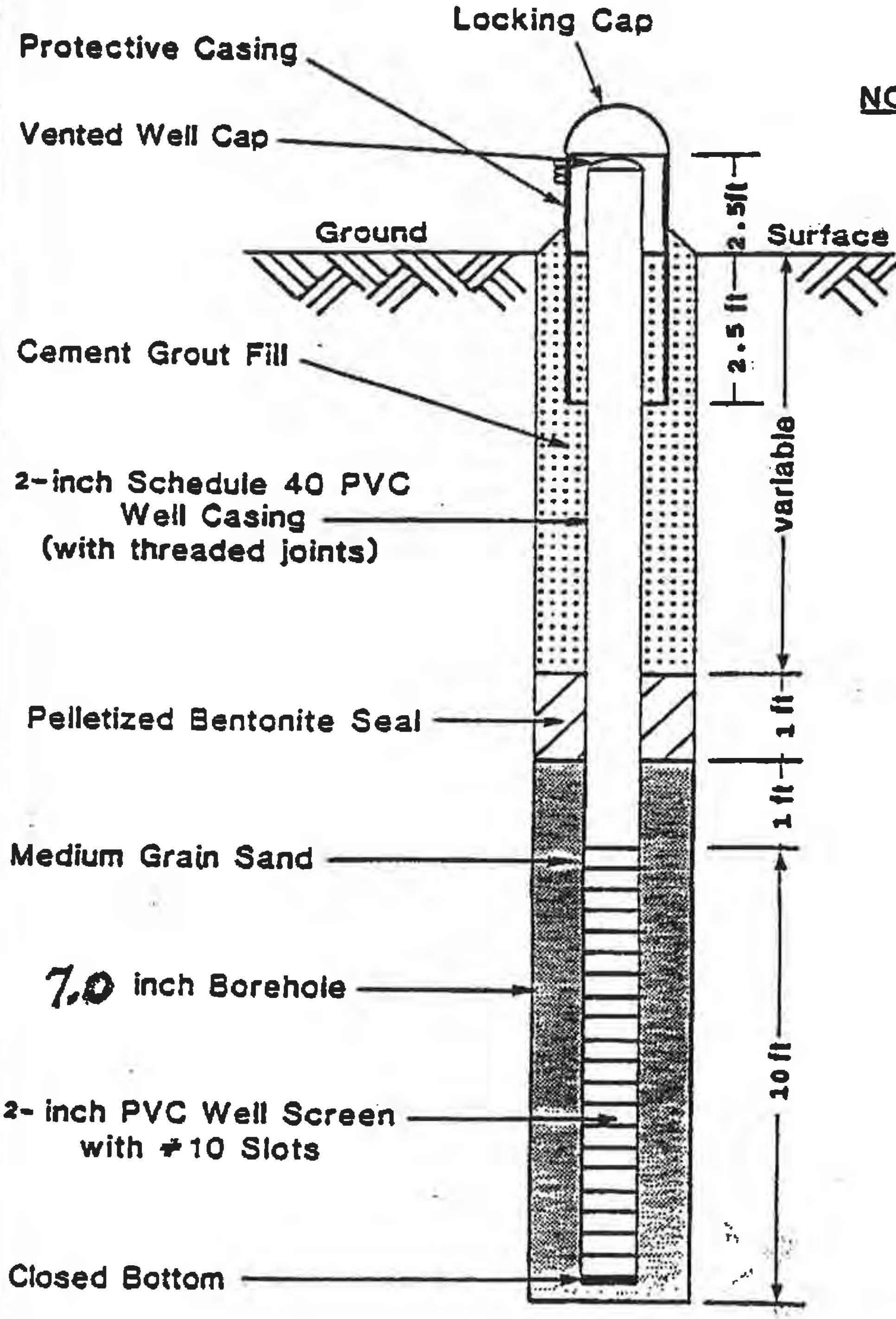
I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTEI
CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECOR

SUBMIT ORIGINAL TO DIVISION OF ENVIRONMENTAL MANAGEMENT AND A COPY TO THE WELL OWNER

Michael N. Burns
(Signature of Contractor or Agent)

9-24-96
(Date)

MONITORING WELL CONSTRUCTION



NOTE:

1. Well head to be labled: "Well is for monitoring and not considered safe for drinking."

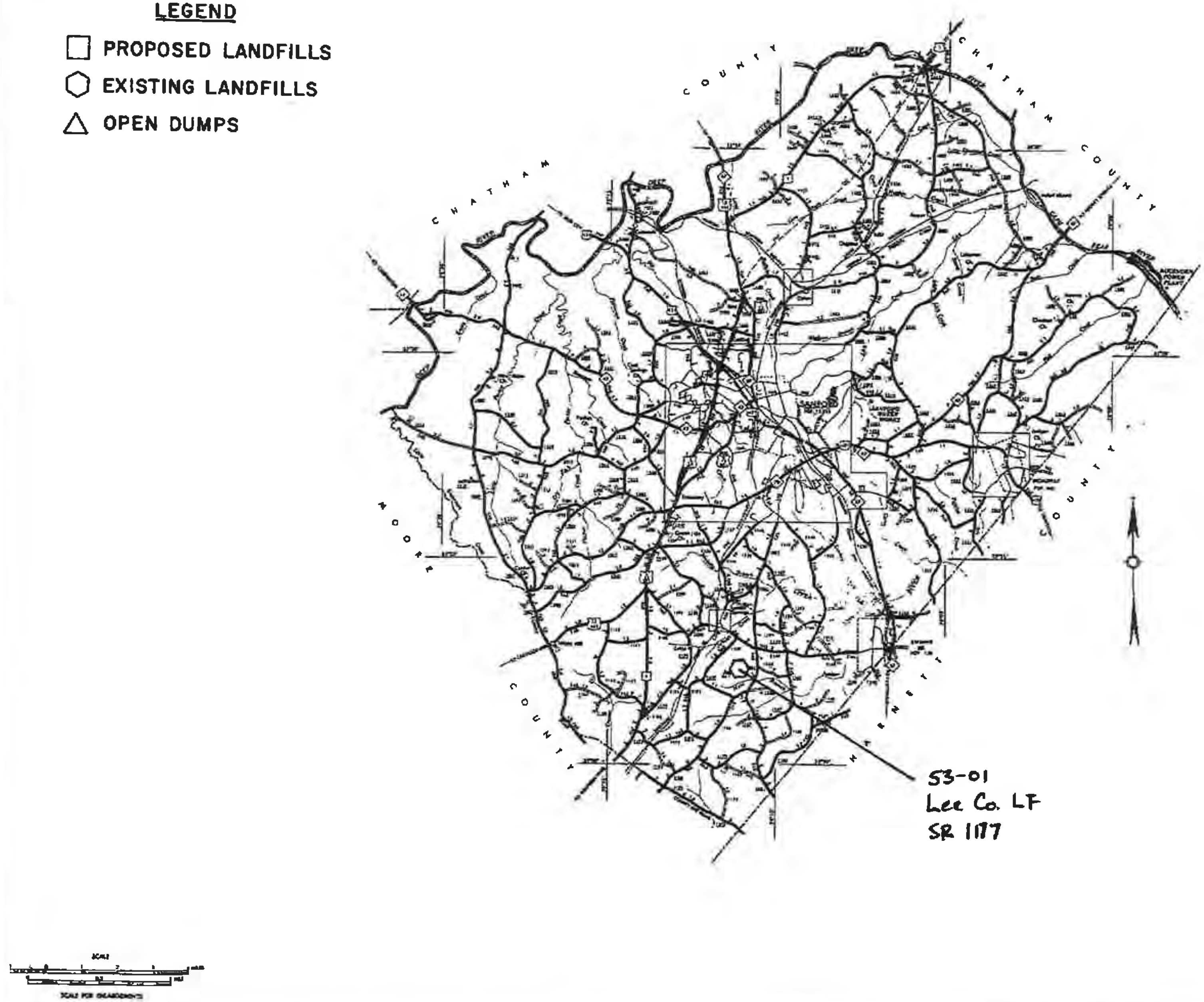
PATTERSON EXPLORATION SERVICES

LEGEND

☐ PROPOSED LANDFILLS

⬡ EXISTING LANDFILLS

△ OPEN DUMPS



LEE COUNTY
NORTH CAROLINA


N
W
E
S
SPRINGS
SCALE: 1" = 1,000

LEE COUNTY PUBLIC WORKS

PO BOX 1968
805 S. FIFTH STREET
SANFORD, NC 27330
919-774-8440
FAX # 919-774-8526

Fax

To:	Larry Rose	From:	Joseph Cherry
Fax:	(919)733-4810	Pages:	2
Phone:		Date:	July 26, 2002
Re:	Landfill Monitoring	CC:	

☐ Urgent ☒ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

• Comments:

Mr. Rose:

The properties circled on the enclosed map are still using well water. I will be on vacation so if you have any questions, please contact Marc Clark at (919) 774-8440.

Thank you for your assistance in this matter.

Joe

7/96

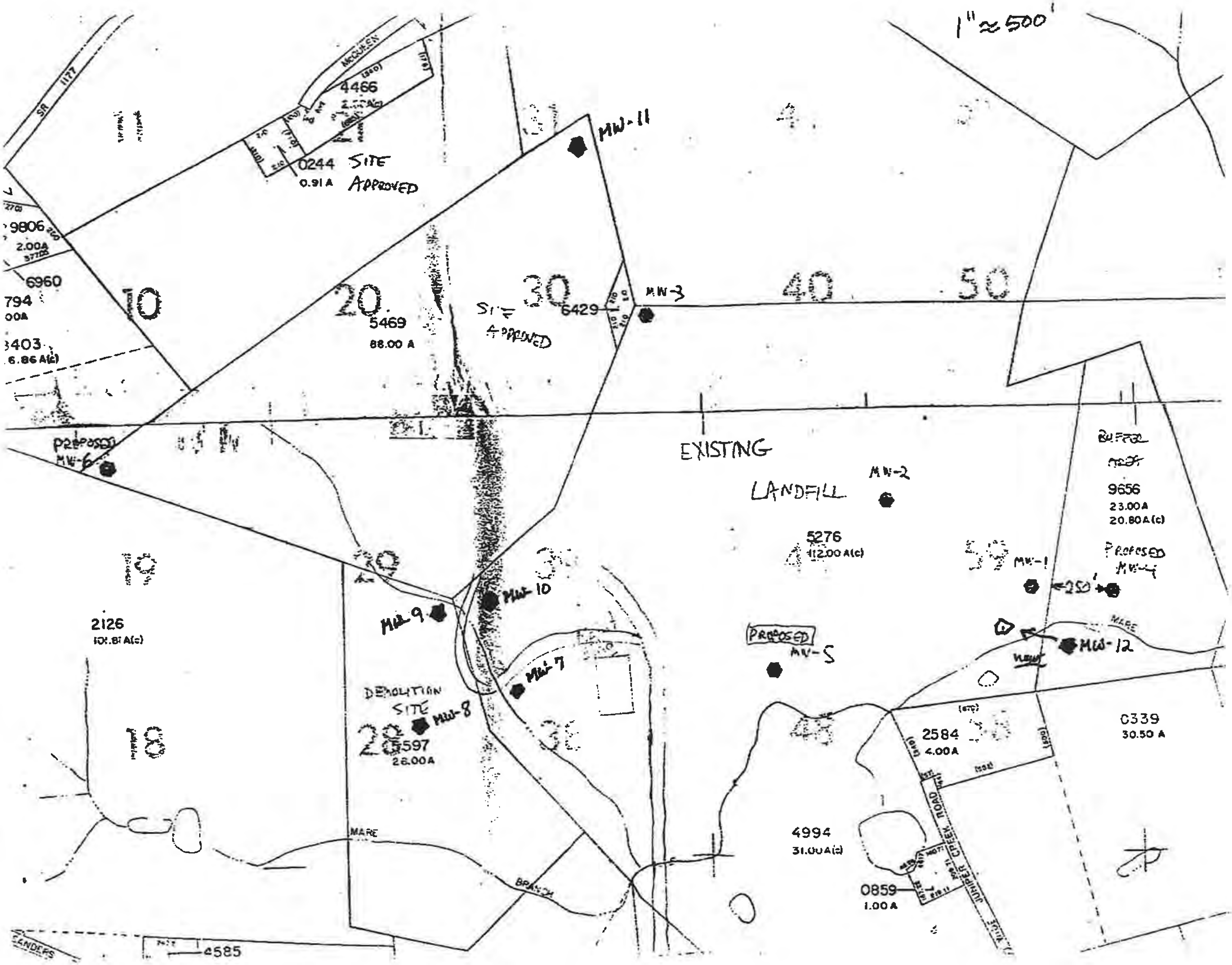
LEE COUNTY LANDFILL
MONITOR WELLS ELEVATIONS

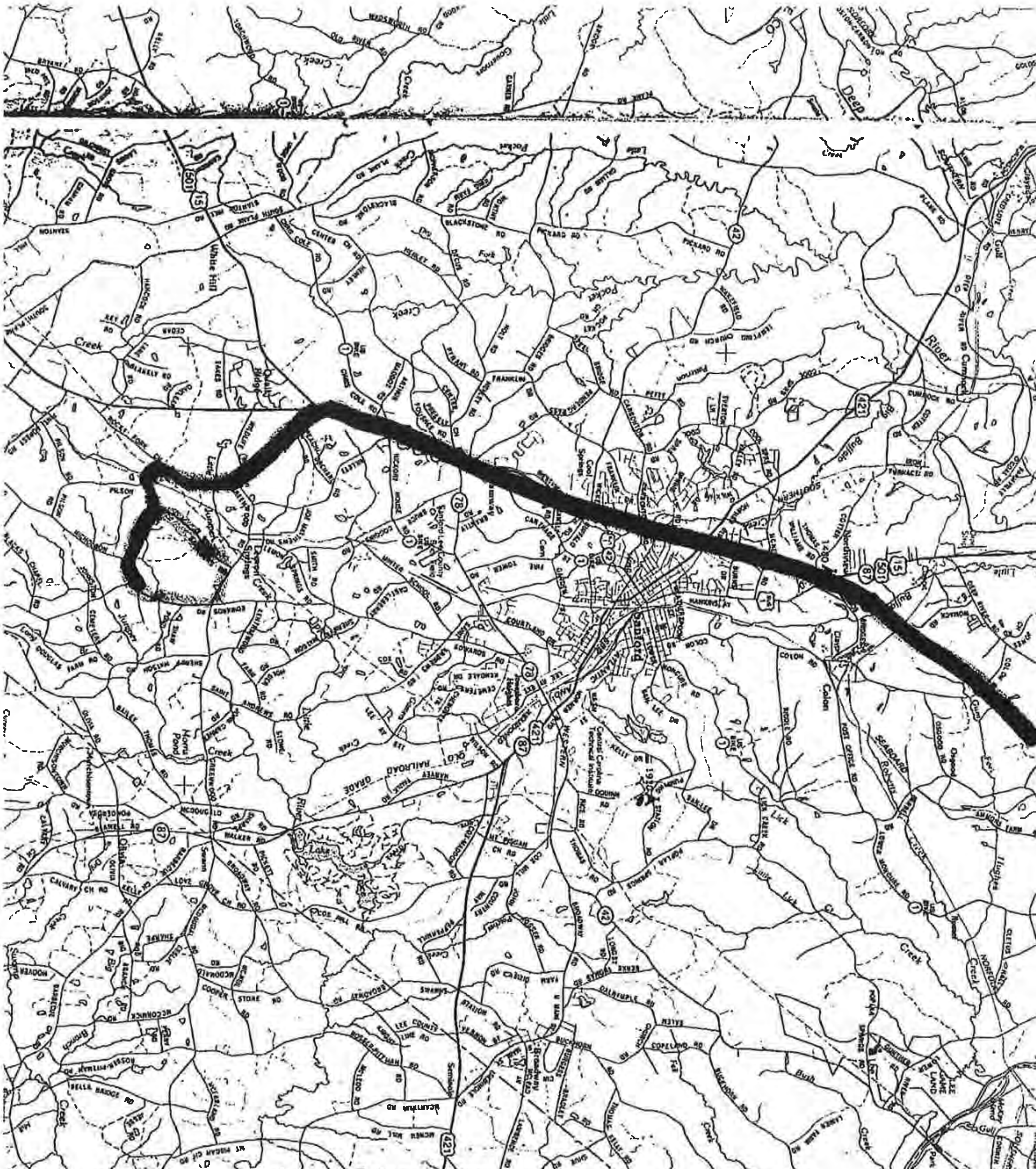
LEGEND
G = GROUND
TC = TOP OF CASING (OPEN)
TP = TOP OF PIPE

WELL # 4
G = 344.0'
TC = 346.1'
TP = 345.9'
WELL # 5
G = 348.7'
TC = 351.3'
TP = 351.1'
WELL # 6
G = 400.1'
TC = 402.3'
TP = 402.1'
WELL # 7
G = 357.8'
TC = 360.3'
TP = 360.3'
WELL # 8
G = 363.3'
TC = 365.8'
TP = 365.8'

WELL # 9
G = 381.0'
TC = 384.0'
TP = 384.2'
WELL # 10
G = 373.9'
TC = 376.9'
TP = 377.0'
WELL # 11
G = 396.6'
TC = 399.4'
TP = 399.6'
WELL # 12
G = 334.9'
TC = 337.5'
TP = 337.4'

NORTH CAROLINA REGISTERED SEAL L-3403 LAND SURVEYOR MICHAEL A. CAIN


1" ≈ 500'
SR 1177
MCQUEEN
4466
0244
0.91 A
SITE
APPROVED
MW-11
9806
2.00A
6960
794
3403
10
20
5469
88.00 A
SITE
APPROVED
30
6429
MW-3
40
50
PROPOSED
MW-6
EXISTING
LANDFILL
MW-2
BUFFER
9656
23.00A
20.80A(c)
PROPOSED
MW-4
5276
412.00 A(c)
MW-1
250'
19
2126
MW-10
MW-9
MW-7
PROPOSED
MW-5
NEW
MW-12
MARE
DEMOLITION
SITE
MW-8
28
0597
26.00A
2584
4.00A
0339
30.50 A
18
4994
31.00A(c)
JUNIPER CREEK ROAD
0859
1.00A
BRANCH
SANDERS
4585



Sanford
COURTLAND DR
CALVARY CH RD
COOPER STORE RD
BELLA BRIDGE RD
MT PISGAH CH RD
RAILROAD
Lake

APPENDIX M
Historical NOAA Precipitation Graphs for North Carolina – 1895 to 2014

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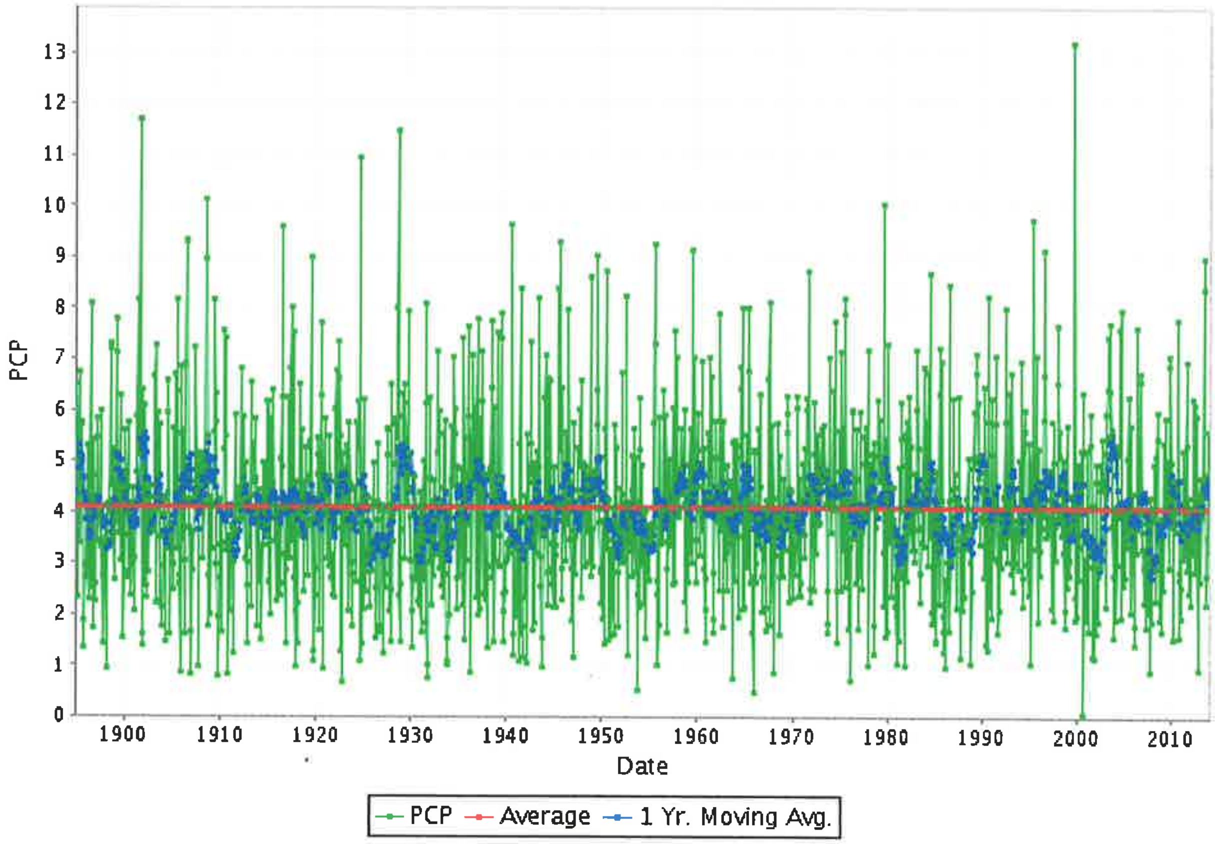
NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)
National Climatic Data Center
U.S. Department of Commerce

DOC > NOAA > NESDIS > NCDC Search Field: Search NCDC

Land-Based Data / NNDC CDO / Product Search / Help

NORTH CAROLINA - PCP
189501 - 201401



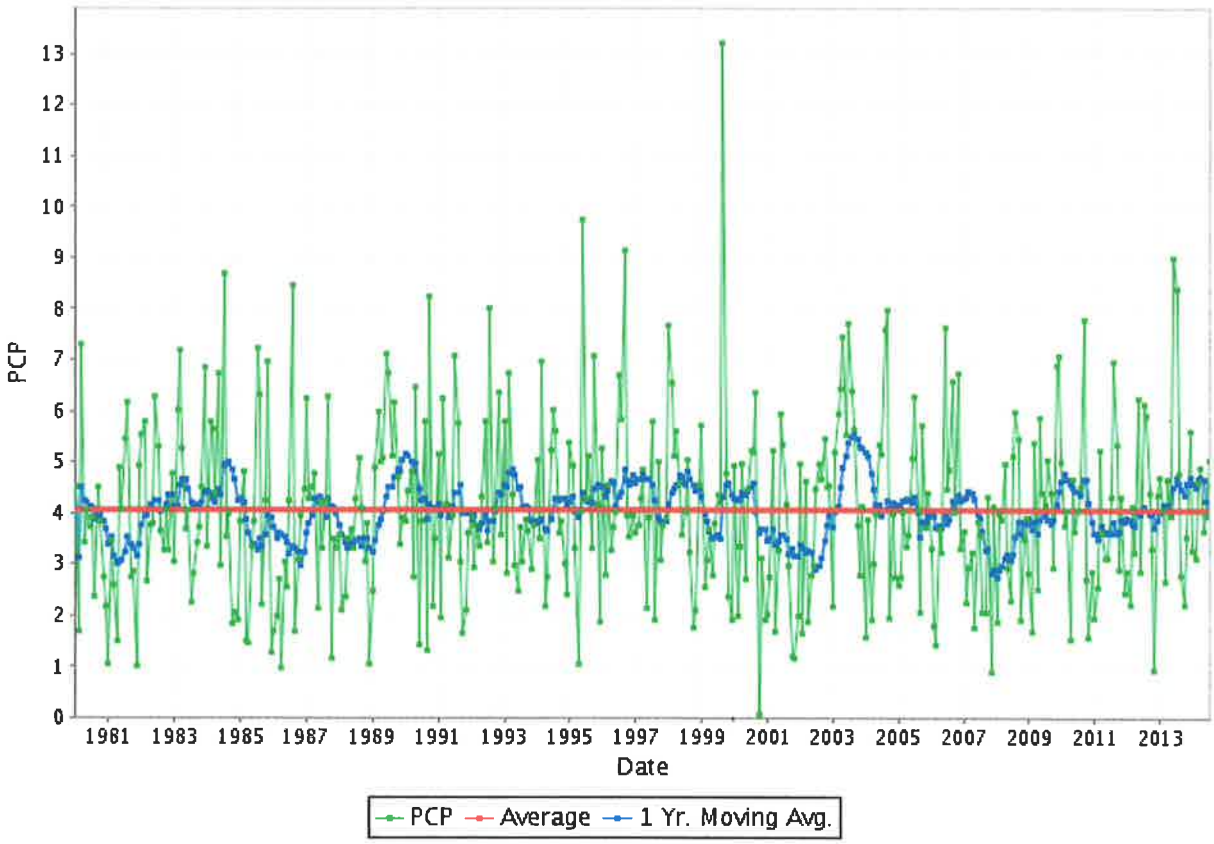
Privacy Policy USA.gov Disclaimer

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)
National Climatic Data Center
U.S. Department of Commerce

DOC > NOAA > NESDIS > NCDC Search Field: Search NCDC

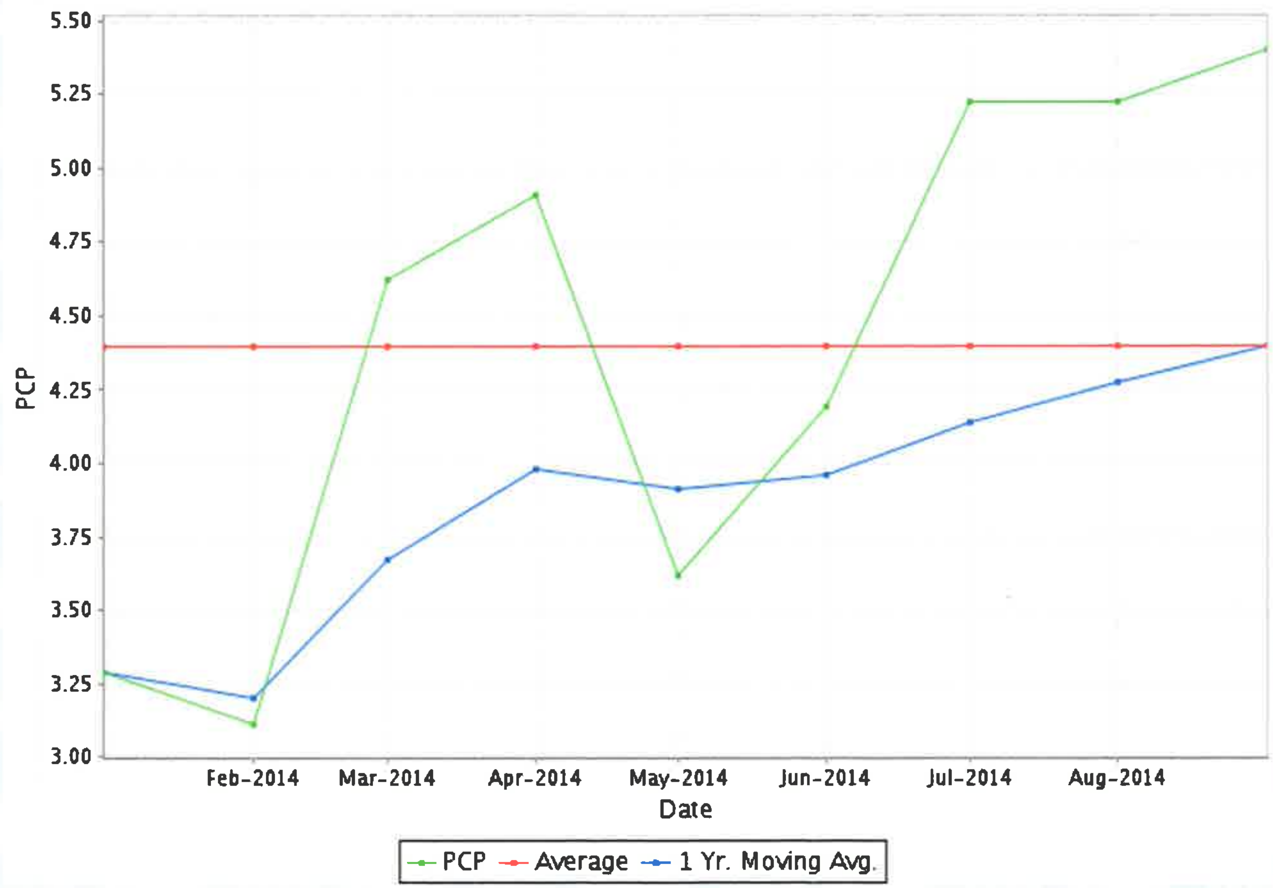
Land-Based Data / NNDC CDO / Product Search / Help

NORTH CAROLINA - PCP
198001 - 201407



Privacy Policy USA.gov Disclaimer

NORTH CAROLINA - PCP
201401 - 201409



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APPENDIX N
Earthquake Data

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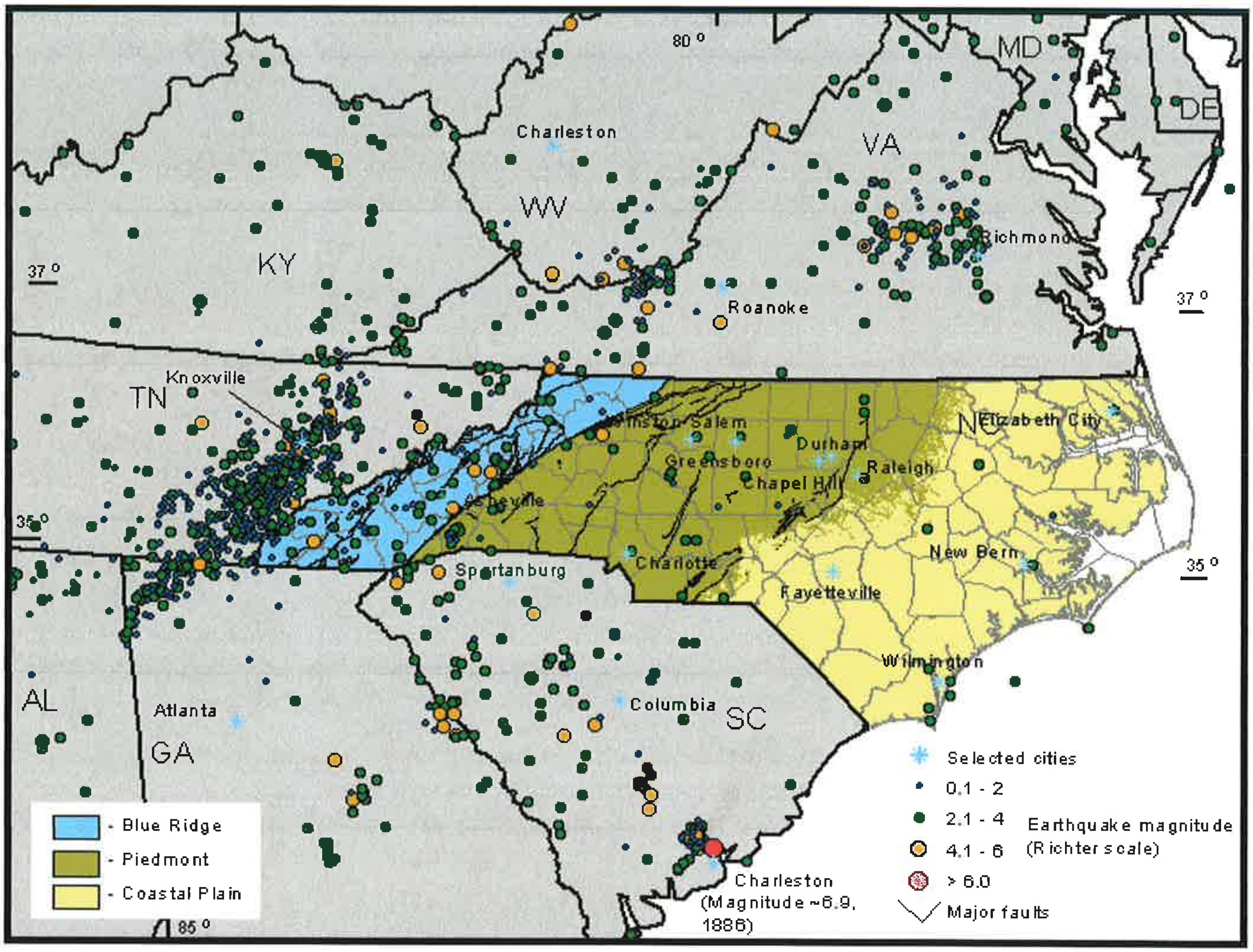
Earthquake Epicenters in North Carolina and Portions of Adjacent States (1698-1997)



This is a map of earthquake epicenters recorded in North Carolina and portions of adjacent states between 1698 and 1997. Epicenters are shown only for labeled states. Major geologic provinces and known major faults exposed at the surface are shown for North Carolina. Faults identified to date in North Carolina are ancient and inactive. The lack of correspondence between the locations of earthquake epicenters and these faults indicates they are not responsible for earthquakes in North Carolina within historical times. The faults beneath the surface that generate earthquakes have yet to be positively identified.

Earthquake data before 1886 are sparse. Seismic instruments were installed in the region in the late 1920's. Prior to that time earthquake data are based on historical records. The distribution of seismograph stations did not allow for location of earthquakes with magnitudes <4 until 1962-1963. Micro-earthquake networks began operating in the region in the mid-1970's.

Geology from North Carolina Geological Survey, 1985, Geologic Map of North Carolina (scale 1:500,000). Earthquake data from 1698-1992 are from Virginia Polytechnical and State University. Data from 1993-

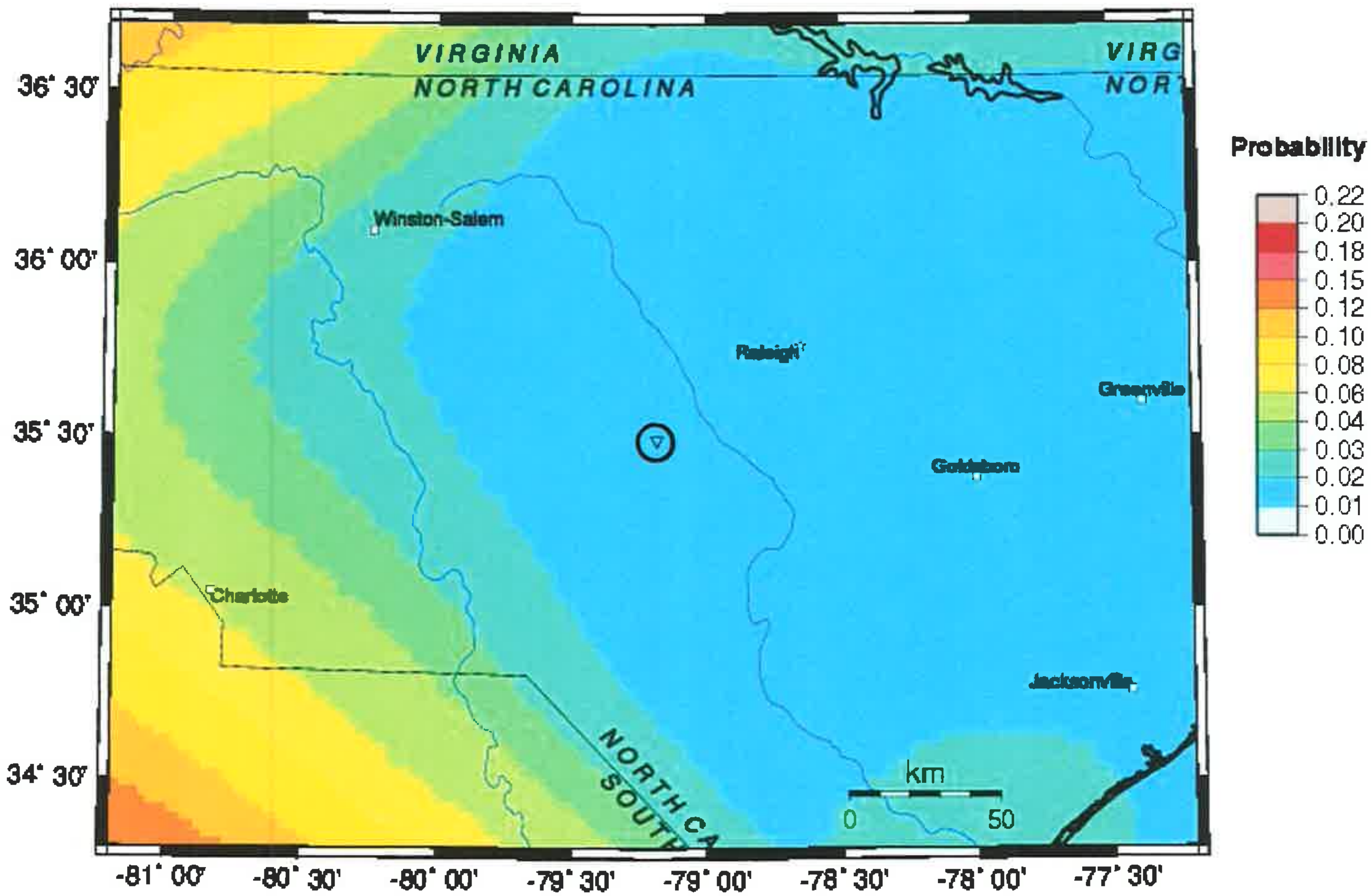
1997 are from the U. S. Geological Survey National Earthquake Information Center (http://wwwneic.cr.usgs.gov/).

The map and text above are modified from Geologic Note 7: Map of Earthquake Epicenters in North Carolina and Portions of Adjacent States (1698-1997)
To get a copy of Geological Note 7, contact our Sales Office.

NCGS HOME
Back to NCGS Main Page

Probability of earthquake with M ≥ 4.75 within 100 years & 50 km

U.S. Geological Survey PSHA Model Site: SANFORD NC . .



GMT 2014 Aug 25 20:28:25 Earthquake probabilities from USGS OFR_02-420 PSHA. 50 km maximum horizontal distance. Site of interest: triangle. Epicenters mb>5 black circles: rivers blue.

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APPENDIX O
Typical Groundwater Monitor Well Construction Diagram

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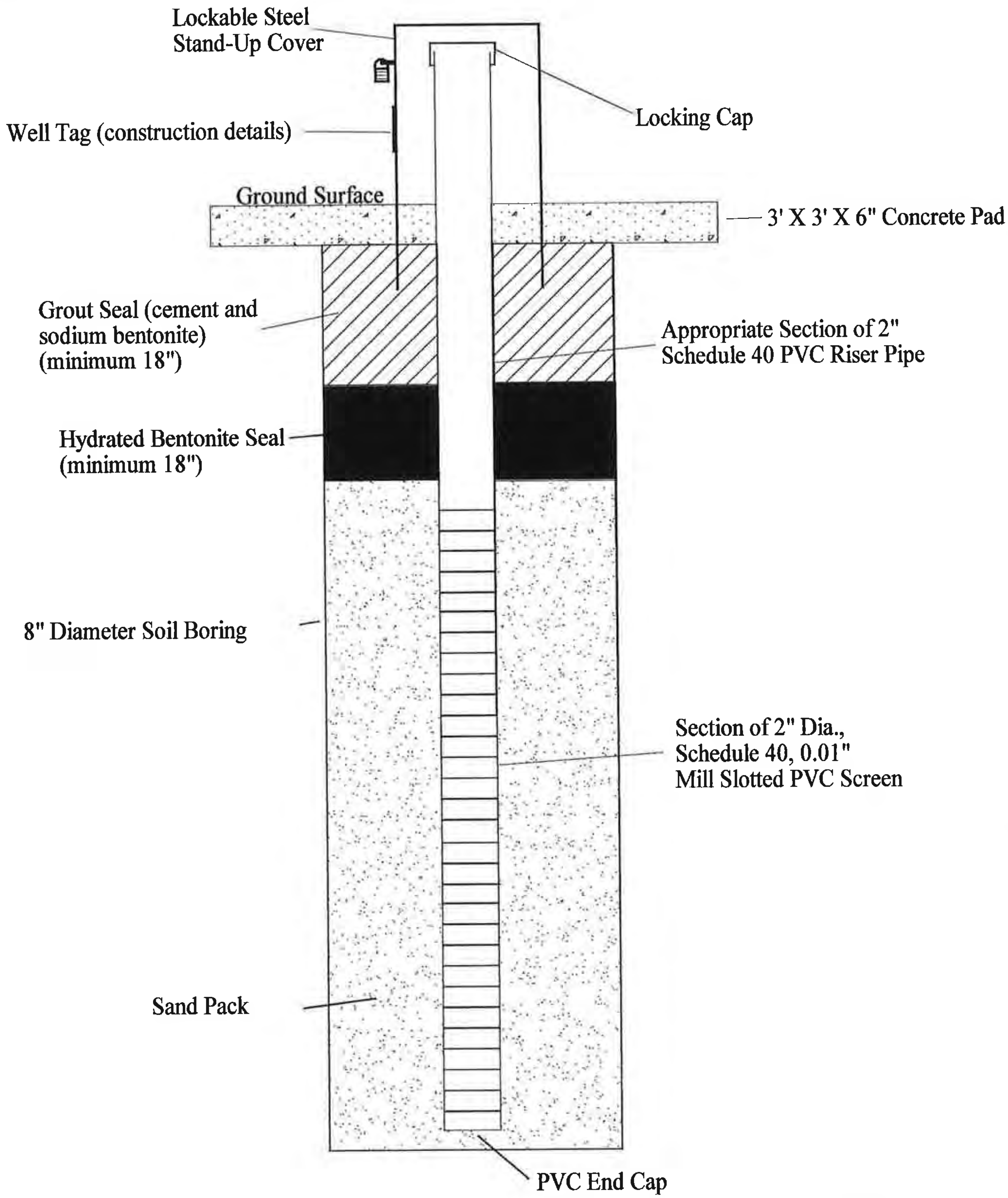

No Scale

Colon Mine RSFS 1303 Brickyard Road Sanford, North Carolina	Buxton Environmental, Inc.	Typical Groundwater Monitor Well Construction Diagram

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