Carmen Johnson

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Duke Power

Marshall Steam Station

Catawba County, N.C.

Flue Gas Desulfurization (FGD) Residue
Landfill Permit Application
Site Suitability Information

August 29, 2003

Volume 2

Hydrogeologic Study
S&ME Project No. 1264-02-578

S&ME

APPROVED
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION
DATE 1/14/05 BY
Central Office
16-09

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Solid Waste
Section

August 20, 2003

Duke Power
526 South Church Street
P.O. Box 1006
Mail Code: EC01U
Charlotte, North Carolina 28201-1006

ATTENTION: Mr. Tim Smart, P.E.

Reference: Hydrogeologic Study
FGD Scrubber Landfill
Duke Power – Marshall Steam Station
Terrell, North Carolina
S&ME Project No. 1264-02-578

Dear Mr. Smart:

S&ME is pleased to submit the *Hydrogeologic Study* for the proposed Duke Power FGD Scrubber Landfill at the Marshall Steam Station in Terrell, North Carolina. The hydrogeologic exploration was completed in general accordance with Duke Power's *Description of Scope of Work* dated September 6 and 30, 2002 and S&ME's approved proposal 02548A dated October 1, 2002. This report is provided for your use and/or submittal to the NCDENR.

S&ME appreciates this and every opportunity we have to be of service to you and Duke Power. We trust this information is responsive to your needs at this time. If you have any questions please contact us at your convenience. Thank you for choosing S&ME.

Respectfully Submitted,

S&ME, Inc.

Julie R. Petersen
Staff Professional

Al Quarles, L.G.
Senior Hydrogeologist

NORTH CAROLINA LICENSED SEAL 1133 GEOLOGIST AL QUARLES

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HYDROGEOLOGIC STUDY
Marshall Steam Station – FGD Scrubber Landfill
S&ME Project No. 1264-02-578

S&ME has completed a hydrogeologic study for the proposed FGD Scrubber Landfill ("landfill") for Duke Power's Marshall Steam Station located on Highway 150 in Terrell, Catawba County, North Carolina (Figures 1 and 2). The purpose of this study was to evaluate the general subsurface conditions in the area of the landfill and to obtain hydrogeologic information required by the North Carolina Solid Waste Management Rule 15A NCAC 13B .0504. Results of our field and laboratory testing are included in Appendices I and II. Calculations for the estimated seasonal high groundwater elevations are included in Appendix III and the hydrogeologic drawings are included in Appendix IV.

1.0 PROJECT DESCRIPTION

In response to the Clean Air Act of 1990 and its subsequent amendments mandating the reduction of sulfur dioxide (SO_2) emissions from power plants, Duke Power is evaluating installation of a flue gas desulfurization (FGD) scrubber system at its Marshall Steam Station located in Terrell, North Carolina. FGD systems involve the introduction of lime to the flue gas stream resulting in a calcium sulfite or calcium sulfate output residue commonly known as FGD sludge. The specific process being considered for the Marshall Steam Station is a "wet" process. Once dried, the FGD sludge may be used for beneficial purposes (e.g., production of wallboard, structural fill, etc.) or may be landfilled.

In support of the overall FGD system planning, Duke Energy requested S&ME to conduct a hydrogeologic study for the option for a potential FGD scrubber landfill. The landfill will be located on the northern portion of the Duke Power – Marshall Steam Station property (Figures 1 and 2). The proposed landfill location is shown on Sheet 1 of 7, Boring Location Plan.

2.0 SITE CONDITIONS

The landfill area currently consists of a dirt road and wooded area. The ground surface elevations within the landfill ranges from approximately 865 feet (MSL) in the northern portion of the area to 800 feet (MSL) in the northeastern portion of the area.

The topography of the landfill area includes a topographic and surface water divide comprised of a northwest-southeast ridge. The eastern limb of the ridge slopes steeply to the east toward the ash basins. The western limb slopes to the southwest towards a stream channel that transects the western portion of the landfill area and flows to the south.

An evaluation was performed by Duke Power on the aforementioned stream channel and is included in this report in Appendix V. To summarize, the stream channel was divided into three sections: Sections A, B and C. "Section A" is the northern segment of the stream channel located upstream of the wetlands area. Both the stream channel and wetlands area are indicated on Sheet 1 of 7, Boring Location Plan, in Appendix IV. "Section A" is classified as an ephemeral channel (non-jurisdictional) due to its lack of a well-defined channel and absence of aquatic life. Flow was not readily apparent during the stream channel evaluation, but present.

"Section B" is located immediately below the wetlands and north of a man-made ridge in the southwestern portion of the landfill area that crosses the stream channel. The purpose of the ridge is unknown. A culvert is located beneath the ridge for surface water flow from the north to the south, however the culvert appears to be partially blocked. "Section B" is classified as "an unimportant intermittent channel." The channel is well defined and its flow is controlled by rainfall and storage in the wetlands. Due to the presence of terrestrial vegetation in the channel, it appears as though the stream is potentially dry during dry periods.

"Section C" begins south of the man-made ridge, originating at the partially blocked culvert. "Section C" is classified as "an unimportant intermittent channel" due to its flow being likely intermittent during periods of precipitation and storage in the wetlands. The stream channel appears to become a groundwater discharge feature south of the man-made ridge with flow to Lake Norman (See Figure 1).

Based on S&ME's soil borings adjacent to the wetlands, it appears that the surface water present is due to perched conditions. The uppermost soil in the soil borings adjacent to the wetlands was classified as high plasticity clay and extended to depths exceeding 10 feet below land surface. The presence of the high plasticity clay inhibits the infiltration of surface water/precipitation and allows

surface water to "pool" at the land surface. S&ME believes that "Sections A and B" and the wetlands are products of stormwater runoff and surface water storage and are not directly connected with the underlying groundwater surface which on average is approximately 20 feet below land surface in the area surrounding the wetlands.

3.0 REGIONAL HYDROGEOLOGY

The site lies in the King's Mountain Belt of the Piedmont Physiographic Province of North Carolina. The area is underlain by metamorphic rock covered by a thick layer of residual soil and weathered rock (regolith) in most places. Groundwater occurs in the soil/weathered rock layer and in the underlying bedrock. Springs and seeps may be common along drainage features and surface water bodies.

3.1 Geology And Topography

The Marshall Steam Station plant is located in the Piedmont Geologic Province, specifically within the King's Mountain Belt. Igneous and metamorphic rock, which is covered by a thick layer of residual soil and weathered rock (regolith), predominantly underlie this region of North Carolina. Rock consists largely of schist, gneiss, diorite and granite formed during the Precambrian and Paleozoic Eras (Figure 3, Geologic Map). Foliation and/or contacts between rock types strike northeast-southwest, with dip angles ranging from vertical to 45 degrees in the area. While numerous types of rock occur in Catawba County, mica schist, gneiss and granite are the most prevalent rock types within the landfill property and surrounding area.

The topography and relief of the Piedmont has developed from differential weathering of the igneous and metamorphic rock. Ridges and hills have developed over the more resistant rock, whereas gently rolling, subdued topography has developed on the more easily weathered and erodible rock. Because of continued weathering, the rock in the Piedmont Province is now generally covered with a mantle of soil that has formed from the in-place weathering of the parent bedrock. The soils that overlie bedrock have variable thickness, and are generally referred to as residuum (residual soils) and saprolite. The residuum is typically finer grained, has a higher clay content, and retains less of the original rock and mineral structure than the underlying saprolite because of the advanced weathering. Similarly, the soils typically become coarser grained with

increasing depth because of decreased weathering. As the degree of weathering decreases, residuum grades into saprolite, which generally retains the overall appearance, texture, gradation, foliation and structure of the parent rock. Saprolite generally grades into partially weathered rock and fractured rock with increasing depth as the unweathered bedrock is approached. The transition between residuum, saprolite and partially weathered rock is gradational and varies laterally and vertically.

3.2 Hydrogeology

Groundwater generally occurs within the residuum and saprolite under unconfined aquifer conditions. Because of the heterogeneous texture and structure of saprolite, alternating layers of differing moisture content are common. The residuum and saprolite typically have a high total porosity, but a low permeability. Therefore, these soils store water from precipitation and slowly recharge the underlying bedrock aquifer by downward infiltration. The partially weathered rock layer is a transition layer from the overlying saprolite to the underlying bedrock, and is often more permeable than the underlying material, depending on the percentage of fine-grained sediment and secondary porosity.

Groundwater occurs in the bedrock along fractures, joints and other openings created by weathering. The groundwater surface may occur within the bedrock when the bedrock is relatively close to the ground surface. Within the Piedmont, low permeable units or aquitards do not typically exist that would result in a confining layer separating the bedrock from the overlying soils. Thus the soils and bedrock are generally in hydraulic connection.

The number of fractures in the bedrock generally decreases with depth. As a result, the highest water bearing zones generally are encountered within the upper 30 feet of the bedrock.

Groundwater percolation to deeper portions of the bedrock is restricted by the decrease in available flow paths (fractures) with depth. The groundwater is forced to follow fractures to discharge points near streams and springs. Thus, movement of groundwater is from recharge areas (topographic highs) to discharge areas (streams and springs).

Groundwater fluctuations are typically the result of changes in precipitation and seasonal evapotranspiration. Groundwater levels generally begin to decline in April or May due to increasing evapotranspiration and continue to decline through October/November after plants become dormant and temperatures decrease. Long-term changes in the groundwater levels occur due to abnormal wet or dry periods. During winter months, precipitation recharges the aquifer as evapotranspiration losses decrease and with an increase in frontal-type rainfall events. Generally, the highest groundwater levels occur between March and May. Groundwater fluctuations due to withdrawal by pumped wells is not great in the region (LeGrand, 1961).

In the Catawba County area, most industrial and domestic water supplies are obtained from wells. Dug and bored wells are common in rural areas and obtain water from the weathered zone above bedrock. Wells drilled into bedrock typically have higher yields than bored or dug wells. However, drilled wells that do not intersect water-bearing fractures can have very low yields. As a result individual wells show a great range of yield in the area. Generally, wells drilled on ridges and hills are lower producing than wells drilled on flat areas and in draws and valleys.

The depth to groundwater table varies from zero in valleys, to more than 100 ft below the ground surface on sharply rising hills. In general, and under natural conditions, the groundwater surface is a subdued reflection of the land surface.

Groundwater quality in the Catawba County area varies due to local variations in rock type. The majority of groundwater aquifers meet primary and secondary drinking water standards. Excessive iron, manganese or sulfate may occur in some areas.

4.0 GEOTECHNICAL AND HYDROGEOLOGICAL EVALUATION

4.1 Field Exploration

To evaluate subsurface characteristics in the landfill area, S&ME performed soil test borings at twenty-one locations (B-1 through B-7, MS-1 through MS-11, and OW-1 through OW-3) shown sheet 1 of 7: Boring Location Plan in Appendix IV. Fourteen of the twenty-one borings (B-1, B-2, B-5, B-7, MS-1 through MS-4 and MS-6 through MS-11) encountered auger refusal ranging in

depth from 25.5 to 79.5 feet below land surface. Four of the nineteen borings (B-3, B-4, B-6 and MS-5) were advanced to 90 feet below land surface without encountering auger refusal. Rock cores were collected in five borings (B-2, B-5, B-7, MS-1 and MS-7).

S&ME and Duke Power personnel selected the boring locations based on site conditions. A licensed surveyor surveyed each boring, after completion, for horizontal and vertical control. Table 1 summarizes elevation data and boring/well construction information for the observation wells used for this study.

The soil test borings were extended to depths ranging from 25.5 to 90 feet below the existing ground surface using an ATV B-57 truck mounted drill rig and a Dietrich D-50 track mounted drill rig, both equipped with continuous flight hollow-stem augers.

Standard penetration tests were performed at designated intervals in the soil test borings in accordance with ASTM D 1586-84 to provide an index for estimating soil strength and relative density. In conjunction with the penetration testing, split-spoon soil samples were recovered for classification and laboratory testing. Undisturbed samples and Bag samples were also collected in selected borings for classification and laboratory testing.

At eighteen of the twenty-one boring locations (B-1 through B-7 and MS-1 through MS-11), two borings were advanced. The first boring was advanced to the shallow depth of auger refusal or 90 feet to collect geotechnical and lithologic data and rock core samples. The second adjacent boring was advanced to a selected depth below land surface for the installation of a shallow observation well. All of the geotechnical borings were abandoned in-place by grouting to the land surface. The test boring records and well logs (Appendix I) include lithologic characteristics, depth to groundwater, and well installation details

4.2 Field Testing

In order to evaluate the hydrologic characteristics of subsurface materials, observation wells were installed at all twenty-one boring locations in the landfill area. In-situ permeability tests (slug tests) were performed in selected observation wells to evaluate the horizontal permeability or hydraulic

conductivity of the subsurface materials. In-situ tests were performed using a rising head technique. The data for these tests were analyzed using the Bouwer and Rice method as presented in Appendix II. Test results are summarized in Table 3, Summary of Field and Laboratory Permeability Data.

Based on the field permeability tests in the observation wells screened predominantly in the saprolite zone, the hydraulic conductivity of the saprolite ranges from 1.0E-04 centimeters per second (cm/sec) to 7.2E-04 cm/sec with a geometric average of 2.6E-04 cm/sec. The testing of one well (B-7) screened in partially weathered rock (PWR) indicated a hydraulic conductivity of 2.1E-05 cm/sec. These values are within the range of reported values for silty sands (Freeze and Cherry, 1979).

4.3 Laboratory Testing

Representative samples of the on-site soils obtained during the field exploration were tested in S&ME's Charlotte laboratory. Soil classification tests included grain size distribution with hydrometers, Atterberg limits, specific gravity tests, permeability tests, remolded permeability tests and standard proctors. Results of the laboratory classification tests are presented on Table 6, Summary of Laboratory Test Data. The laboratory testing procedures along with the laboratory test data sheets are included in Appendix II, grouped by boring number.

4.4 Subsurface Conditions

The subsurface conditions in the landfill area consist of residual soils and partially weathered rock (PWR) which have formed by the in-place weathering of the parent bedrock. The residual soils grade with depth into zones of PWR that generally overlie the underlying bedrock. In general, the transition between the material types is gradual (in the vertical and horizontal dimensions) and may not be an abrupt change as indicated in the soil test boring records or Cross Sections (Sheet 5 of 7, 6 of 7 and 7 of 7, Appendix IV). For general soil descriptions and lithology at particular boring locations, refer to the respective boring logs in Appendix I.

A topsoil layer approximately 4 inches thick was encountered in six of the borings. Beneath the topsoil and at ground surface, residual material consisting of silts, silty clays, clayey silts, sandy silts and silty sands were encountered to depths of 13.5 to 68.5 ft below land surface. Underlying the

upper residual materials, partially weathered rock (PWR) was encountered at depths ranging from 13.5 (B-1) to 68.5 (B-3) feet below land surface.

Residuum: Residuum is the weathered, unconsolidated material usually found beneath the topsoil. Very little of the physical characteristics of the parent bedrock are retained. The residuum encountered in the landfill borings ranged from silty clays to clayey silts and silty sands to sandy silts. The residuum extended to depths ranging from 2.5 to 14 feet below land surface and is located above the groundwater surface.

Saprolite: Saprolite is the product of weathered bedrock and usually retains some physical characteristics of the parent bedrock. Saprolite is an unconsolidated material that usually grades with depth into PWR or bedrock. The saprolite encountered in the landfill borings ranged from silts to clayey silts and sandy silts to silty sands. The saprolite extends to depths ranging from 13.5 to 68.5 feet below land surface. Field permeability tests yielded a geometric average hydraulic conductivity of 2.6E-04 cm/sec for the wells screened predominantly within the saprolite. Estimated total porosity values for the saprolite range from 40% to 45% based on grain size distributions (Table 4).

Partially Weathered Rock (PWR): PWR is defined as material exhibiting Standard Penetration Resistances in excess of 100 blows per foot and is often classified as penetrable, residual materials which when sampled typically become coarse to fine sandy silts or silty coarse to fine sand. Lithologically, the PWR found in the borings for the proposed Beneficial Fill area is characterized as coarse to fine silty sand and medium to fine sandy silts. The PWR extended to depths ranging from 25.5 to 90 ft below land surface. One field permeability test performed in a well (B-7) screened entirely within the PWR yielded a hydraulic conductivity of 2.1E-05 cm/sec. The estimated total porosity values for the PWR is 35% based on grain size distributions (Table 4).

Bedrock: When sampled, the bedrock from the core samples was classified as granite, schist and gneiss. Horizontal to high-angle fractures are present in the upper ten feet of bedrock as seen in the photographs included in Appendix I. Many fractures are iron stained indicating flow of oxidizing groundwater. Bedrock was encountered at depths ranging from 25.5 to 79.5 feet below land surface

in the borings. Four of the borings (B-3, B-4, B-6 and MS-5) did not encounter bedrock to depths of 90 ft bls. Recovery for the cores ranged from 86% to 100% with rock quality designations ranging from 16% to 63%.

Please note that only one rock outcrop was observed during field activities. The outcrop was observed in the vicinity of boring B-1 in the adjacent drainage feature. We believe this outcrop to be an isolated mass of rock and not an exposed section of the underlying bedrock because bedrock was encountered at 25.5 feet below land surface at B-1 located approximately 30 to 50 feet away. No other rock outcrops were noted during field activities.

5.0 SITE HYDROGEOLOGY

5.1 Observation Well Installation

To evaluate the groundwater flow regime at the landfill, observation wells were installed at all twenty-one locations. Construction logs of the observation wells are included in Appendix I for reference. In general, the well screens, or sand packs were placed to intersect the groundwater surface. The observation wells were constructed with ten-foot lengths of machine slotted, two-inch diameter PVC screen with PVC casing extending to above ground surface. The annular space between each screen and borehole was filled with fine sand to two feet above the top of the slotted screen.

Within each annulus, a two-foot-thick bentonite seal was placed above the sand pack, and the remaining annular space was grouted with neat cement to the ground surface.

5.2 Groundwater Levels and Groundwater Surface

Water levels were measured in the observation wells at time of installation, at 24-hours following installation and periodically thereafter. Water level data collected in the observation wells are provided in Table 2. The groundwater level data collected on August 8, 2003 are presented on Sheet 2 of 7, Groundwater Surface Map in Appendix IV. The water levels from the monitoring wells in the proposed landfill area and the site topography were used to create the Groundwater Surface Map.

Based on Sheet 2 of 7, Groundwater Surface Map in Appendix IV, for the landfill, the groundwater surface slopes to the east toward the ash basins. The horizontal hydraulic gradient at the landfill ranges from approximately 0.004 ft/ft to 0.06 ft/ft.

5.3 Estimated Seasonal High Groundwater

Sheet 3 of 7, Estimated Seasonal High Groundwater Surface Map in Appendix IV was generated based on historical water level data from four existing groundwater monitoring wells located on the Duke Power property (MW-1 through MW-4), water level measurement data collected in the landfill observation wells and local precipitation data (Appendix III). Hydrographs of the water levels were developed for the on-site monitoring wells to evaluate seasonal high water levels relative to precipitation. Hydrographs of the observation wells were also developed to evaluate the rising trend in water level elevations on-site due to the increased monthly rainfall during this evaluation period. Groundwater level data used for the evaluation and historical monthly rainfall data is presented in Appendix III.

The on-site monitor well hydrographs (MW-1 through MW-4) from 1989 to 2003 indicate that seasonal high water levels generally occur during the months of March, April and/or May, with the highest water levels recorded during the years of 1993 and 1998. However, due to the abnormally high precipitation this year, water level elevations are continuing to rise, when normally water level elevations decrease from mid spring to early fall.

Water level elevations in the monitoring wells were compared with precipitation data for the period from August 1989 through August 2003. Groundwater fluctuations were calculated as the difference between maximum water levels and minimum water levels in Appendix III. The groundwater fluctuations range from approximately 2.33 feet in MW-3 to 10.65 feet in MW-4. Based on calculations, the water level hydrographs, and historical precipitation data, the groundwater levels generally fluctuate more in topographic high areas (MW-4) than in topographic low areas (MW-2).

The estimated seasonal high calculation was performed statistically to take into account the high water levels recorded during unseasonably wet periods (i.e. El Nino, 1998 and present conditions) and the low water levels recorded during drought conditions. Data was used from the on-site monitor wells (MW-1 through MW-4) because these wells have the longest period of water level information on-site and include data from both peak water levels to low water levels. The estimated seasonal high groundwater (ESHG) elevations for each "MW" well was computed by adding the mean (average) to 1.282 times the standard deviation at the 90% quantile. An assumption was made that an unusually wet period may occur once per ten years, thus the 90% quantile was selected. Once the ESHG elevation was calculated for the on-site monitor wells (MW-1 through MW-4), the ESHG elevation was compared to the August 8, 2003 water level elevations on-site and the difference was calculated. The ESHG elevations ranged from 2.15 feet higher in MW-4 to 0.29 feet lower in MW-3 than the August 2003 water level elevations. The differences indicate that the current water level elevations on-site are at or near seasonal highs.

To estimate the ESHG elevations for the observation wells in similar topographic locations as MW-1 through MW-4, hydrographs were created from the on-site observation wells. The hydrographs created showed three types of trends in the water level elevations compared to their topographic locations. The three trends exhibited were labeled as "A", "B", and "C" type wells.

"A" type wells are located in topographically low areas on site near groundwater discharge features with depths to water ranging from approximately 8 to 29 feet below land surface (bls). "A" type wells exhibit increasing water level elevations from February 2003 to May 2003. In June 2003 water levels declined and then appear to stabilize in August 2003. For the "A" type wells, the peak water level elevation in May 2003 was used as a conservative estimate for the ESHG.

"B" type wells are located in-between topographically high and low areas of the site with depths to water ranging from approximately 15 to 39 feet bls. "B" type wells exhibit increasing water levels from February to August 2003. However, the increase in water level elevation between the June and August 2003 data was not enough to indicate an increasing trend in data, but an apparent stabilization. For the "B" type wells the August 2003 water level elevation was used to estimate the ESHG.

"C" type wells are located on the topographically high areas of the site with depths to water ranging from approximately 38 to 55 feet bls. "C" type wells exhibit increasing water levels from February to August 2003. The trend in increasing water level elevation indicates that the water level elevation in these wells will continue to rise if abnormally high monthly precipitation rates continue this year. To estimate the ESHG in these wells, linear trends were applied to the graphical data and forecast 60 days out. The forecasted data was approximately 2 feet higher than the August 2003 water level data. The data correspond to the difference in water level elevation in monitor well MW-4 with its estimated seasonal high (2.15 ft). The depth to water in MW-4 is approximately 46 feet bls, which corresponds to the depth to water in the "C" type wells. Typically water level elevations in topographically high areas tend to have the greatest fluctuation between seasonal highs and lows.

The ESHG elevation data and calculations are presented in Appendix III. These data were used to produce Sheet 3 of 7, Estimated Seasonal High Groundwater Surface Map in Appendix IV.

5.4 Groundwater Flow Regime

Based on Sheet 2 of 7, Groundwater Surface Map, the horizontal hydraulic gradients of the groundwater surface in the landfill area ranged from 0.004 ft/ft to 0.06 ft/ft, with an arithmetic average of approximately 0.03 ft/ft. Horizontal hydraulic gradients were calculated by dividing the difference in elevation head by the distance between two end points of a projected groundwater flow path through the observation well, that intersects the upgradient and/or downgradient equipotentials.

Total and effective porosity values were estimated for the monitored intervals of selected observation wells where in-situ permeability tests were performed. For the saprolite wells, estimates were based on the soil classifications and the "Variation of Porosity, Specific Yield, and Specific Retention with Grain Size" table from Bear, J., 1972, Dynamics of Fluids in Porous Media, American Elsevier, New York, New York in conjunction with Textural classification triangle for unconsolidated materials showing the relationship between particle size and specific yield, from Fetter, C.W., 1994, Applied Hydrogeology, Prentice Hall, Upper Saddle River, New Jersey. Calculations are presented in Appendix III. Total porosity values were also calculated

from the soil samples selected for permeability tests. The estimates are included in Table 4, Summary of Porosity Data.

Horizontal groundwater flow rates in the landfill observation wells were calculated (Table 5). These flow rates are based on the horizontal hydraulic gradients in the landfill area obtained from Sheet 2 of 7, Groundwater Surface Map in Appendix IV, the estimated effective porosity for the predominant lithologic unit in the saturated interval of the screen, and the calculated hydraulic conductivity based on the in-situ permeability tests. As presented in Table 5, groundwater flow rates could range from 1 to 58 feet per year (geometric average of 13 feet per year) in the landfill.

Based on the horizontal hydraulic gradients and the permeability of the uppermost aquifer, groundwater flow in the uppermost aquifer is expected to follow the same general trend as the groundwater surface and in the direction perpendicular to the groundwater contours shown on Sheet 2 of 7, Groundwater Surface Map in Appendix IV. Groundwater flow directions are indicated on Sheets 5, 6 and 7 of 7, Hydrogeological Cross-Sections in Appendix IV where the cross-sections are perpendicular or nearly so to the equipotentials.

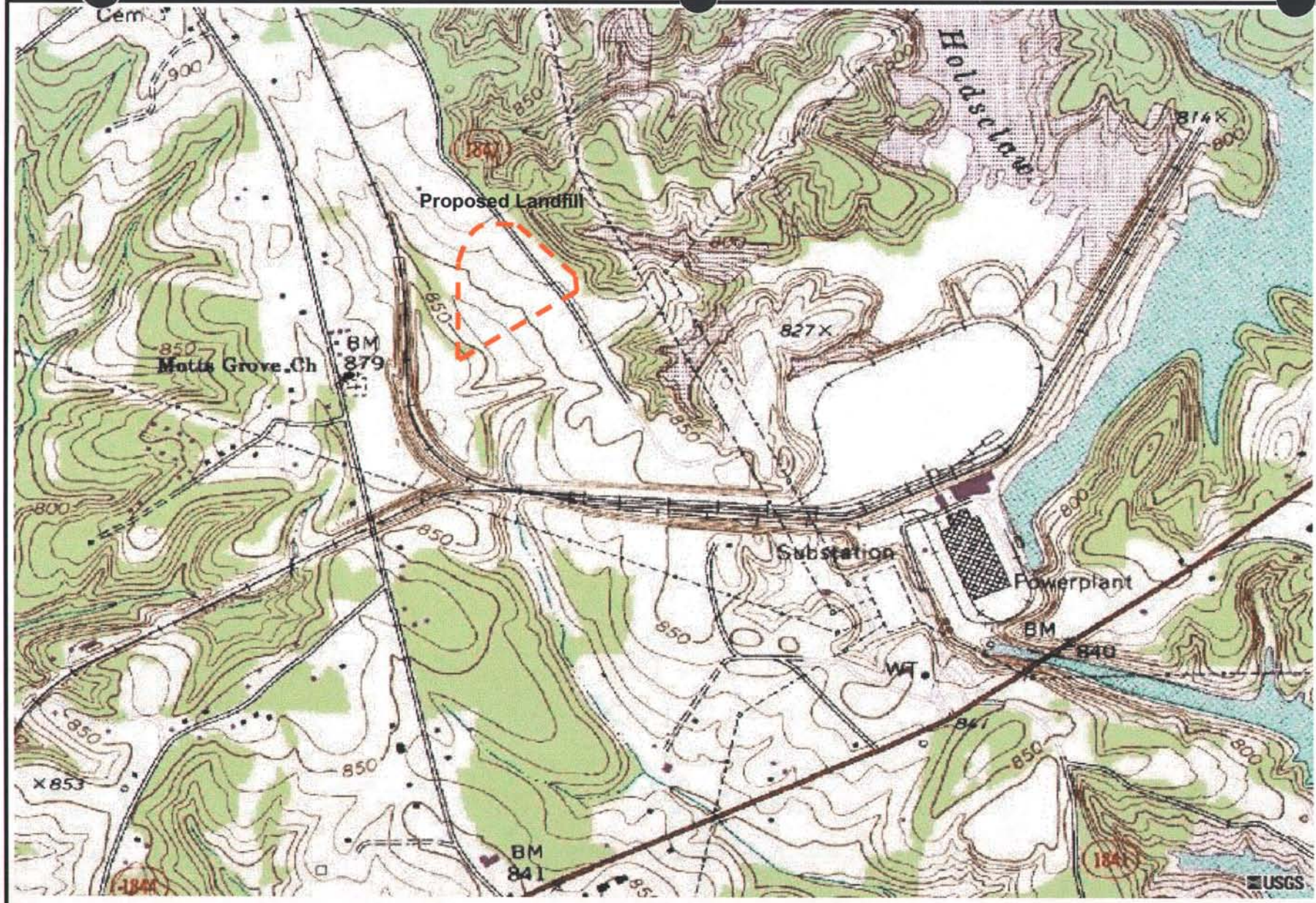
In general, the uppermost aquifer in the landfill area is expected to be typical of local and regional conditions. The predominant groundwater discharge areas are expected to be ash basins located east of the landfill area.

5.5 Fracture Trace Analysis

S&ME performed a fracture trace analysis of the Marshall Steam Station Site and surrounding areas. Information about the structural geology of the area was obtained by reviewing topographic maps for fracture traces within a 1.5-mile radius of the proposed landfill (Figure 4). Fracture traces are recognized on maps as relatively straight-line, non-man made topographic depressions, which are interpreted as surface expressions of underlying fracture zones in the bedrock. The identification of such straight-line features was limited to features greater than or equal to 1000 feet in length. The location of such fracture traces may aid in the location of zones of high hydraulic conductivity.

Nineteen fracture traces were identified within a 1.5-mile radius of the site (Figure 4). The fracture traces were plotted on a rose diagram (Figure 5) which graphically represents the percentage of fracture traces with orientations occurring in each 10°-azimuth increment. The principle direction bearing of NE-SW is indicated on the diagram.

Figures



Source: Terraserver, 1996 USGS Topo

SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JRP
DATE:	2/15/03

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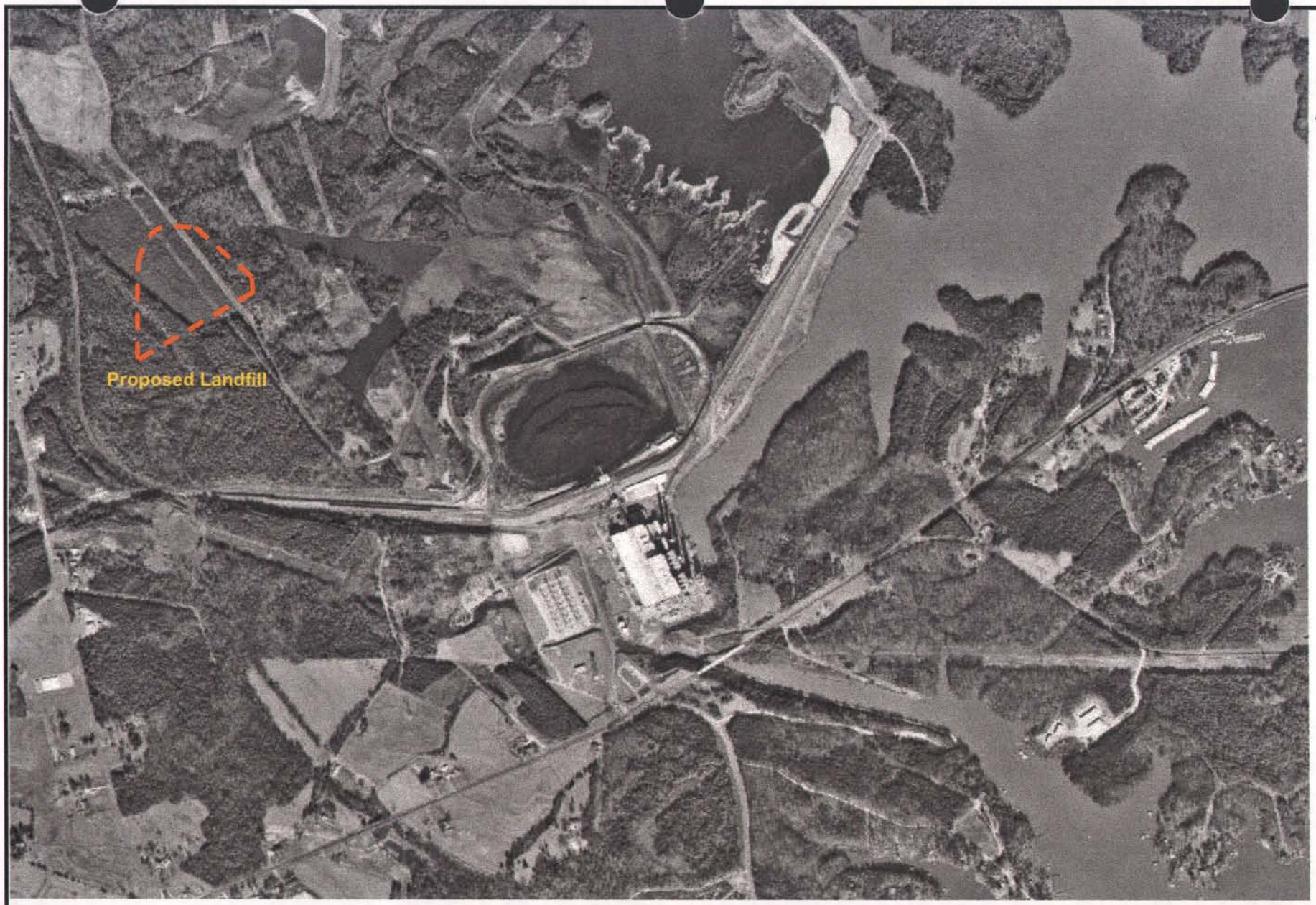
SITE LOCATION MAP - USGS TOPO
Marshall Steam Station - FGD Scrubber Landfill
Terrell, Catawba County, North Carolina

JOB NO. 1264-02-578

FIGURE NO. 1



Source: Terraserver, 1993 Aerial

SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JRP
DATE:	2/15/03

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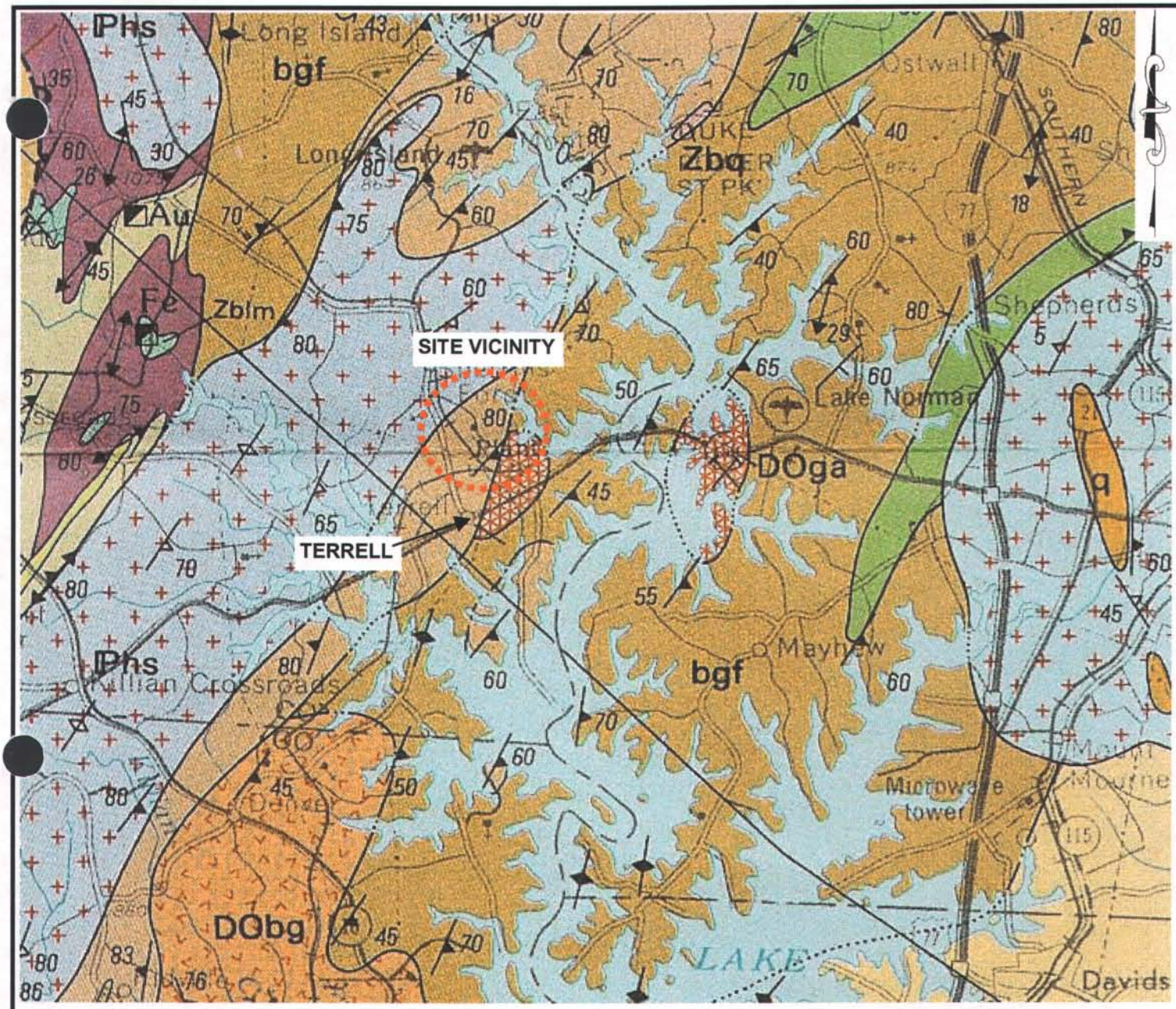
SITE LOCATION AERIAL
Marshall Steam Station - FGD Scrubber Landfill
Terrell, Catawba County, North Carolina

JOB NO. 1264-02-578

FIGURE NO. 2



Battleground Formation (Late Proterozoic)

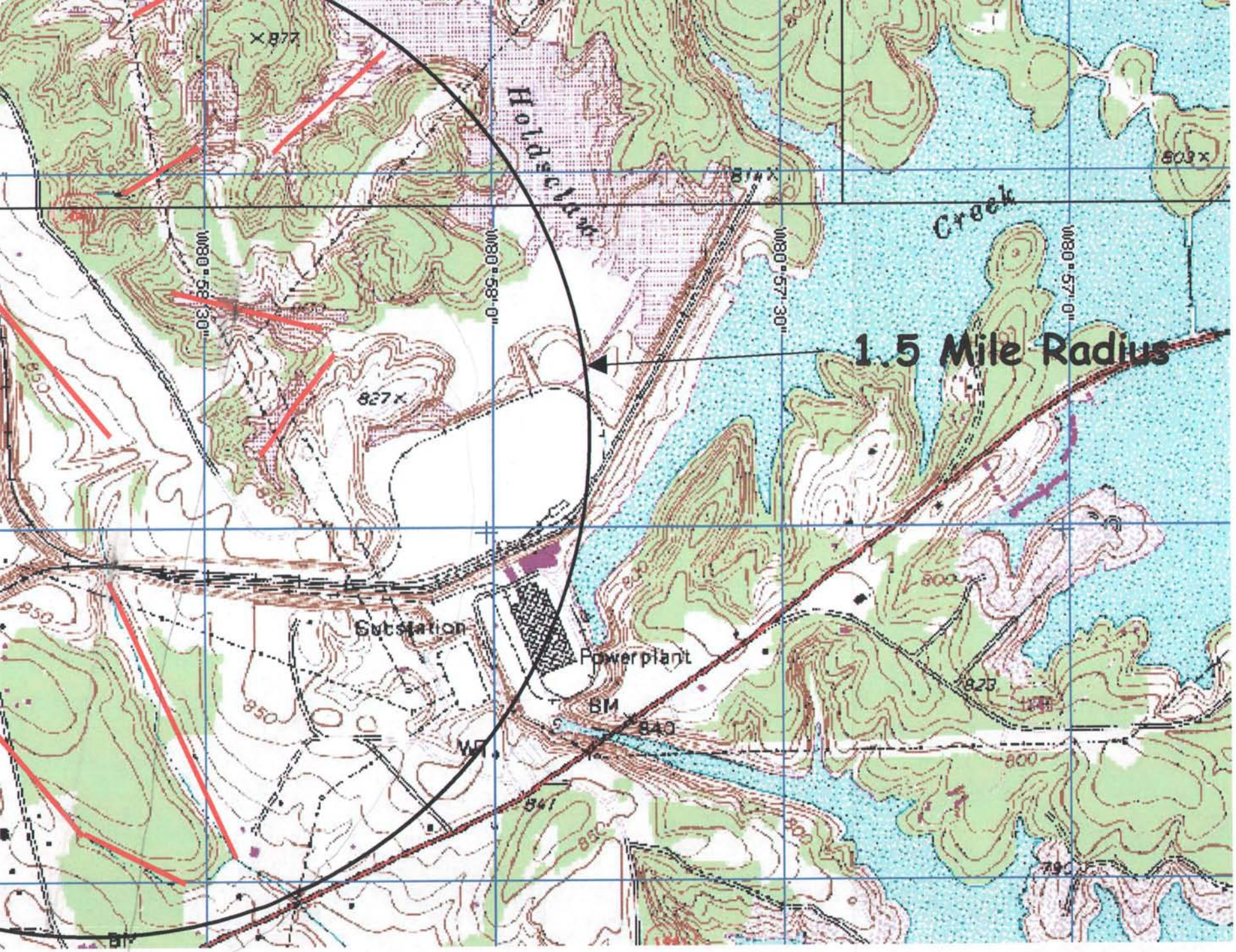
Zbs — Quartz-sericite schist—Very fine to medium-grained quartz-sericite schist and phyllite. Very light gray, light-bluish-gray, light-brown, or yellowish-gray. Composed largely of quartz (typically >50%) and sericitic white mica (muscovite and paragonite). Accessory minerals may include chloritoid, biotite, pyrite, hematite, kyanite, andalusite, sillimanite, staurolite, garnet, oligoclase or albite, chlorite, tourmaline, zircon, and graphite

DOga — Alaskitic granite—Fine-grained, light-gray, muscovite-biotite alaskitic granite. Massive, locally with weak flow foliation

bgf — Fine-grained biotite gneiss—Dominantly of granodioritic composition. Probably metamorphosed dacitic volcanics

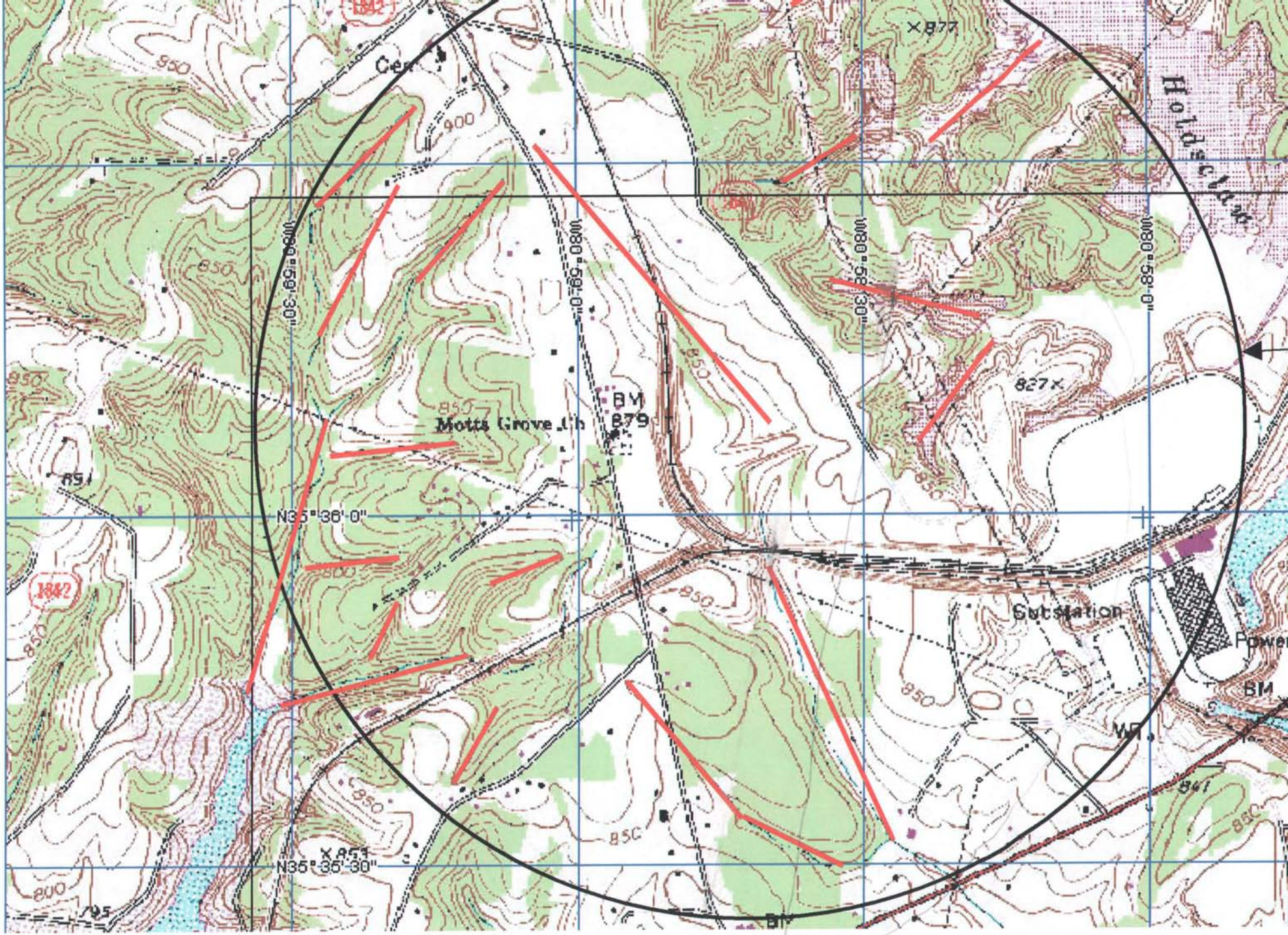
Source: Charlotte Geologic Map

SCALE: NTS	S&ME ENVIRONMENTAL SERVICES • ENGINEERING • TESTING	**GEOLOGIC MAP**	Figure No.
CHECKED BY:		Marshall Steam Station - FGD Scrubber Landfill	3
DRAWN BY: JRP		Terrell, North Carolina	
DATE: 12/20/2002		JOB NO. 1264-02-578	



1" = 2000'

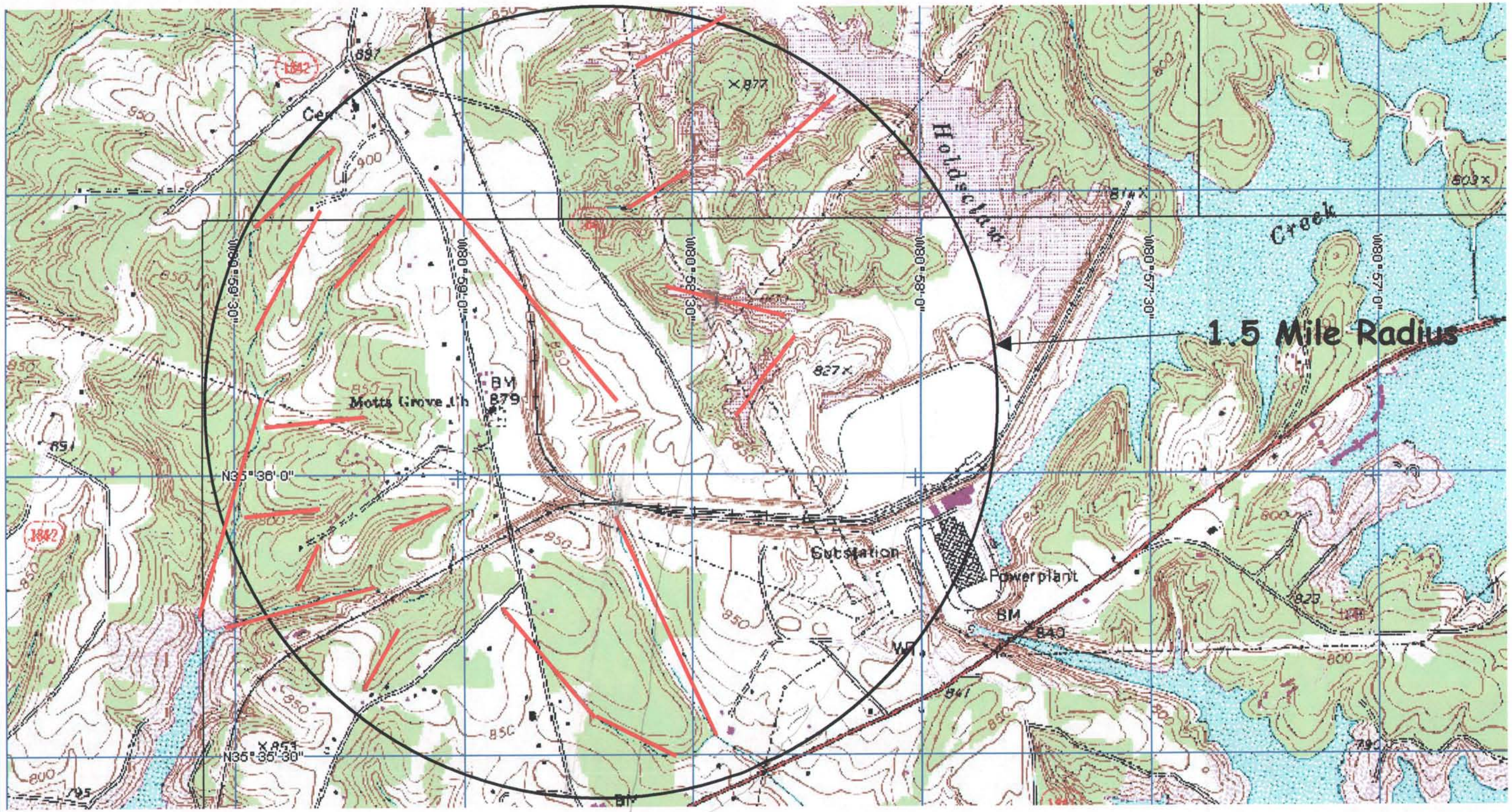
SCALE: 1" = 2000'	SCME	**FRACTURE TRACE SURVEY** MARSHALL STEAM STATION FGD LANDFILL	FIGURE NO.



Fracture Trace

SCALE:	1" = 2000'
CHECKED BY:	

SOURCE:



Fracture Trace

1" = 2000'

SOURCE:
USGS TOPOGRAPHIC MAP
TOPO USA 4.0

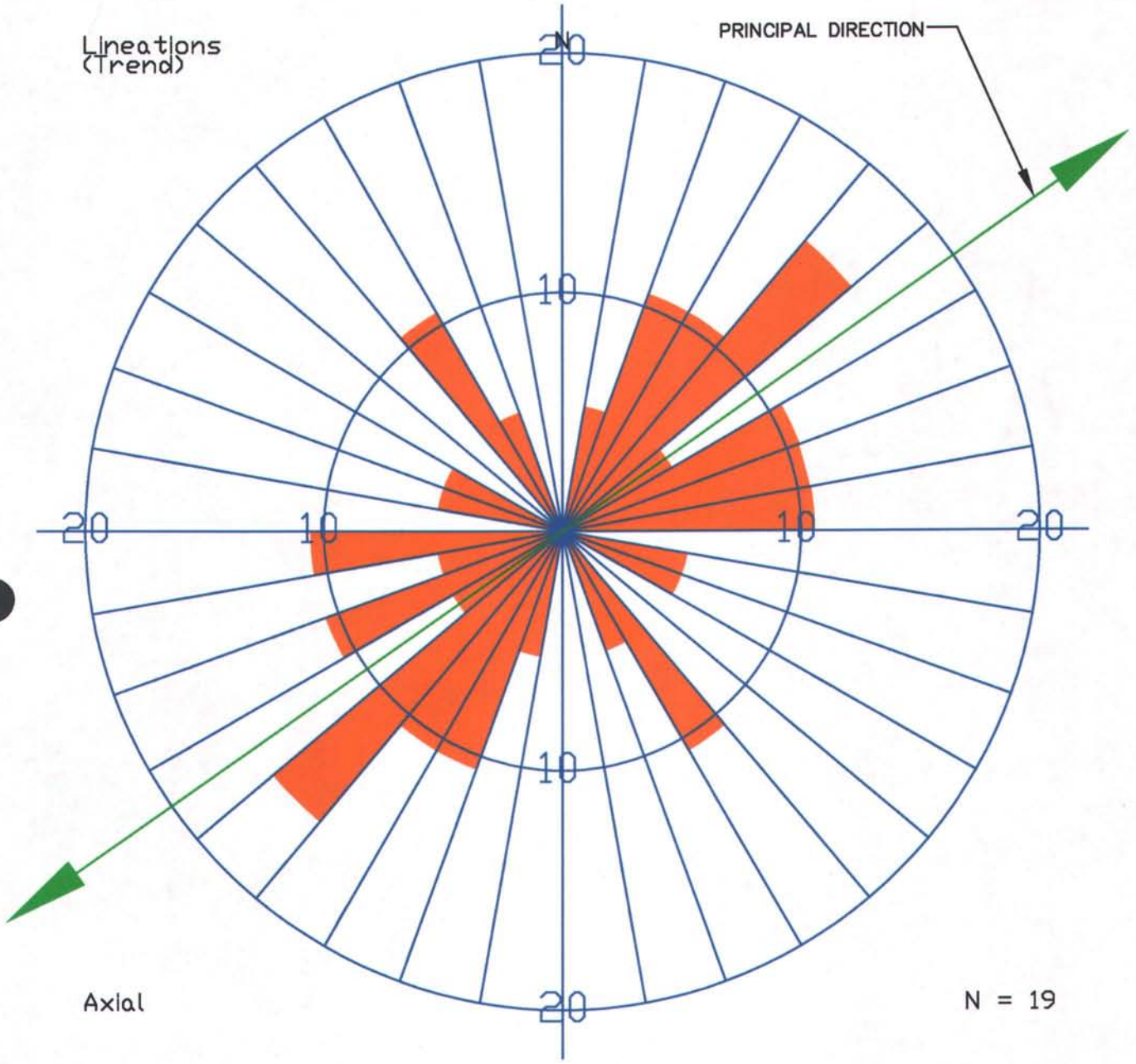
SCALE:	1" = 2000'
CHECKED BY:	
DRAWN BY:	JRP
DATE:	5/22/03

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

FRACTURE TRACE SURVEY
MARSHALL STEAM STATION-FGD LANDFILL
TERRELL, CATAWBA COUNTY, NC

JOB NO. 1264-02-578

FIGURE NO. **4**



SCALE: AS SHOWN	S&ME ENGINEERING · TESTING ENVIRONMENTAL SERVICES	FRACTURE TRACE ORIENTATIONS	FIGURE NO.
CHECKED BY:		MARSHALL STEAM STATION – FGD LANDFILL TERRELL, NORTH CAROLINA	5
DRAWN BY: JRP			
DATE: 5–27–03		JOB NO: 1264–02–578	

Tables

Table 1
Survey and Well Construction Data

Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578

Well ID	Northing	Easting	Ground Surface Elevation (ft-msl)	Top of Casing Elevation (ft-msl)	Stick-up (ft-als)	Riser Interval (ft-bls)	Screen Interval (ft-bls)	Grout Interval (ft-bls)	Bentonite Interval (ft-bls)	Sand Pack Interval (ft-bls)	Top of PWR (ft-bls)	Top of Bedrock (ft-bls)	Top of Bedrock (ft-msl)
B-1	681146.91	141271.80	808.59	811.57	2.98	0 to 6	6 to 16	0 to 3	3 to 5	5 to 16	13.5	25.5	783.09
B-2	680914.96	1412408.71	857.85	860.76	2.91	0 to 44	44 to 54	0 to 40	40 to 42	42 to 54	57	70	787.85
B-3	680602.94	1412624.39	856.18	859.34	3.16	0 to 46	46 to 56	0 to 42	42 to 44	44 to 56	68.5	>90	<766.18
B-4	680428.02	1412993.27	858.42	861.47	3.05	0 to 49	49 to 59	0 to 45	45 to 47	47 to 59	58.5	>90	<768.42
B-5	679968.41	1413123.89	841.27	844.07	2.80	0 to 31	31 to 41	0 to 27	27 to 29	29 to 41	44	78	763.27
B-6	680035.53	1412750.03	851.59	854.50	2.91	0 to 37	37 to 47	0 to 33	33 to 35	35 to 47	58.5	>90	<761.59
B-7	679556.21	1413059.02	851.68	854.55	2.87	0 to 50.5	50.5 to 60.5	0 to 46.5	46.5 to 48.5	48.5 to 60.5	38.5	64.5	787.18
MS-1	680783.33	1413134.44	813.33	816.32	2.99	0 to 14	14 to 24	0 to 10	10 to 12	12 to 24	32	54.5	758.83
MS-2	680048.86	1413358.83	820.17	823.18	3.01	0 to 19.5	19.5 to 29.5	0 to 15.5	15.5 to 17.5	17.5 to 29.5	28.5	35.5	784.67
MS-3	679780.73	1413390.57	811.50	814.53	3.03	0 to 10	10 to 20	0 to 6	6 to 8	8 to 20	32	45	766.50
MS-4	679168.92	1412970.30	844.60	847.68	3.08	0 to 36	36 to 46	0 to 32	32 to 34	34 to 46	48.5	79.5	765.10
MS-5	679223.17	1412595.39	839.10	842.04	2.94	0 to 28	28 to 38	0 to 24	24 to 26	26 to 38	53.5	>90	<749.1
MS-6	679732.80	1412500.68	839.19	841.90	2.71	0 to 28	28 to 38	0 to 24	24 to 26	26 to 38	38.5	61	778.19
MS-7	680161.50	1412251.27	833.14	836.18	3.04	0 to 16	16 to 26	0 to 12	12 to 14	14 to 26	33.5	36.8	796.34
MS-8	680717.89	1412027.98	848.31	851.42	3.11	0 to 20	20 to 30	0 to 16	16 to 18	18 to 30	38.5	52	796.31
MS-9	681384.45	1412181.74	865.36	868.04	2.68	0 to 40	40 to 50	0 to 36	36 to 38	38 to 50	53.5	74	791.36
MS-10	681027.64	1411622.46	848.29	851.29	3.00	0 to 10	10 to 20	0 to 6	6 to 8	8 to 20	38.5	44	804.29
MS-11	680297.49	1411564.82	856.87	859.78	2.91	0 to 29	29 to 39	0 to 25	25 to 27	27 to 39	43.5	59	797.87
OW-1	680557.37	1411953.15	839.40	842.50	3.10	0 to 16	16 to 26	0 to 12	12 to 14	14 to 26	>26	>26	<813.4
OW-2	680264.15	1412126.18	833.38	836.36	2.98	0 to 16	16 to 26	0 to 12	12 to 14	14 to 26	>26	>26	<807.38
OW-3	679540.04	1412086.50	832.70	835.66	2.96	0 to 17	17 to 27	0 to 13	13 to 15	15 to 27	>26	>26	<806.7

Notes:
ft-msl: Feet - mean sea level
ft-als: Feet - above land surface
ft-bls: Feet - below land surface
PWR: Partailly Weathered Rock

Table 2
Groundwater Level Elevations

Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578

Well ID:	B-1	B-2	B-3	B-4	B-5	B-6	B-7	MS-1	MS-2	MS-3	MS-4	MS-5	MS-6	MS-7	MS-8	MS-9	MS-10	MS-11	OW-1	OW-2	OW-3
Installation Date:	1/15/03	12/16/02	12/11/02	12/3/02	1/7/03	12/9/02	1/10/03	12/3/02	1/6/03	12/3/02	1/8/03	12/18/02	12/17/02	1/3/02	1/14/03	1/16/03	7/8/03	7/9/03	2/12/03	2/12/03	2/11/03
TOC Elevation:	811.57	860.76	859.34	861.47	844.07	854.50	854.55	816.32	823.18	814.53	847.68	842.04	841.90	836.18	851.42	868.04	851.29	859.78	842.50	836.36	835.66
TIME OF BORING																					
DTW-TOC:	11.78	49.91	57.16	60.55	40.80	44.71	60.37	18.99	30.51	17.03	46.98	34.94	31.36	22.54	30.61	55.08	20.00	36.91	23.10	23.98	25.46
WL-ELEV.:	799.79	810.85	802.18	800.92	803.27	809.79	794.18	797.33	792.67	797.50	800.70	807.10	810.54	813.64	820.81	812.96	831.29	822.87	819.40	812.38	810.20
24 - HOUR																					
DTW-TOC:	10.38	48.55	52.16	55.05	39.10	45.53	49.37	16.99	23.51	15.88	42.28	34.55	29.60	22.54	30.31	47.18	15.00	35.91	23.11	20.54	20.85
WL-ELEV.:	801.19	812.21	807.18	806.42	804.97	808.97	805.18	799.33	799.67	798.65	805.40	807.49	812.30	813.64	821.11	820.86	836.29	823.87	819.39	815.82	814.81
FEBRUARY 6, 2003																					
DTW-TOC:	10.35	47.60	50.45	55.01	38.73	44.49	49.30	14.29	23.60	15.42	42.12	34.18	29.83	22.14	29.90	45.47					
WL-ELEV.:	801.22	813.16	808.89	806.46	805.34	810.01	805.25	802.03	799.58	799.11	805.56	807.86	812.07	814.04	821.52	822.57					
FEBRUARY 25, 2003																					
DTW-TOC:	10.05	47.38	50.24	54.68	38.50	44.29	49.29	12.85	23.29	15.03	41.94	34.04	28.94	21.94	29.70	45.30			20.93	20.43	22.88
WL-ELEV.:	801.52	813.38	809.10	806.79	805.57	810.21	805.26	803.47	799.89	799.50	805.74	808.00	812.96	814.24	821.72	822.74			821.57	815.93	812.78
MARCH 28, 2003																					
DTW-TOC:	9.79	46.77	49.53	53.97	37.80	43.62	48.87	11.55	22.43	14.51	41.42	33.41	27.60	20.50	29.00	44.73			20.16	19.26	21.09
WL-ELEV.:	801.78	813.99	809.81	807.50	806.27	810.88	805.68	804.77	800.75	800.02	806.26	808.63	814.30	815.68	822.42	823.31			822.34	817.10	814.57
APRIL 29, 2003																					
DTW-TOC:	9.46	45.77	48.30	52.63	35.92	42.61	47.94	9.93	21.73	14.03	40.54	32.32	26.39	18.77	27.98	43.39			19.11	17.58	19.21
WL-ELEV.:	802.11	814.99	811.04	808.84	808.15	811.89	806.61	806.39	801.45	800.50	807.14	809.72	815.51	817.41	823.44	824.65			823.39	818.78	816.45
MAY 28, 2003																					
DTW-TOC:	9.03	44.99	47.24	51.35	34.05	41.73	47.02	7.70	21.55	13.60	39.67	31.46	25.49	17.23	27.05	42.17			18.11	16.08	17.44
WL-ELEV.:	802.54	815.77	812.10	810.12	810.02	812.77	807.53	808.62	801.63	800.93	808.01	810.58	816.41	818.95	824.37	825.87			824.39	820.28	818.22
JUNE 30, 2003																					
DTW-TOC:	9.43	43.86	45.94	50.29	31.48	40.49	45.52	9.50	21.74	13.84	38.35	30.31	25.65	16.88	26.16	40.44			17.39	15.60	18.00
WL-ELEV.:	802.14	816.90	813.40	811.18	812.59	814.01	809.03	806.82	801.44	800.69	809.33	811.73	816.25	819.30	825.26	827.60			825.11	820.76	817.66
August 8, 2003																					
DTW-TOC:	9.51	43.07	45.17	49.45	30.33	39.46	43.95	9.88	22.01	13.85	37.09	29.99	26.61	16.65	25.57	39.36	15.22	29.95	16.78	15.19	18.77
WL-ELEV.:	802.06	817.69	814.17	812.02	813.74	815.04	810.60	806.44	801.17	800.68	810.59	812.05	815.29	819.53	825.85	828.68	836.07	829.83	825.72	821.17	816.89

Notes:

TOC	Top of casing
DTW-TOC	Depth to water below top of casing
WL-Elev	Water level elavation

Table 3 — **Marshall Steam Station - FGD Scrubber Landfill**

Summary of Field and Laboratory Permeability Data — **S&ME Project No. 1264-02-578**

FIELD

Well ID	Saturated Depths (ft-bls)	Soil Description	Predominant Geologic Unit	Hydraulic Conductivity (ft/day)	Hydraulic Conductivity (cm/sec)	Test Method
B-3	49 - 56	Sl. Clayey Silty M/F Sand	Saprolite	5.0E-01	1.8E-04	Slug Test
B-4	52 - 59	Fine Sandy Silt	Saprolite	4.4E-01	1.6E-04	Slug Test
B-6	42.62 - 47	Sl. Clayey Silty M/F Sand	Saprolite	4.4E-01	1.6E-04	Slug Test
B-7	46.5 - 60.5	Sl. Clayey Silty M/F Sand	PWR	6.1E-02	2.1E-05	Slug Test
MS-2	20.5 - 29.5	Silty Fine Sand	Saprolite	6.4E-01	2.3E-04	Slug Test
MS-4	39.2 - 46	Silty Fine Sand	Saprolite	1.6E+00	5.6E-04	Slug Test
MS-5	31.61 - 38	Sl. Clayey Silty C/F Sand	Saprolite	1.3E+00	4.6E-04	Slug Test
MS-6	26.89 - 38	Silty M/F Sand	Saprolite	2.9E-01	1.0E-04	Slug Test
MS-7	19.5 - 26	Sl. Clayey Silty M/F Sand	Saprolite	8.7E-01	3.1E-04	Slug Test
MS-8	27.2 - 30	Silty M/F Sand	Saprolite	5.5E-01	1.9E-04	Slug Test
MS-10	12.2 - 20	Fine Sandy Silt	Saprolite	4.0E-01	1.4E-04	Slug Test
MS-11	27 - 39	Silty C/F Sand	Saprolite	5.0E-01	1.8E-04	Slug Test
OW-1	20.01 - 26	Silty C/F Sand	Saprolite	1.6E+00	5.8E-04	Slug Test
OW-2	17.55 - 26	Silty C/F Sand	Saprolite	1.0E+00	3.7E-04	Slug Test
OW-3	17.89 - 27	Silty M/F Sand	Saprolite	2.0E+00	7.2E-04	Slug Test
Geometric Average (All)					2.2E-04	
Arithmetic Average (All)					2.9E-04	
Geometric Average (Saprolite)					2.6E-04	
Arithmetic Average (Saprolite)					3.3E-04	

Notes:

Geometric averages were obtained by taking the natural log of the individual hydraulic conductivity values, finding the mean of the natural logs for the geologic unit, and then obtaining the exponential of that value.

Example: Geometric Average (selected saprolite wells)

Well ID	K	ln(K)
B-3	1.8E-04	-8.64
B-4	1.6E-04	-8.76
B-6	1.6E-04	-8.77
	mean ln(K) =	-8.72
	exp(mean ln(K))=	1.6E-04

Table 3
Summary of Field and Laboratory Permeability Data

Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578

LABORATORY

Well ID	Sample Depth (ft-bls)	Soil Description	Predominant Geologic Unit	Sample Type	Confining Pressure (psi)	Hydraulic Conductivity (cm/sec)
B-1	0 - 10	Micaceous Sandy Silt	Residuum	Bag	2.5	1.2E-05
B-2	0 - 10	Clayey Silt	Residuum	Bag	2.5	3.7E-06
B-3	50 - 52	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	UD	10 20 30	1.2E-04 9.6E-05 8.9E-05
B-4	0 - 10	Clayey Silt	Residuum	Bag	2.5	4.9E-06
B-5	0 - 10	Micaceous Clayey Silt	Residuum	Bag	2.5	6.1E-06
B-6	43 - 45	Sl. Clayey Silty M/F Sand	Saprolite	UD	10 20 30	7.2E-05 4.8E-05 5.4E-05
B-7	30 - 32	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	UD	10 20 30	1.3E-03 1.3E-03 1.3E-03
B-7	0 - 10	Clayey Silt	Residuum	Bag	2.5	1.71-05
MS-1	20 - 22	Clayey M/F Sandy Silt	Saprolite	UD	10 20	2.2E-07 1.2E-07
MS-3	15 - 17	Sl. Clayey Silty C/F Sand	Saprolite	UD	10 20	5.7E-04 6.1E-04
MS-5	32 - 34	Micaceous Sl. Clayey Silty C/F Sand	Saprolite	UD	10 20	3.5E-04 4.7E-04

K_H vs K_V

Well ID	Slug Test Saturated Depth (ft-bls)	Undisturbed Sample Depth (ft-bls)	Predominant Geologic Unit	K Horizontal (cm/sec)	K Vertical (cm/sec)
B-3	49 - 56	50 - 52	Saprolite	1.8E-04	1.2E-04
B-6	42.62 - 47	43 - 45	Saprolite	1.6E-04	7.2E-05
MS-5	31.61 - 38	32-34	Saprolite	4.6E-04	3.5E-04

Table 4
Summary of Porosity Data

Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578

Well ID	Sample Type	Sample Depth	Soil Desription	Predominant Geologic Unit	USCS Classification	Soil Laboratory Data Used For Calculation	Effective Porosity	Total Porosity
BULK SAMPLES (BAG)								
B-1	BAG	0 - 10'	Micaceous Sandy Silt	Residuum	ML	Proctor	- - -	0.34
B-1	BAG	0 - 10'	Micaceous Sandy Silt	Residuum	ML	Remolded Permeabilty	- - -	0.40
							AVE	**0.37**
B-2	BAG	0 - 10'	Clayey Silt	Residuum	MH	Proctor	- - -	0.46
B-2	BAG	0 - 10'	Clayey Silt	Residuum	MH	Remolded Permeabilty	- - -	0.44
							AVE	**0.45**
B-3	BAG	0 - 10'	Sandy Clayey Silt	Residuum	MH	Proctor	- - -	0.45
B-4	BAG	0 - 10'	Clayey Silt	Residuum	MH	Proctor	- - -	0.48
B-4	BAG	0 - 10'	Clayey Silt	Residuum	MH	Remolded Permeability	- - -	0.41
							AVE	**0.45**
B-5	BAG	0 - 10'	Micaceous Clayey Silt	Residuum	MH	Proctor	- - -	0.47
B-5	BAG	0 - 10'	Micaceous Clayey Silt	Residuum	MH	Remolded Permeability	- - -	0.47
							AVE	**0.47**
B-6	BAG	0 - 10'	Micaceous Clayey Silt	Residuum	MH	Proctor	- - -	0.44
B-7	BAG	0 - 10'	Clayey Silt	Residuum	MH	Proctor	- - -	0.51
B-7	BAG	0 - 10'	Clayey Silt	Residuum	MH	Remolded Permeability	- - -	0.49
							AVE	**0.50**
UNDISTURBED SAMPLES (UD)								
B-3	UD	50 - 52'	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	SM	Hydrometer	0.30	0.42
B-3	UD	50 - 52'	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	SM	Permeability	- - -	0.56
							AVE	**0.49**
B-6	UD	43 - 45'	Sl. Clayey Silty M/F Sand	Saprolite	SM	Hydrometer	0.31	0.42
B-6	UD	43 - 45'	Sl. Clayey Silty M/F Sand	Saprolite	SM	Permeability	- - -	0.60
							AVE	**0.51**
B-7	UD	30 - 32'	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	SM	Hydrometer	0.37	0.40
B-7	UD	30 - 32'	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	SM	Permeability	- - -	0.52
							AVE	**0.46**
MS-1	UD	20 - 22'	Clayey M/F Sandy Silt	Saprolite	ML	Hydrometer	0.08	0.45
MS-1	UD	20 - 22'	Clayey M/F Sandy Silt	Saprolite	ML	Permeability	- - -	0.46
							AVE	**0.46**
MS-3	UD	15 - 17'	Sl. Clayey Silty C/F Sand	Saprolite	SM	Hydrometer	0.32	0.41
MS-3	UD	15 - 17'	Sl. Clayey Silty C/F Sand	Saprolite	SM	Permeability	- - -	0.54
							AVE	**0.48**
MS-5	UD	32 - 34'	Micaceous Sl. Clayey Silty C/F Sand	Saprolite	SM	Hydrometer	0.29	0.43
MS-5	UD	32 - 34'	Micaceous Sl. Clayey Silty C/F Sand	Saprolite	SM	Permeability	- - -	0.58
							AVE	**0.50**
SPLIT SPOON SAMPLES (SS)								
B-2	SS	48.5 - 50'	Micaceous Silty M/F Sand	Saprolite	SM	Hydrometer	0.26	0.43
B-5	SS	33.5 - 35'	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	SM	Hydrometer	0.25	0.43
B-7	SS	48.5 - 60'	Sl. Clayey Silty M/F Sand with Rock Frag	PWR	SM	Hydrometer	0.29	0.35
MS-7	SS	18.5 - 20	Micaceous Sl. Clayey Silty M/F Sand	Saprolite	SM	Hydrometer	0.27	0.43
MS-8	SS	23.5 - 25'	Micaceous Sl. Clayey Silty C/F Sand	Saprolite	SM	Hydrometer	0.25	0.43

Notes:

Porosity from Hydrometers was calculated from Fetter and Bear diagrams based on Grain size (Calculation in App III).

Porosity from Proctors calculated in Appendix III, based on Maximum Dry Density.

Porosity from Permeabilities calculated the same as from proctors, except dry density was taken from unit weight of soil in shelby tube.

Table 5

Groundwater Flow Velocity

Marshall Steam Station - FGD Scrubber Landfill

S&ME Project No. 1264-02-578

					08/08/2003				
		K	*n*				*I*	*v*	
Well ID	TOC Elev.	Hydraulic Cond. (ft/day)	porosity		DTW-TOC (ft)	WL-Elev. (ft)	Gradient (ft/ft)	Flow Velocity (ft/yr)	Predominant Geologic Unit
			effective (ne)	total (n)					
B-1	811.57	6.4E-01	26%	43%	9.51	802.06	0.06	54	Saprolite
B-2	860.76	5.0E-01	26%	43%	43.07	817.69	0.02	14	Saprolite
B-3	859.34	5.0E-01	30%	42%	45.17	814.17	0.02	12	Saprolite
B-4	861.47	4.4E-01	30%	42%	49.45	812.02	0.01	5	Saprolite
B-5	844.07	6.4E-01	25%	43%	30.33	813.74	0.01	9	Saprolite
B-6	854.50	4.4E-01	31%	42%	39.46	815.04	0.007	4	Saprolite
B-7	854.55	6.1E-02	37%	40%	43.95	810.60	0.01	1	PWR
MS-1	816.32	6.4E-01	8%	45%	9.88	806.44	0.02	58	Saprolite
MS-2	823.18	6.4E-01	32%	41%	22.01	801.17	0.04	29	Saprolite
MS-3	814.53	6.4E-01	32%	41%	13.85	800.68	0.03	22	Saprolite
MS-4	847.68	1.6E+00	37%	40%	37.09	810.59	0.004	6	Saprolite
MS-5	842.04	1.3E+00	29%	43%	29.99	812.05	0.01	16	Saprolite
MS-6	841.90	2.9E-01	31%	42%	26.61	815.29	0.01	3	Saprolite
MS-7	836.18	8.7E-01	27%	43%	16.65	819.53	0.01	12	Saprolite
MS-8	851.42	5.5E-01	25%	43%	25.57	825.85	0.02	16	Saprolite
MS-9	868.04	5.0E-01	26%	43%	39.36	828.68	0.03	21	Saprolite
MS-10	851.29	4.0E-01	30%	42%	15.22	836.07	0.02	10	Saprolite
MS-11	859.78	5.0E-01	25%	43%	29.95	829.83	0.02	15	Saprolite
OW-1	842.50	1.6E+00	25%	43%	16.78	825.72	0.02	47	Saprolite
OW-2	836.36	1.0E+00	25%	43%	15.19	821.17	0.01	15	Saprolite
OW-3	835.66	2.0E+00	29%	43%	18.77	816.89	0.01	25	Saprolite
							Geometric Average	13	
							ArithmetricAverage	19	

Note: Flow Velocity = (K*I)/ne

Shaded numbers indicate value estimated from similar soil types

K value from Bouwer and Rice Slug Test Data

Porosity values from Fetter and Bear Calculations

SUMMARY OF LABORATORY TEST DATA
TABLE 6

Boring No.	Sample Depth (Ft)	Sample Type *	USCS Class.	Soil Description	Hydro-geologic Unit	Natural Moisture Content (%)	% Finer No. 200	Atterberg Limits		Specific Gravity	Unit Weight (pcf)	Hydraulic Conductivity k (cm/sec)	Proctor Data	
								LL	PI				Max. Dry Density (pcf)	Opt. Moisture Content (%)
B-1	3.5 - 5	SS	CL	Coarse/Fine Sandy Silty Clay	Residuum		54.2	46	22					
B-1	0 - 10	BAG	ML	Sandy Silt	Residuum	20.8		34	9	2.63	102.3	See Lab Data Sheets	108.4	17.2
B-2	48.5 - 50	SS	SM	Silty Med/Fine Sand	Saprolite		46.1	NP	NP					
B-2	0 - 10	BAG	MH	Clayey Silt	Residuum	28		56	15	2.67	85.4	See Lab Data Sheets	89.7	25.1
B-3	18.5 - 20	SS	MH	Med/Fine Sandy Clayey Silt	Saprolite		71.7	55	11	2.67				
B-3	68.5 - 75	SS	SM	Sl. Clayey Silty Med/Fine Sand	PWR		37.1	35	2	2.74				
B-3	0 - 10	BAG	MH	Clayey Silt	Residuum	21.6		58	22	2.68			92.4	27.3
B-3	50 - 52	UD	SM	Sl. Clayey Silty Med/Fine Sand	Saprolite	26.7	26.5	NP	NP	2.77	99.8	See Lab Data Sheets		
B-4	3.5 - 5	SS	MH	Med/Fine Sandy Clayey Silt	Residuum		69.1	64	16					
B-4	0 - 10	BAG	MH	Clayey Silt	Residuum	23.1		69	20	2.73	83.3	See Lab Data Sheets	88	29.4

Note: Graphic Presentations of Results of Proctor, Grain Size, and other tests follow this summary in Appendix II

* SS = Split Spoon Sample (ASTM D-1586)
UD = Undisturbed Sample (ASTM D-1587)
BAG = Bulk Sample
NP = Non Plastic

JOB NAME: **Marshall Steam Station - FGD Scrubber Landfill**
LOCATION: **Terrell, North Carolina**
JOB NUMBER: **1264-02-578**

SUMMARY OF LABORATORY TEST DATA
TABLE 6

Boring No.	Sample Depth (Ft)	Sample Type *	USCS Class.	Soil Description	Hydro-geologic Unit	Natural Moisture Content (%)	% Finer No. 200	Atterberg Limits		Specific Gravity	Unit Weight (pcf)	Hydraulic Conductivity k (cm/sec)	Proctor Data	
								LL	PI				Max. Dry Density (pcf)	Opt. Moisture Content (%)
B-5	8.5 - 10	SS	SM	Clayey Silty Med/Fine Sand	Residuum		42.7	NP	NP					
B-5	33.5 - 35	SS	SM	Clayey Silty Med/Fine Sand	Saprolite		33	39	NP					
B-5	0 - 10	BAG	MH	Clayey Silt	Residuum	30.8		59	17	2.75	86.4	See Lab Data Sheets	90.9	27.4
B-6	3.5 - 5.0	SS	SM	Clayey Silty Med/Fine Sand	Residuum		44.9	48	3					
B-6	58.5- 60	SS	SM	Sl. Clayey Silty Med/Fine Sand	PWR		30.8	NP	NP					
B-6	43 - 45	UD	SM	Clayey Silty Med/Fine Sand	Saprolite	39.4	31.9	37	NP	2.67	84.7	See Lab Data Sheets		
B-6	0 - 10	BAG	MH	Clayey Silt	Residuum	27.6		52	11	2.66			93	25
B-7	48.5 - 60	SS	SM	Sl. Clayey Silty Med/Fine Sand	PWR		20.9	NP	NP	2.81				
B-7	30 - 32	UD	SM	Sl. Clayey Silty Med/Fine Sand	Saprolite	9.3	11.5	NP	NP	2.85	99.4	See Lab Data Sheets		
B-7	0 - 10	BAG	MH	Clayey Silt	Residuum	28.5		62	14	2.77	80.7	See Lab Data Sheets	84.8	32.9

Note: Graphic Presentations of Results of Proctor, Grain Size, and other tests follow this summary in Appendix II

* SS = Split Spoon Sample (ASTM D-1586)
UD = Undisturbed Sample (ASTM D-1587)
BAG = Bulk Sample
NP = Non Plastic

JOB NAME: **Marshall Steam Station - FGD Scrubber Landfill**
LOCATION: **Terrell, North Carolina**
JOB NUMBER: **1264-02-578**

SUMMARY OF LABORATORY TEST DATA
TABLE 6

Boring No.	Sample Depth (Ft)	Sample Type *	USCS Class.	Soil Description	Hydro-geologic Unit	Natural Moisture Content (%)	% Finer No. 200	Atterberg Limits		Specific Gravity	Unit Weight (pcf)	Hydraulic Conductivity k (cm/sec)	Proctor Data	
								LL	PI				Max. Dry Density (pcf)	Opt. Moisture Content (%)
MS-1	8.5 - 10	SS	SM	Sl. Clayey Silty Med/Fine Sand	Saprolite		33.6	38	NP					
MS-1	20 - 22	UD	ML	Clayey Med/Fine Sandy Silt	Saprolite	37.9	64.3	45	12	2.66	87.4	See Lab Data Sheets		
MS-3	15 - 17	UD	SM	Sl. Clayey Silty Coarse/Fine Sand	Saprolite	31.8	22.4	NP	NP	2.74	90.3	See Lab Data Sheets		
MS-4	3.5 - 5.0	SS	MH	Sl. Sandy Clayey Silt	Residuum		82.5	83	33	2.72				
MS-5	32 - 34	UD	SM	Sl. Clayey Silty Coarse/Fine Sand	Saprolite	22.7	21.3	NP	NP	2.72	98.1	See Lab Data Sheets		
MS-7	8.5 - 10	SS	CH	Med/Fine Sandy Silty Clay	Residuum		82.9	61	36					
MS-7	18.5 - 20	SS	SM	Sl. Clayey Silty Med/Fine Sand	Saprolite		36.8	41	NP					
MS-8	23.5 - 25	SS	SM	Sl. Clayey Silty Coarse/Fine Sand	Saprolite		31	NP	NP	2.67				

Note: Graphic Presentations of Results of Proctor, Grain Size, and other tests follow this summary in Appendix II

* SS = Split Spoon Sample (ASTM D-1586)
UD = Undisturbed Sample (ASTM D-1587)
BAG = Bulk Sample
NP = Non Plastic

JOB NAME: **Marshall Steam Station - FGD Scrubber Landfill**
LOCATION: **Terrell, North Carolina**
JOB NUMBER: **1264-02-578**
PAGE 3 of 3

Appendix

1

APPENDIX I

BORING LOGS, WELL LOGS, WELL CONSTRUCTION RECORDS

FIELD EXPLORATION PROCEDURES

Soil Test Boring: Nineteen (19) soil test borings (19 observation wells) were drilled at the locations shown on the Boring Location Plan, Sheet No. 1 of 6. Soil sampling and penetration testing were performed in accordance with ASTM D 1586-84.

The borings were advanced with hollow-stem augers, and soil samples were obtained at the observation well locations at standard intervals 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 is designated the "Standard Penetration Resistance", when properly evaluated, is an index to soil strength, relative 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 classified in the field by a staff geologist. Test Boring Records are attached showing the soil descriptions and Standard Penetration Resistances.

Rock Coring: At five (5) locations, rock coring procedures were utilized to determine the character and continuity of the refusal materials. Core drilling procedures were carried out in accordance with ASTM Specification D 2113-70. Initially, casing was set through the overburden soil to keep the hole from collapsing. Refusal materials were then cored with a diamond-studded bit fastened to the end of a hollow double-tube core barrel. The cuttings were brought to the surface during coring by circulating water. Rock core samples of the materials penetrated were protected and retained in a swivel-mounted inner tube. Upon completion of each core run, the core barrel was brought to the surface and the samples removed and placed in boxes. Samples were then taken to the laboratory where the rock was identified and the "Recovery" and Rock Quality Designation (RQD) determined.

The "Recovery" is the ratio of the sample length obtained to the length drilled, expressed as a percent. The RQD is the percentage of the length of the core recovered which has core segments four or more inches long compared to the total length of the run. The RQD value applies to rock cored with either an NX or NQ bit size. The percent recovery and RQD are related to rock soundness and continuity. Deere (Ref.6:13, Sowers and Sowers) denotes rock quality by the RQD value as follows:

RQD (%)	ROCK QUALITY
90 to 100	Excellent
75 to 90	Good
50 to 75	Fair
25 to 50	Poor

Generalized rock descriptions, percent recovery, and RQD values are shown on the appropriate Test Boring Records. An NQ size bit was used for the coring which designates bits which obtain samples 1-7/8 inches in diameter.

Undisturbed Sampling: Split-spoon samples obtained during penetration testing are suitable for visual examination and classification tests, but are not sufficiently intact for quantitative laboratory testing. Relatively undisturbed samples were obtained by forcing a section of three-inch (3") O.D., 16 gauge steel tubing into the soil at the desired sampling levels. This sample procedure is described by ASTM Designation D-1587. The tube, together with the encased soil, was carefully removed from the ground and made airtight. The locations and depths of undisturbed samples are shown on the appropriate Test Boring Records.

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG B-1**
DATE DRILLED: **1/15/03**	ELEVATION: **808.6**	NOTES: **Bag Samples Collected at 10 and 20 ft bls.** **Auger Refusal Encountered at 25.5 ft bls.**
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **25.5**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **7.4 ft bls at 24 hrs.**	
DRILLER: **Brian Wilson, NC Cert No. 2718**	DRILL RIG: **Mobile B-57**	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
5		RESIDUUM: Reddish Brown Micaceous Coarse to Fine Sandy Silty **CLAY** with Some Grey High Plasticity Clay Seams **(CL)**		803.6	1		14
10		SAPROLITE: Greyish Brown and White Miaceous Silty Fine **SAND**	▼ ▽	798.6	2		27
15		PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown and White Miaceous Silty Fine **SAND**		793.6	3		50/5
20				788.6	4		50/1
25		PARTIALLY WEATHERED ROCK: When Sampled Becomes Black, White and Brown Miaceous Silty Medium to Fine **SAND** with Rock Fragments **Auger Refusal at 25.5 ft bls**		783.6	5		50/3

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: B-1 **TOTAL DEPTH: 16 ft bls**

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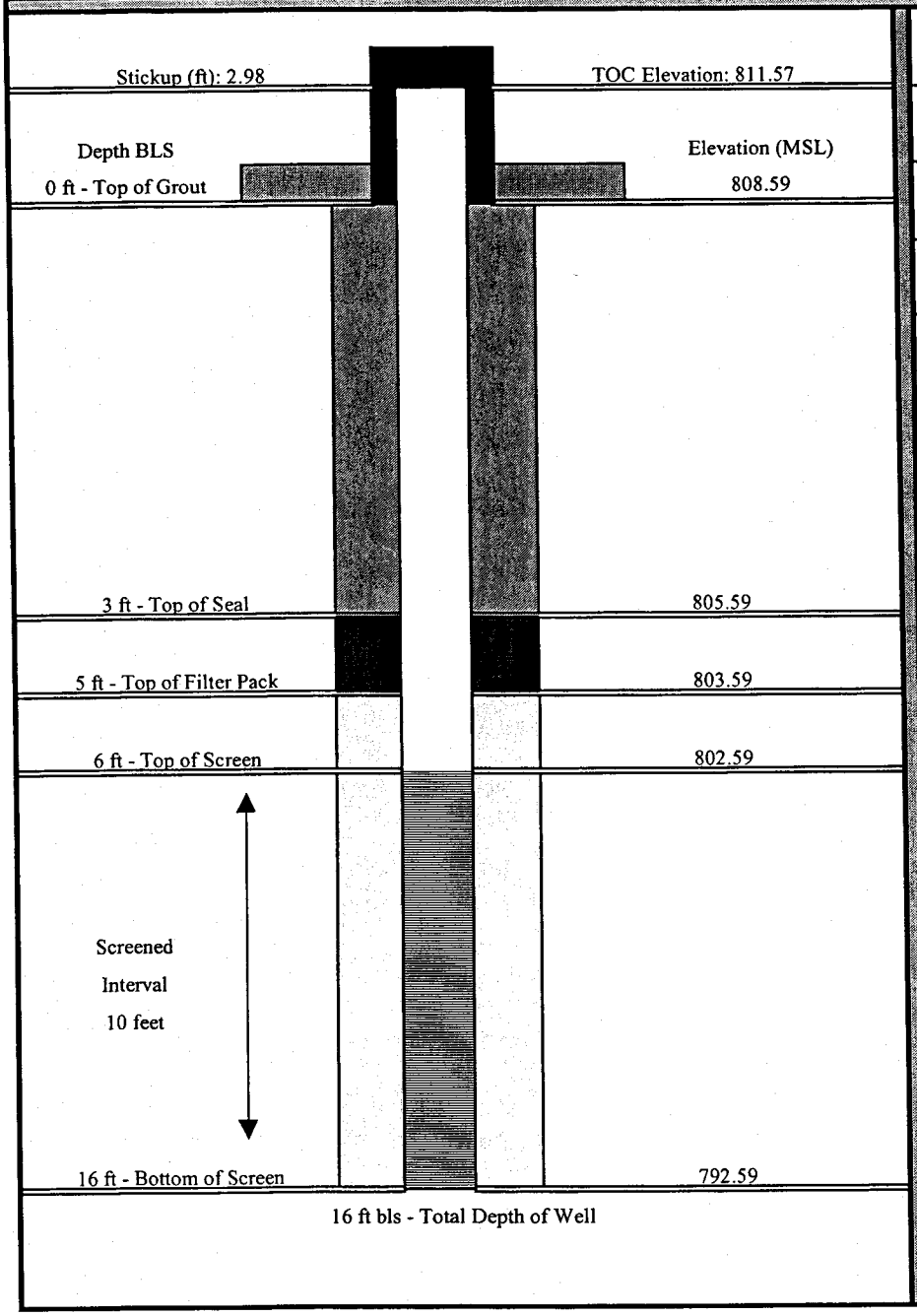
S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/15/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
7.4 ft bls at 24-hrs	681146.9	1412710.8	811.57	808.59



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 6 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
6 to 16 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 3 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
3 to 5 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
5 to 16 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-1)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Sandy Silty Clay
7	13.5	Silty Fine Sand
13.5	16	PWR

4. DATE DRILLED 01/15/2003
5. TOTAL DEPTH 16 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 10.4 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 6	Ft.	2-inch	Sch. 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	0	To 3	Ft.	Neat Cement	Pour
From	3	To 5	Ft.	Bentonite	Pour

14. SCREEN:

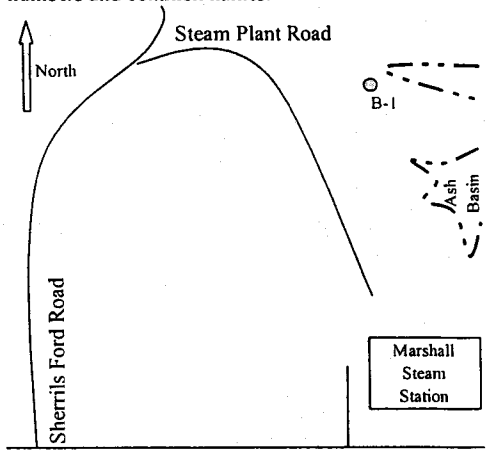
	Depth			Diameter		Slot Size		Material
From	6	To 16	Ft.	2-inch	in.	0.01	in.	PVC
From		To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	5	To 16	Ft.	#1	Silica Sand
From		To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

Brian E. Wilson 2/6/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG B-2**
DATE DRILLED: **12/16/02**	ELEVATION: **857.9**	NOTES: **Bag samples collected every 10 ft to 60 ft bls.** **Auger Refusal Encountered at 70 ft bls.**
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **80.0**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **45.64 ft bls at 24 hrs.**	
DRILLER: **Jay Little, NC Cert No. 2717**	DRILL RIG: **Diedrich D-50**	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	Topsoil/Rootmat			
5	RESIDUUM: Red Slightly Micaceous Fine Sandy Silty **CLAY**	852.9	1	15
10	RESIDUUM: Tannish Red Micaceous Slightly Sandy **SILT**	847.9	2	17
15	SAPROLITE: Tannish Red Very Micaceous Slightly Sandy **SILT**	842.9	3	18
20	SAPROLITE: Grey and White Very Micaceous Fine Sandy **SILT**	837.9	4	13
25	SAPROLITE: Reddish Tan and White Micaceous Silty Fine **SAND** with Manganese Staining	832.9	REC 100% 5	14
30	SAPROLITE: Greyish Tan and White Micaceous Fine Sandy **SILT**	827.9	6	18
35	SAPROLITE: Reddish Tan and White Fine Sandy **SILT** with Manganese Staining	822.9	7	26
40	SAPROLITE: Greyish Tan and White Very Micaceous Fine Sandy **SILT** with Manganese Staining	817.9	8	19
45	SAPROLITE: Greyish Tan and White Very Micaceous Silty Medium to Fine **SAND (SM)**	812.9	9	29
50		807.9	10	53
55	SAPROLITE: Reddish Tan Micaceous Fine Sandy **SILT** with Manganese Staining	802.9	REC 40% 11	67
60	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Tan and White Very Micaceous Silty Fine **SAND**	797.9	12	50/5
65	PARTIALLY WEATHERED ROCK: When Sampled Becomes Reddish Tan Micaceous Fine to Medium Sandy **SILT** with Manganese Staining **Auger Refusal at 70 ft bls**	792.9	13	50/2
70	BEDROCK: Sampled as Pink Granite	787.9		
75	BEDROCK: Sampled as Fine Grained Granite-Gneiss (Very Weathered)	782.9	REC 86% RQD 58%	
80		777.9		

STANDARD PENETRATION TEST DATA (blows/ft): 10, 20, 30, 60, 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/13/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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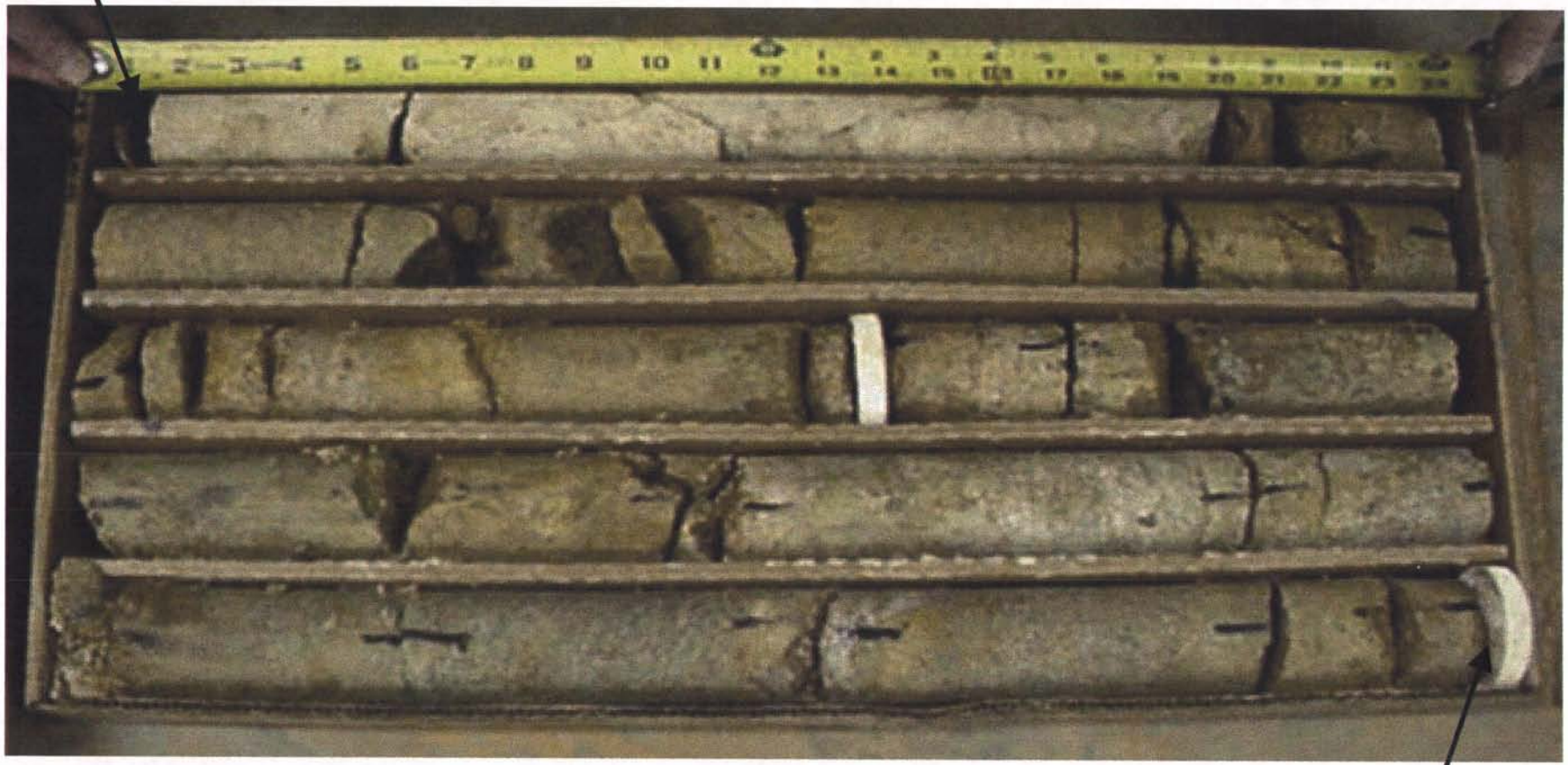
Start - 70 ft bls



End - 80 ft bls

70 to 71.7 - Pink granite
71.7 to 80 - Fine grained granite gneiss (very weathered)

REC = 86%
RQD = 58%

SCALE:	As Shown
CHECKED BY:	
DRAWN BY:	JRP
DATE:	1/27/03

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ROCK CORE B-2
Marshall Steam Station - FGD Scrubber Landfill
Terrell, North Carolina

JOB NO. 1264-02-578

FIGURE NO.

MONITORING WELL CONSTRUCTION

WELL ID: B-2 **TOTAL DEPTH: 54 ft bls**

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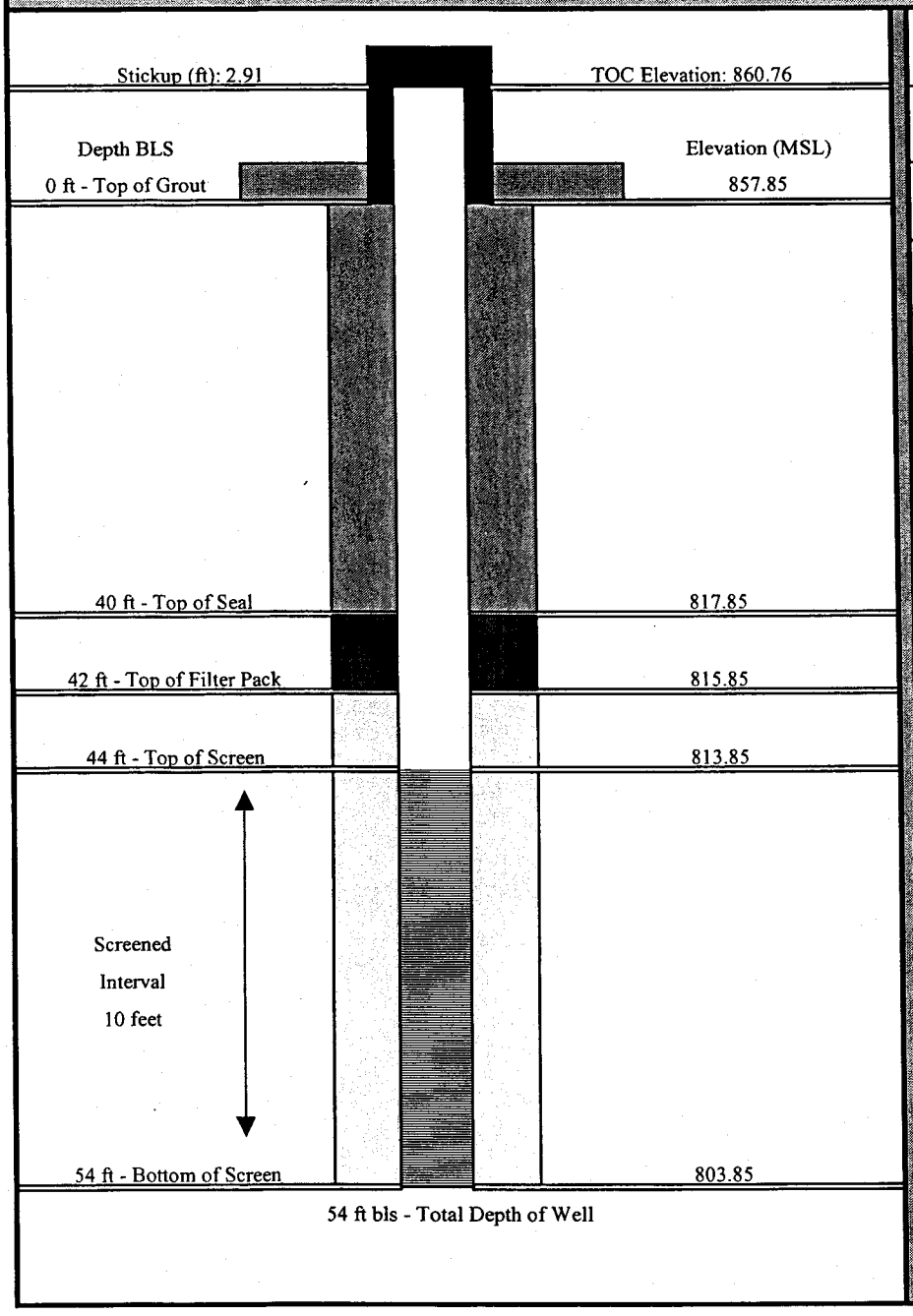
S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/16/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
45.64 ft bls at 24-hrs	680915.0	1412408.7	860.76	857.85



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 44 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
44 to 54 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 40 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
40 to 42 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
42 to 54 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-2)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well
2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)
3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number
4. DATE DRILLED 12/16/2002
5. TOTAL DEPTH 54 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 50 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 44 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 40 Ft.	Neat Cement	Pour
From	40	To 42 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	44	To 54 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

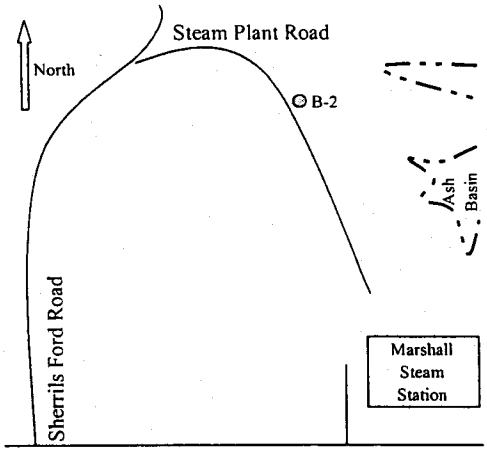
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From	42	To 54 Ft.	#1	Silica Sand
From		To Ft.		

DEPTH From	To	DRILLING LOG Formation Descrpition
0	to 7	Sandy Silty Clay
7	to 17	Slightly Sandy Silt
17	to 22	Fine Sandy Silt
22	to 27	Silty Fine Sand
27	to 42	Fine Sandy Silt
42	to 52	Silty Fine Sand
52	to 54	Fine Sandy Silt

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY 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

Jay A. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG B-3**
DATE DRILLED: 12/11/02	ELEVATION: 856.2	NOTES: Bag samples collected every 10 ft to 70 ft bls.
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 90.0	
LOGGED BY: Julie Petersen	WATER LEVEL: 49 ft bls at 24 hrs.	
DRILLER: Jay Little, NC Cert No. 2717	DRILL RIG: Diedrich D-50	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	Rootmat/Topsoil			
	RESIDUUM: Red Slightly Sandy Clayey **SILT**			
5	RESIDUUM: Tannish Red Silty Fine **SAND**	851.2	1	17
10	SAPROLITE: Tannish Brown Fine Sandy **SILT**	846.2	2	13
15	SAPROLITE: Reddish Tan Medium to Fine Sandy Clayey **SILT** with Some Manganese Staining **(MH)**	841.2	3	15
20		836.2	4	14
25		831.2	5	13
30	SAPROLITE: Pinkish White Slightly Micaceous Silty Medium to Fine **SAND** with Quartz Fragments and Some Manganese Staining	826.2	6	23
35		821.2	REC 100% 7	42
40	SAPROLITE: Olive Green and Reddish Tan Micaceous Fine Sandy **SILT** with Manganese Staining	816.2	8	17
45	SAPROLITE: Olive Green and Reddish Tan Micaceous Silty Fine **SAND** with Quartz Fragments and Manganese Staining	811.2	9	17
50	SAPROLITE: Tannish Brown Micaceous Slightly Clayey Silty Medium to Fine **SAND** with Manganese Staining. White Medium to Fine Silty Sand Seam with Quartz Fragments at 65 ft bls. **(SM)**	806.2	10	23
55		801.2	REC 100% 11	38
60		796.2	12	36
65		791.2	13	58
70	PARTIALLY WEATHERED ROCK: When Sampled Becomes Tannish Brown Micaceous Slightly Clayey Silty Medium to Fine **SAND** with Manganese Staining and Rock Fragments **(SM)**	786.2	14	50/4
75		781.2	15	50/4
80	PARTIALLY WEATHERED ROCK: When Sampled Becomes Olive Green and Brown Very Micaceous Fine Sandy **SILT**	776.2	16	50/5
85	PARTIALLY WEATHERED ROCK: When Sampled Becomes Brown and White Very Micaceous Silty Fine **SAND**	771.2	17	50/4
90		766.2	18	50/3

STANDARD PENETRATION TEST DATA (blows/ft)

10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/5/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

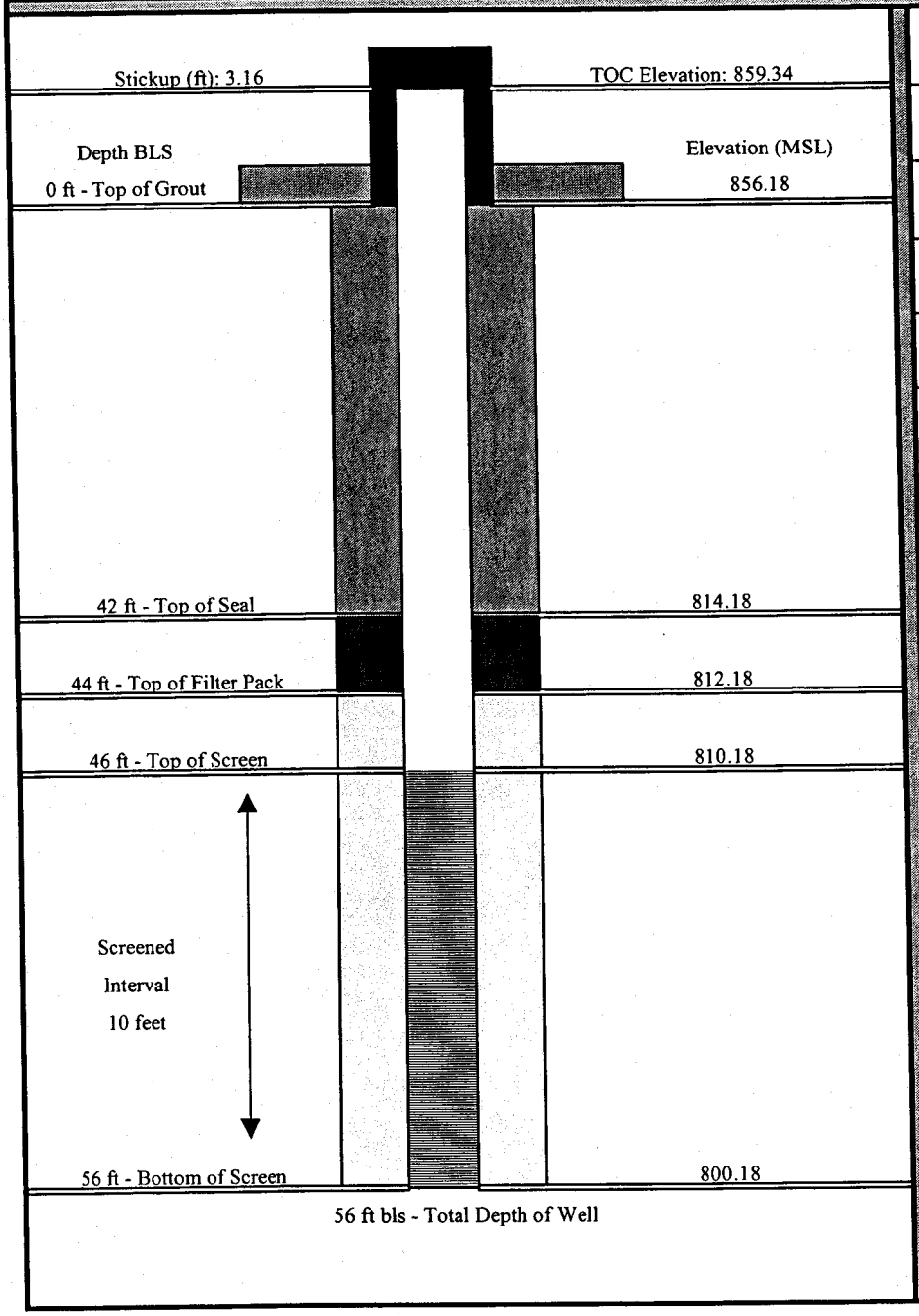
S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: B-3 **TOTAL DEPTH: 56 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/11/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
49 ft bls at 24-hrs	680602.9	1412624.4	859.34	856.18



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 46 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
46 to 56 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 42 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
42 to 44 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
46 to 56 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-3)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/11/2002
5. TOTAL DEPTH 56 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 52 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 46 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 42 Ft.	Neat Cement	Pour
From	42	To 44 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	46	To 56 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

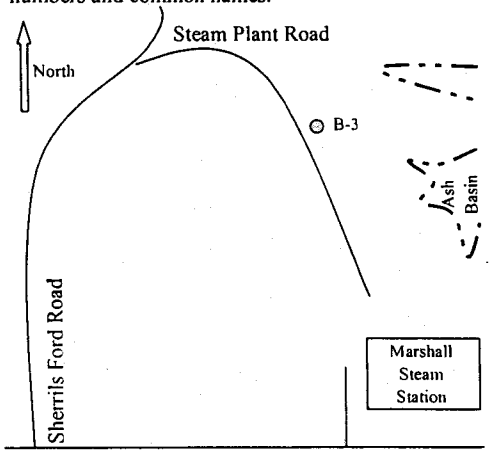
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From	44	To 56 Ft.	#1	Silica Sand
From		To Ft.		

DEPTH From	To	DRILLING LOG Formation Descrpition
0	to 3.5	Clayey Silt
3.5	to 8	Silty Fine Sand
8	to 29.5	Fine Sandy Silt
29.5	to 39	Silty Med/Fine Sand
39	to 42	Fine Sandy Silt
42	to 47	Silty Fine Sand
47	to 56	Fine Sandy Silt

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

Jay G. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

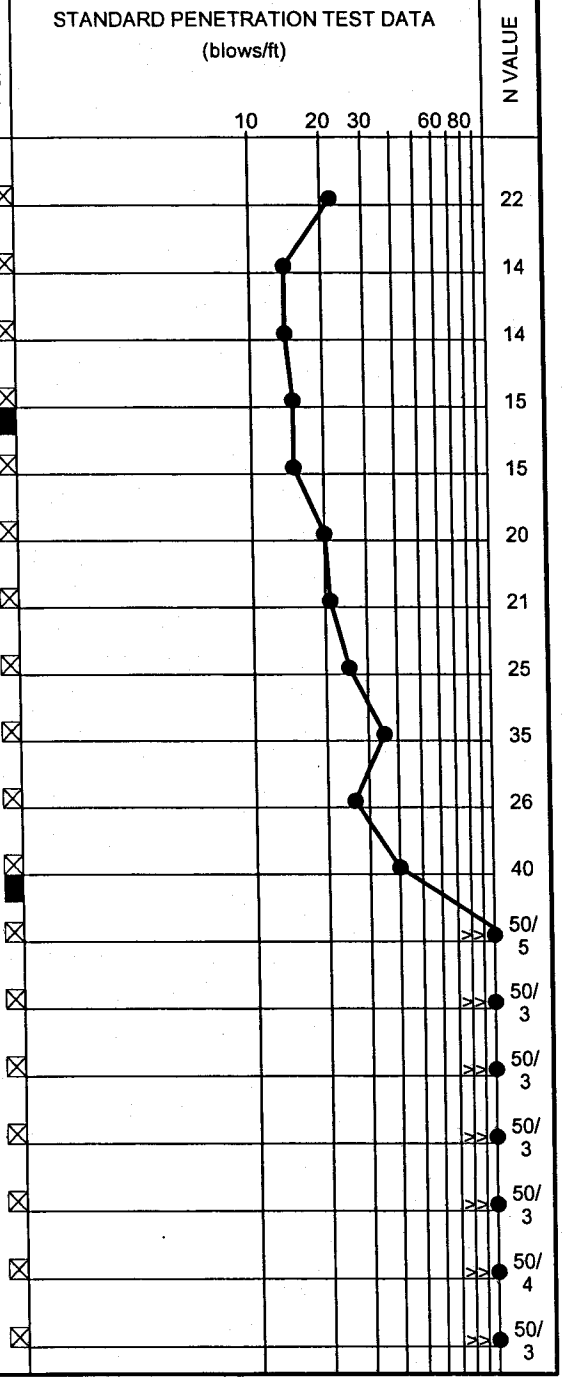
Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT: Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG B-4**

DATE DRILLED: **12/3/02**	ELEVATION: **858.4**	NOTES: **Bag samples collected every 10 ft to 70 ft bls.**
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **90.0**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **52 ft bls at 24 hrs.**	
DRILLER: **Jay Little, NC Cert No. 2717**	DRILL RIG: **Diedrich D-50**	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0–5	RESIDUUM: Yellowish Red Micaceous Medium to Fine Sandy Clayey **SILT (MH)**	853.4	1	22
5–10	SAPROLITE: Yellowish Red Micaceous Slightly Sandy **SILT** with Manganese Staining	848.4	2	14
10–30	SAPROLITE: Reddish Grey to Greyish Brown Very Micaceous Slightly Sandy **SILT**	843.4	3	14
		838.4	4	15
		833.4	REC 100% 5	15
		828.4	6	20
30–40	SAPROLITE: Greyish Red Micaceous Fine Sandy **SILT** with Manganese Staining	823.4	7	21
		818.4	8	25
40–45	SAPROLITE: Greyish Brown Micaceous Silty Fine **SAND** with Manganese Staining	813.4	9	35
45–50	SAPROLITE: Greyish Brown Micaceous Fine Sandy **SILT**	808.4	10	26
50–55	SAPROLITE: Greyish Brown Micaceous Silty Fine **SAND**	803.4	11	40
55–60	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown Micaceous Silty Fine **SAND**	798.4	REC 50% 12	50/5
		793.4	13	50/3
60–70	PARTIALLY WEATHERED ROCK: When Sampled Becomes Olive Green and Brown Micaceous Fine Sandy **SILT**	788.4	14	50/3
70–90	PARTIALLY WEATHERED ROCK: When Sampled Becomes Olive Green and Brown Micaceous Silty Fine **SAND**	783.4	15	50/3
		778.4	16	50/3
		773.4	17	50/4
		768.4	18	50/3



BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

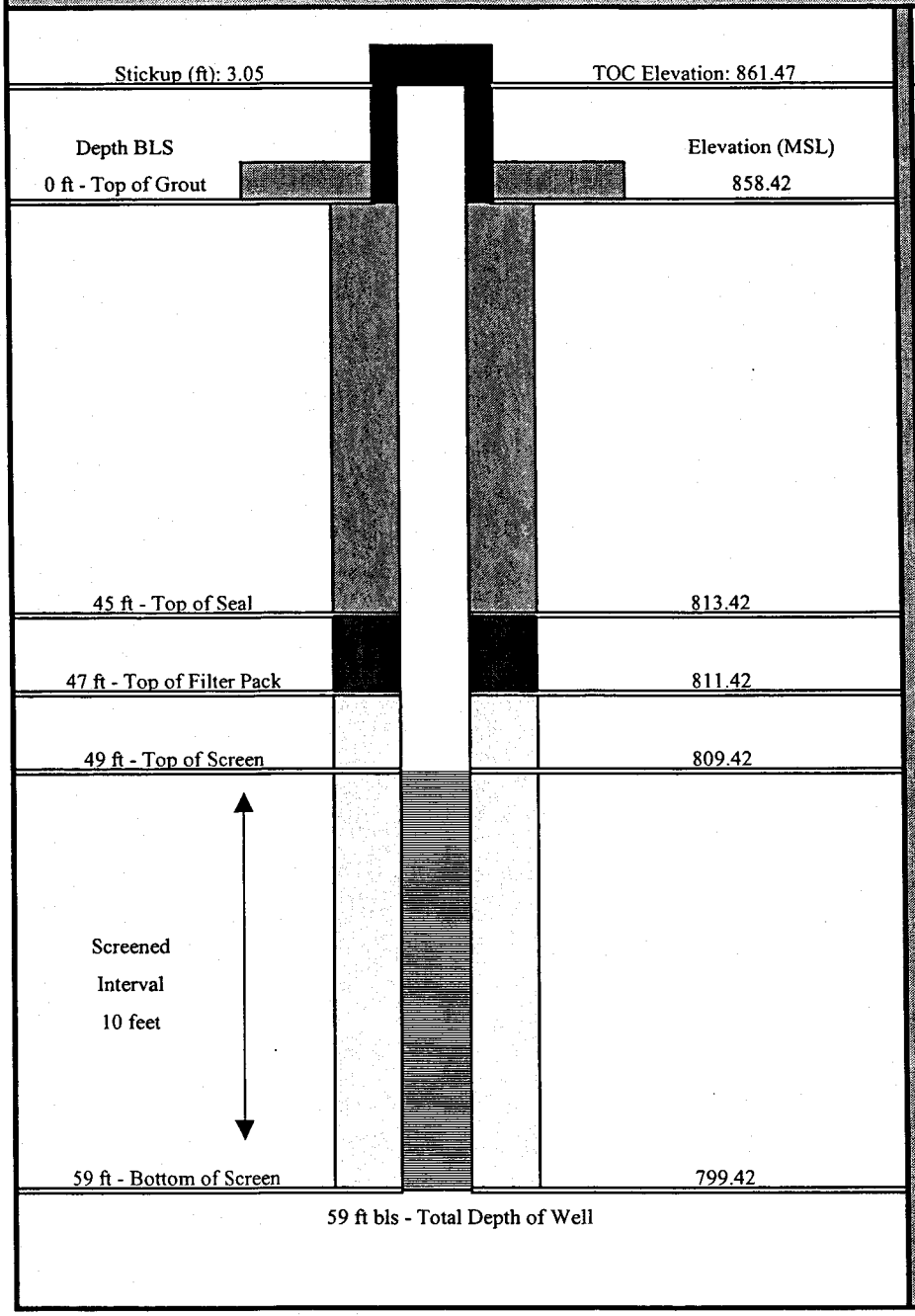
S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: B-4 **TOTAL DEPTH: 59 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/03/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
52 ft bls at 24-hrs	680428.0	1412993.3	861.47	858.42



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 49 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
49 to 59 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 45 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
45 to 47 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
47 to 59 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-4)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/03/2002
5. TOTAL DEPTH 59 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 55 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 49 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 45 Ft.	Neat Cement	Pour
From	45	To 47 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	49	To 59 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

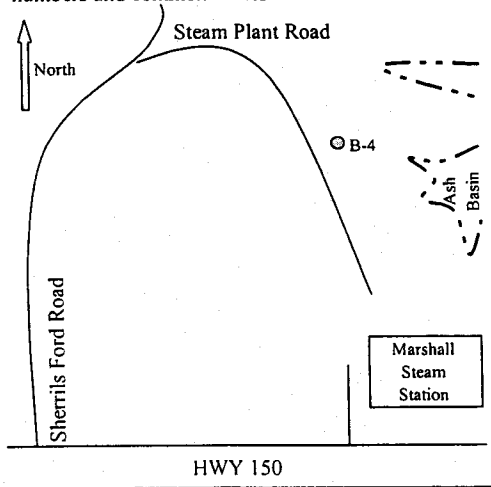
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From	47	To 59 Ft.	#1	Silica Sand
From		To Ft.		

DEPTH From	To	DRILLING LOG Formation Descrpition
0	to 7	Clayey Silt
7	to 42	Fine Sandy Silt
42	to 47	Silty Fine Sand
47	to 52	Fine Sandy Silt
52	to 59	Silty Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

Jay A. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG B-5**
DATE DRILLED: 1/7/03	ELEVATION: 841.3	NOTES: Bag Samples Collected every 10 ft to 50 ft bls. Auger Refusal Encountered at 78 ft bls.
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 88.0	
LOGGED BY: Julie Petersen	WATER LEVEL: 36.3 ft bls at 24 hrs.	
DRILLER: Brian Wilson, NC Cert No. 2718	DRILL RIG: Mobile B-57	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
0		RESIDUUM: Red Micaceous Fine Sandy Silty **CLAY**		836.3	1		18
5		RESIDUUM: Red Miaceous Clayey Silty Medium to Fine **SAND (SM)**		831.3	2		11
10		SAPROLITE: Tan Silty Fine **SAND**		826.3	REC 100% 3		12
15		SAPROLITE: Tannish Brown and White Micaceous Slightly Clayey Silty Medium to Fine **SAND (SM)**		821.3	4		14
20				816.3	5		14
25				811.3	6		10
30				806.3	7		13
35			▼	801.3	8		35
40		SAPROLITE: Tannish Grey and White Micaceous Silty Fine **SAND**	▽	796.3	9		50/4
45		PARTIALLY WEATHERED ROCK: When Sampled Becomes Tannish Grey and White Micaceous Silty Fine **SAND** with Some Rock Fragments		791.3	10		50/4
50		**Auger Refusal at 78 ft bls**		786.3	11		50/3
55				781.3	12		50/3
60				776.3	13		50/5
65				771.3	14		50/1
70				766.3	15		50/1
75				761.3	REC 100% RQD 16%		
80		BEDROCK: Sampled as Pink Granite BEDROCK: Sampled as Gneiss with Minor Layers of Mica Schist		756.3			
85							

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/13/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.

2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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ENVIRONMENTAL SERVICES

9751 Southern Pine Blvd.
Charlotte, NC 28273

Start - 78 ft bls

End - 88 ft bls

78 to 78.5 - Pink Granite
78.5 to 88 - Gneiss with minor layers of mica schist

REC = 100%
RQD = 16%

SCALE:	As Shown
CHECKED BY:	
DRAWN BY:	JRP
DATE:	1/27/03

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

ROCK CORE B-5
Marshall Steam Station - FGD Scrubber Landfill
Terrell, North Carolina

JOB NO. 1264-02-578

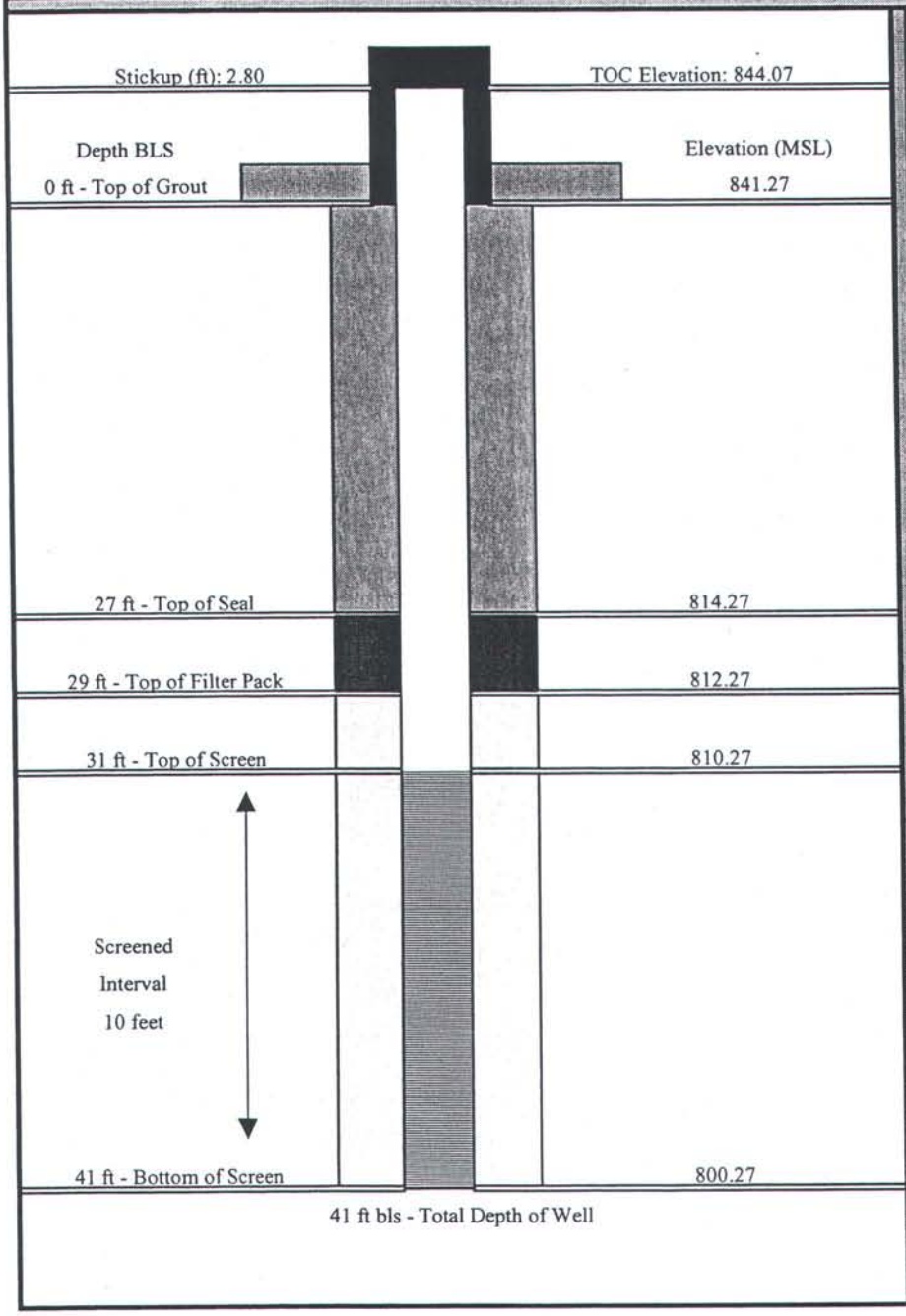
FIGURE NO.

MONITORING WELL CONSTRUCTION

WELL ID: B-5 **TOTAL DEPTH: 41 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/07/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
36.3 ft bls at 24-hrs	679968.4	1413123.9	844.07	841.27



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 31 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
31 to 41 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 27 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
27 to 29 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
29 to 41 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-5)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☑ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/07/2003
5. TOTAL DEPTH 41 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 39.3 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 31 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 27 Ft.	Neat Cement	Pour
From	27	To 29 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	31	To 41 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

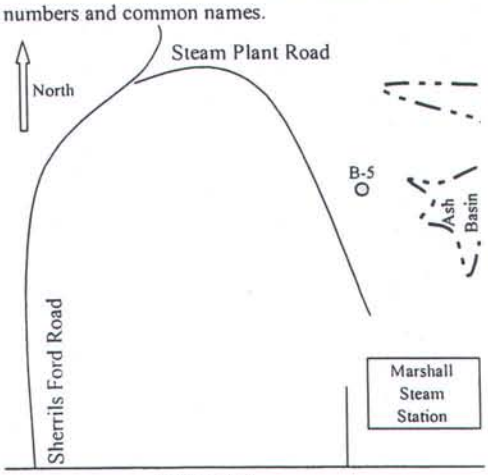
	Depth		Size	Material
From	29	To 41 Ft.	#1	Silica Sand
From		To Ft.		

16. REMARKS: _____

DEPTH From	To	DRILLING LOG Formation Descrpition
0	to 3.5	Silty Clay
3.5	to 9.5	Clayey Silt
9.5	to 12	Silty Fine Sand
12	to 37	Fine Sandy Silt
37	to 41	Silty Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

Brian E. Wilson — 2/6/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

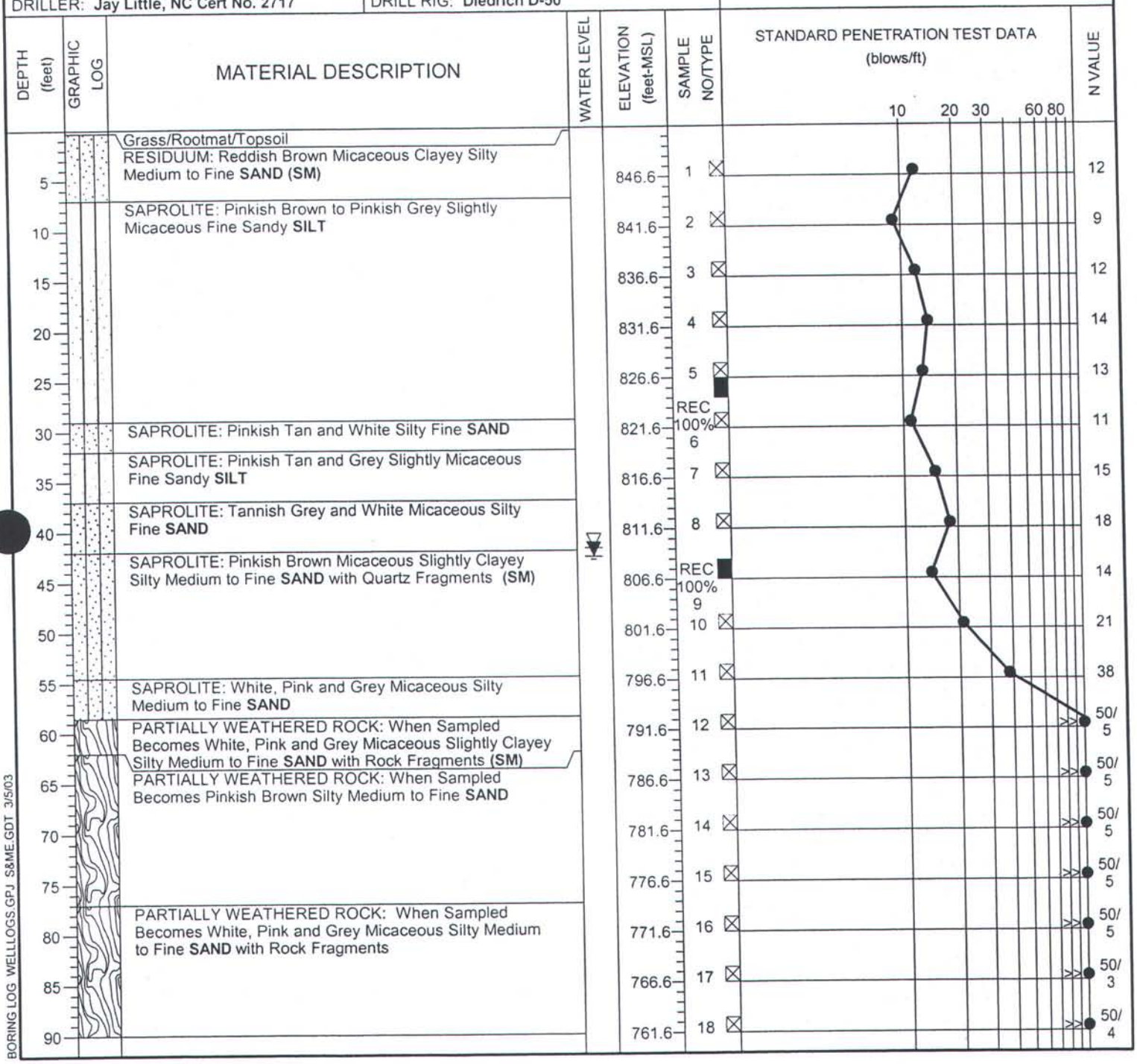
PROJECT: Marshall Steam Station
Terrell, North Carolina
1264-02-578

BORING LOG B-6

DATE DRILLED: 12/9/02
DRILLING METHOD: 4¼" H.S.A.
LOGGED BY: Julie Petersen
DRILLER: Jay Little, NC Cert No. 2717

ELEVATION: 851.6
BORING DEPTH: 90.0
WATER LEVEL: 42.62 ft bls at 24 hrs.
DRILL RIG: Diedrich D-50

NOTES: Bag Samples collected every 10 ft to 70 ft bls.



BORING LOG WELLLOGS.GPJ S&ME.GDT 3/5/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: B-6 **TOTAL DEPTH: 47 ft bls**

S&ME
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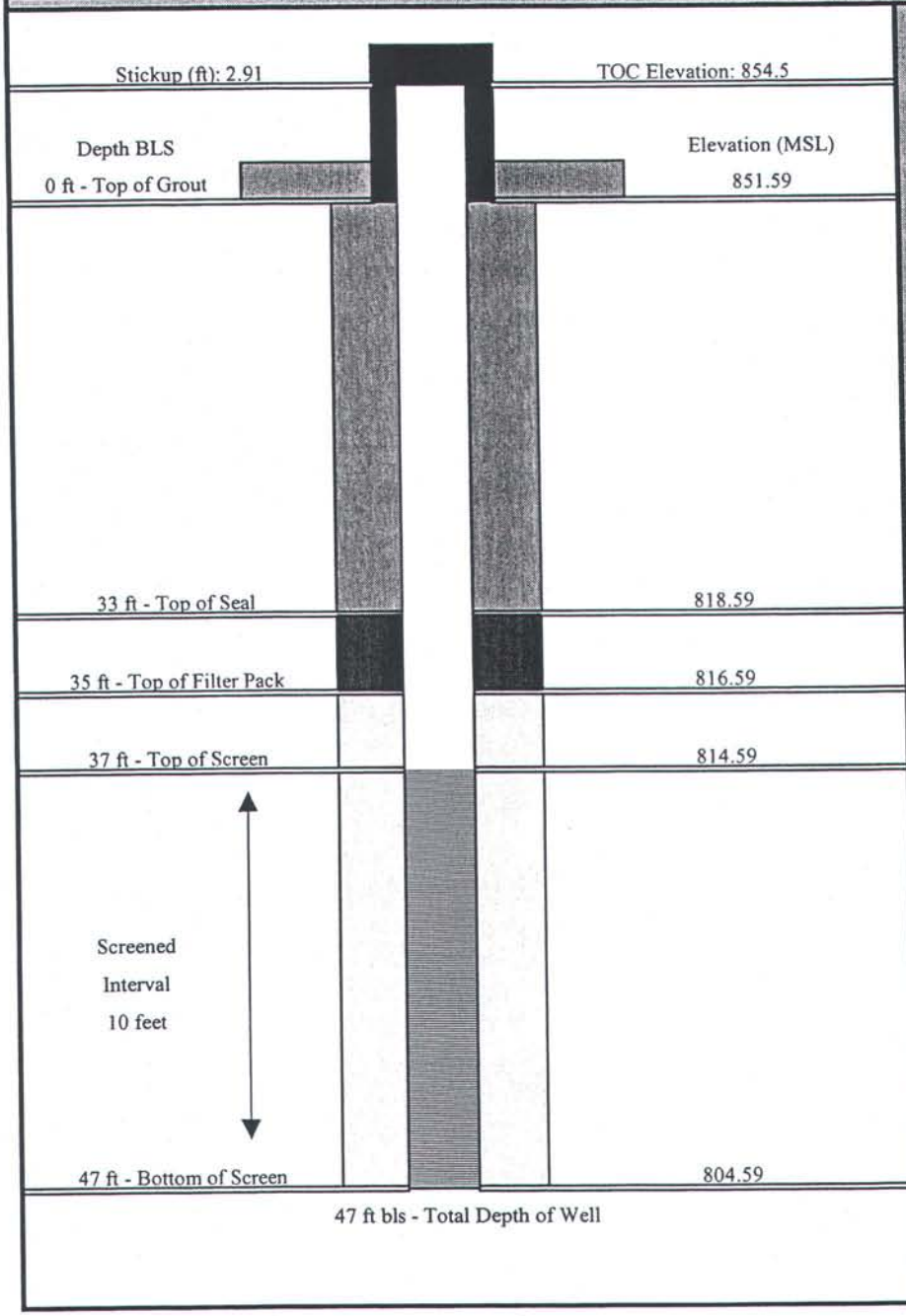
S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/09/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
42.62 ft bls at 24-hrs	680035.5	1412750.0	854.5	851.59



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 37 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	37 to 47 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 33 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	33 to 35 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	35 to 47 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes
NOTES:	**For Lithologic Information See Attached Boring Log**

WELL CONSTRUCTION RECORD

(B-6)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/09/2002
5. TOTAL DEPTH 47 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 45 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To	37 Ft.	2-inch	Sch. 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	0	To	33 Ft.	Neat Cement	Pour
From	33	To	35 Ft.	Bentonite	Pour

14. SCREEN:

	Depth			Diameter		Slot Size		Material
From	37	To	47 Ft.	2-inch	in.	0.01	in.	PVC
From		To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

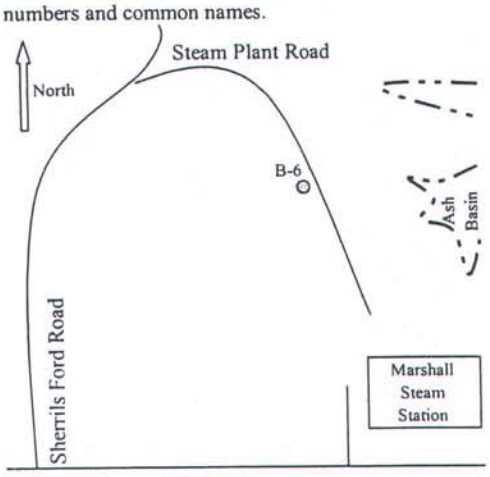
	Depth			Size	Material
From	35	To	47 Ft.	#1	Silica Sand
From		To	Ft.		

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Clayey Silt
7	29	Fine Sandy Silt
29	32	Silty Fine Sand
32	37	Fine Sandy Silt
37	42	Silty Fine Sand
42	47	Fine Sandy Silt

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

Jay C. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG B-7**
DATE DRILLED: 1/10/03	ELEVATION: 851.7	NOTES: Bag Samples Collected every 10 ft to 50 ft bls. Auger Refusal Encountered at 64.5 ft bls.
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 74.5	
LOGGED BY: Julie Petersen	WATER LEVEL: 46.5 ft bls at 24 hrs.	
DRILLER: Brian Wilson, NC Cert No. 2718	DRILL RIG: Mobile B-57	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)	N VALUE
0	Rootmat/Topsoil				
	RESIDUUM: Red Slightly Sandy Silty **CLAY**				
5	RESIDUUM: Red Micaceous Slightly Sandy Clayey **SILT**	846.7	1		14
10	SAPROLITE: Reddish Brown Micaceous Fine Sandy **SILT**	841.7	2		8
15	SAPROLITE: Brown Very Micaceous Fine Sandy **SILT** with Some Manganese Staining	836.7	3		9
20	SAPROLITE: Brown Very Micaceous Silty Fine **SAND**	831.7	4		15
25		826.7	5		11
30	SAPROLITE: Greyish Brown and White Micaceous Slightly Clayey Silty Medium to Fine **SAND** with Some Manganese Staining **(SM)**	821.7	6		13
35		816.7	REC 100% 7		35
40	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown and White Micaceous Silty Medium to Fine **SAND**	811.7	8		50/6
45	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown, Black and White Very Micaceous Silty Medium to Fine **SAND**	806.7	9		50/4
50	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey, Black and White Micaceous Slightly Clayey Silty Medium to Fine **SAND** with Rock Fragments **(SM)**	801.7	10		50/4
55	**Auger Refusal at 64.5 ft bls**	796.7	11		50/1
60		791.7	12		50/3
65	BEDROCK: Sampled as Gneiss with Minor Layers of Mica Schist	786.7			
70	BEDROCK: Sampled as Fine Grained Granite-Gneiss	781.7	REC 100% RQD 45%		

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/13/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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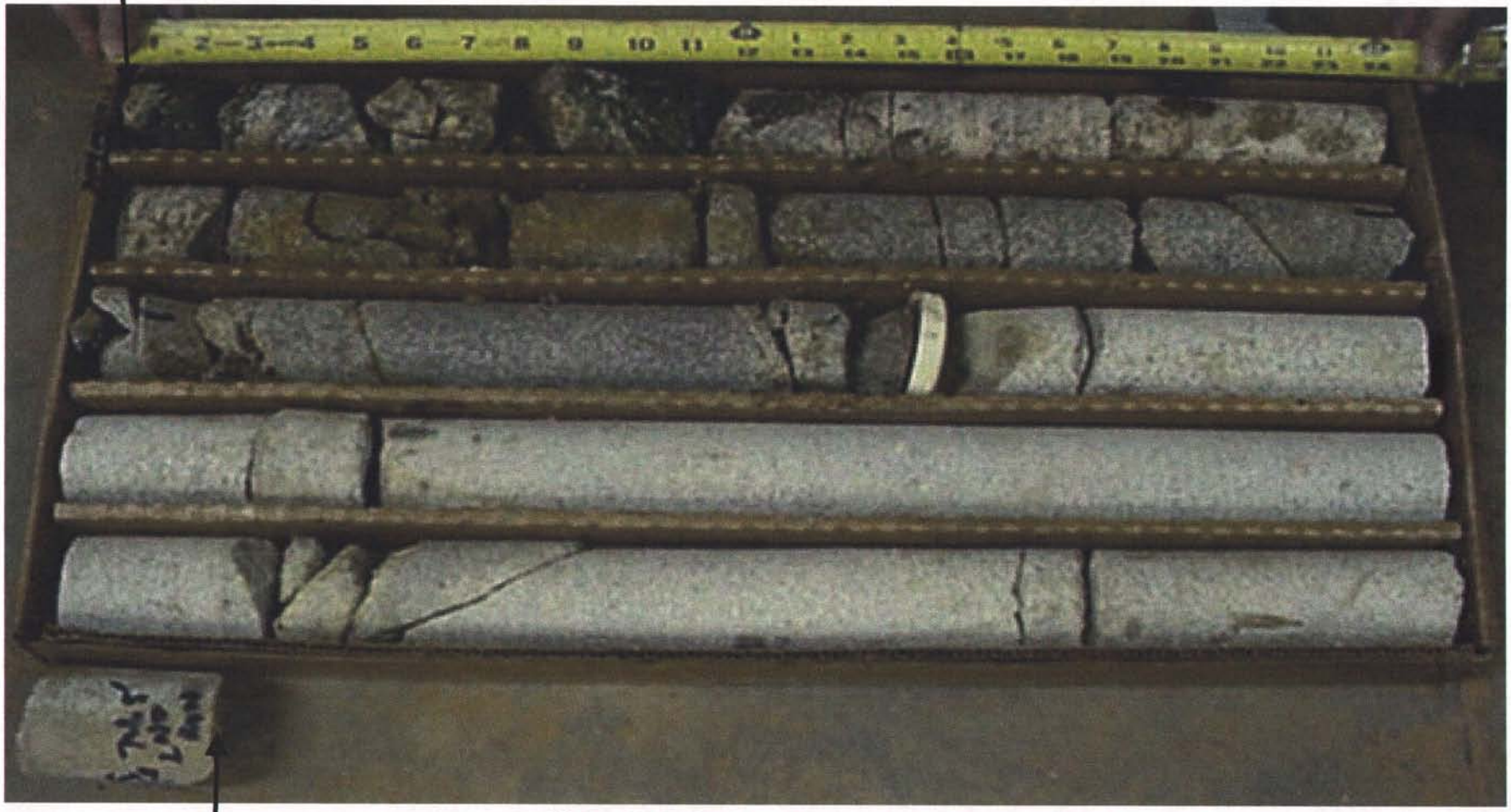
Charlotte, NC 28273

Start - 64.5 ft bls



End - 74.5 ft bls

64.5 to 65.5 - Gneiss with minor layers of mica schist.
65.5 to 74.5 - Fine grained granite gneiss

REC = 100%
RQD = 45%

SCALE:	As Shown
CHECKED BY:	
DRAWN BY:	JRP
DATE:	1/27/03

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

ROCK CORE B-7
Marshall Steam Station - FGD Scrubber Landfill
Terrell, North Carolina

JOB NO. 1264-02-578

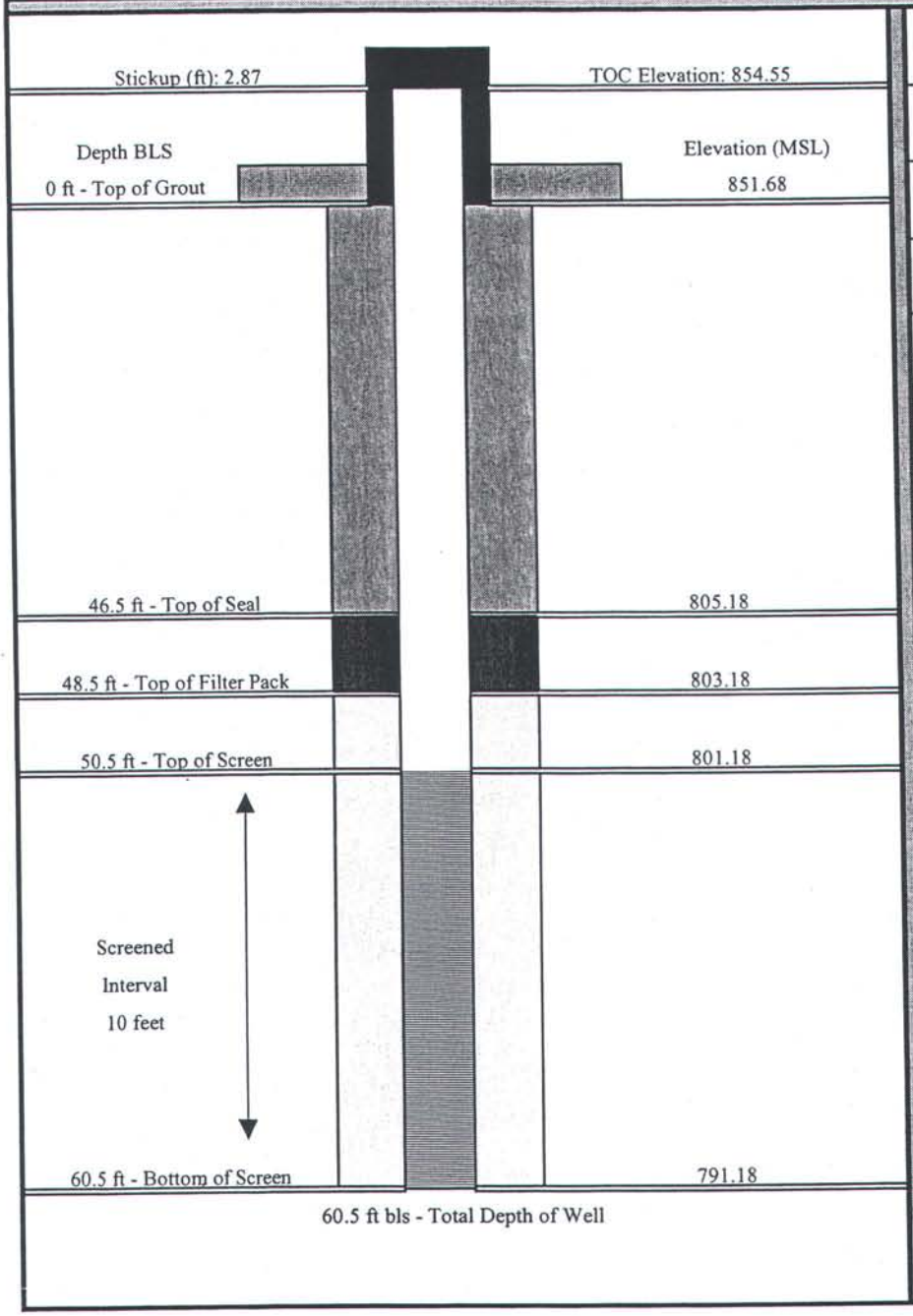
FIGURE NO.

MONITORING WELL CONSTRUCTION

WELL ID: B-7 **TOTAL DEPTH: 60.5 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO: Marshall Steam Station - Beneficial Fill, 1264-03-072			WELL USE / TYPE: Observation	INSTALLATION DATE: 01/10/2003
DRILLING CONTRACTOR: S&ME, Inc.	DRILLER AND LICENCE NO.: Brian Wilson, 2718			DRILLING METHOD: 4.25 HSA
STATIC WATER LEVEL: 46.5 ft bls at 24-hrs	NORTHING: 679556.2	EASTING: 1413059.0	TOP OF CASING ELEV.: 854.55	GROUND SURFACE ELEV.: 851.68



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 50.5 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
50.5 to 60.5 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 46.5 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
46.5 to 48.5 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
48.5 to 60.5 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(B-7)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/10/2003
5. TOTAL DEPTH 60.5 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 49.5 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	3	Silty Clay
3	7	Clayey Silt
7	17	Fine Sandy Silt
17	27	Silty Fine Sand
27	38.5	Silty Med/Fine Sand
38.5	60.5	PWR

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	50.5 Ft.	2-inch	Sch. 40	PVC
		Ft.			
		Ft.			

13. GROUT:

	Depth From	To	Material	Method
	0	46.5 Ft.	Neat Cement	Pour
	46.5	48.5 Ft.	Bentonite	Pour

14. SCREEN:

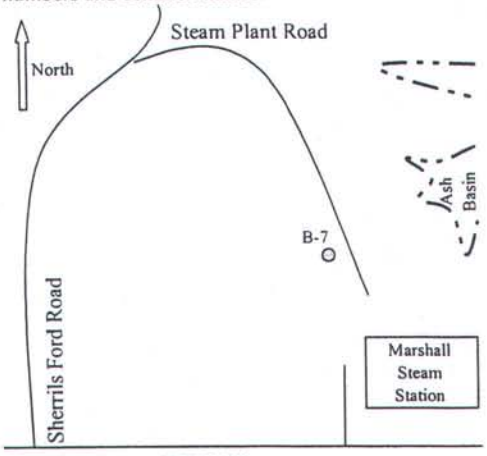
	Depth From	To	Diameter	Slot Size	Material
	50.5	60.5 Ft.	2-inch in.	0.01 in.	PVC
		Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	To	Size	Material
	48.5	60.5 Ft.	#1	Silica Sand
		Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

Brian E. Wilson — 2/6/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG MS-1**
DATE DRILLED: **12/3/02**	ELEVATION: **813.3**	NOTES: **Bag Samples Collected at 30 and 40 ft bls.** **Auger Refusal Encountered at 54.5 ft bls.**
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **64.5**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **14 ft bls at 24 hrs.**	
DRILLER: **Jay Little, NC Cert No. 2717**	DRILL RIG: **Diedrich D-50**	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
5	RESIDUUM: Brownish Red Micaceous Silty Fine **SAND** with Manganese Staining	808.3	1		10
10	SAPROLITE: Yellowish Red Micaceous Slightly Clayey Silty Medium to Fine **SAND (SM)**	803.3	2		13
15	SAPROLITE: Reddish Brown Micaceous Slightly Sandy **SILT** with Manganese Staining ▼	798.3	3		8
20	SAPROLITE: Grey and White Clayey Medium to Fine Sandy **SILT (ML)**	793.3	4		67
25	SAPROLITE: Reddish Brown and Grey Micaceous Silty Fine **SAND**	788.3	REC 100% 5		23
30		783.3	6		27
35	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey and White Silty Medium to Fine **SAND** **Auger Refusal at 54.5 ft bls**	778.3	7	>>	50/5
40		773.3	8	>>	50/2
45		768.3	9	>>	50/3
50		763.3			
55	BEDROCK: Sampled as Fine Grained Granite-Gneiss with a Coarse Grained Granite Seam at 63.5 ft.	758.3			
60		753.3	REC 99% RQD 63%		

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/13/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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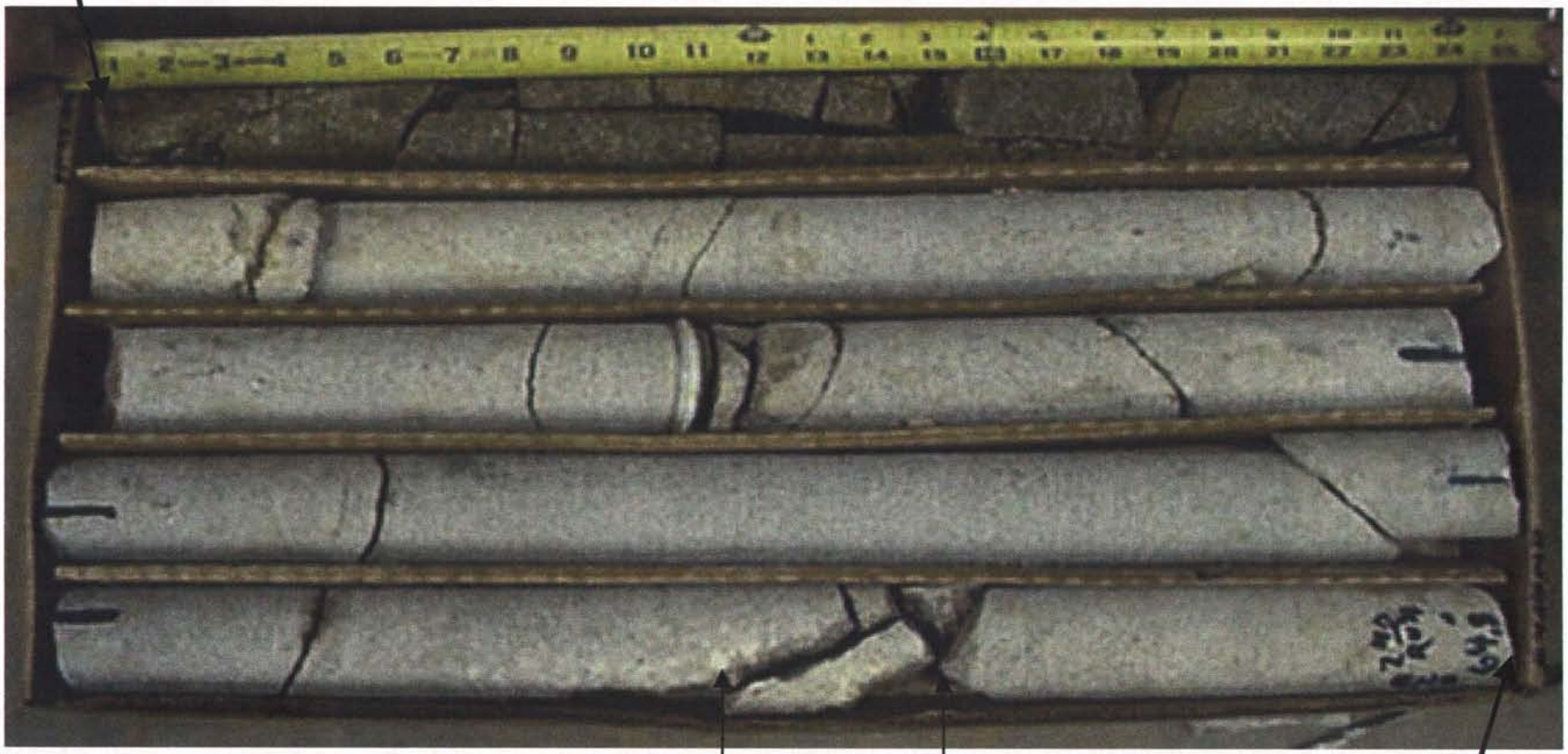
Charlotte, NC 28273

Start - 54.5 ft bls



Granite Seam

End- 64.5 ft bls

54.5 to 64.5 - Fine grained granite gneiss with coarse grained granite seam at approximately 63.5 ft

REC = 99%
RQD = 63%

SCALE:	As Shown
CHECKED BY:	
DRAWN BY:	JRP
DATE:	1/27/03

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

ROCK CORE MS-1
Marshall Steam Station - FGD Scrubber Landfill
Terrell, North Carolina

JOB NO. 1264-02-578

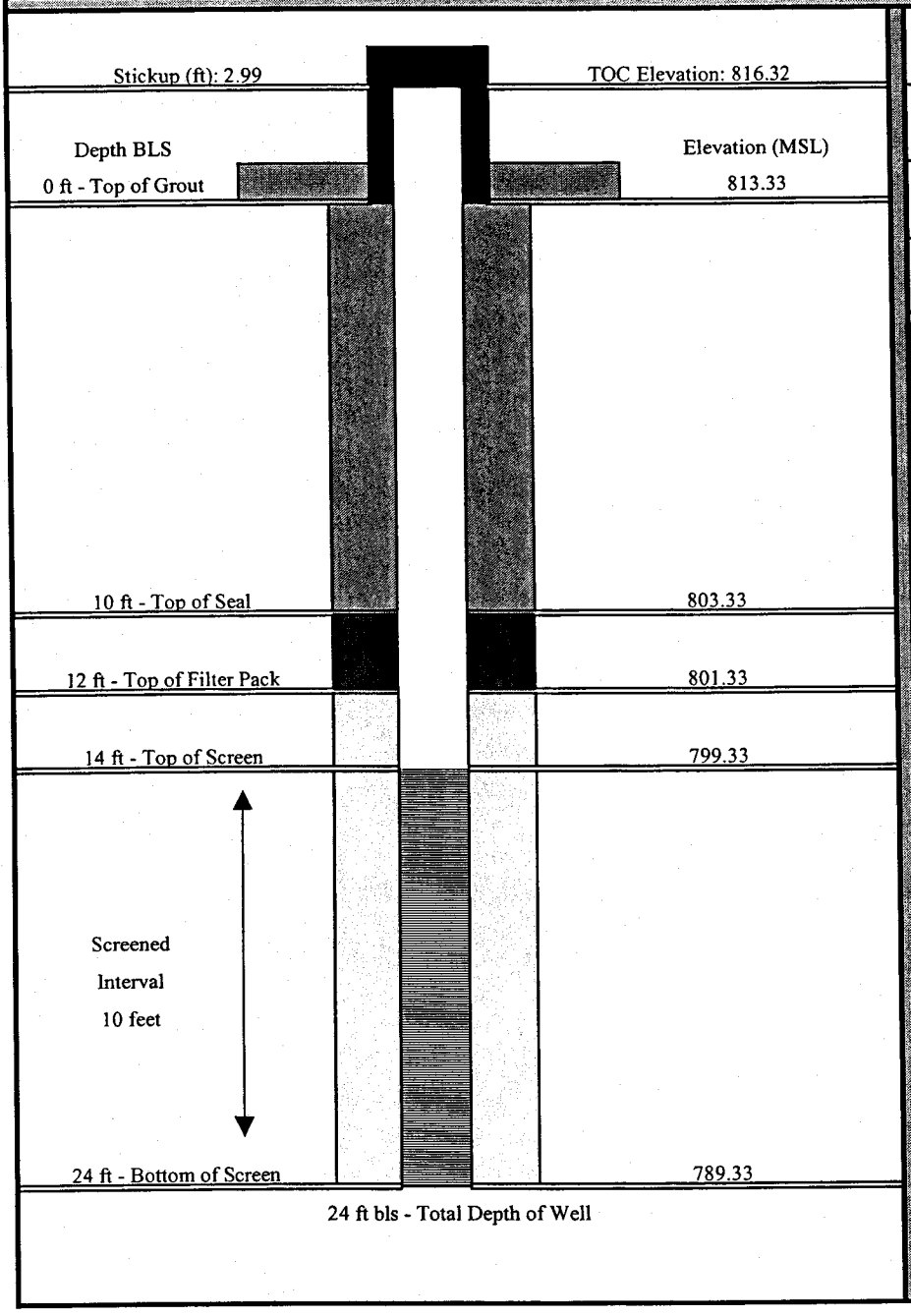
FIGURE NO.

MONITORING WELL CONSTRUCTION

WELL ID: MS-1 **TOTAL DEPTH: 24 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/03/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
14 ft bls at 24-hrs	680783.3	1413134.4	816.32	813.33



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 14 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
14 to 24 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 10 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
10 to 12 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
12 to 24 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-1)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/03/2002
5. TOTAL DEPTH 24 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 17 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Silty Fine Sand
7	12	Silty Med/Fine Sand
12	17	Slightly Sandy Silt
17	24	Silty Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	0	14		2-inch	Sch. 40	PVC

13. GROUT:

	Depth From	To	Ft.	Material	Method
	0	10		Neat Cement	Pour
	10	12		Bentonite	Pour

14. SCREEN:

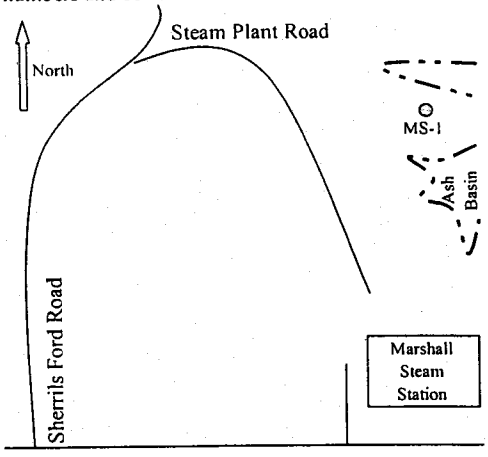
	Depth From	To	Ft.	Diameter		Slot Size		Material
	14	24		2-inch	in.	0.01	in.	PVC
					in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	12	24		#1	Silica Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

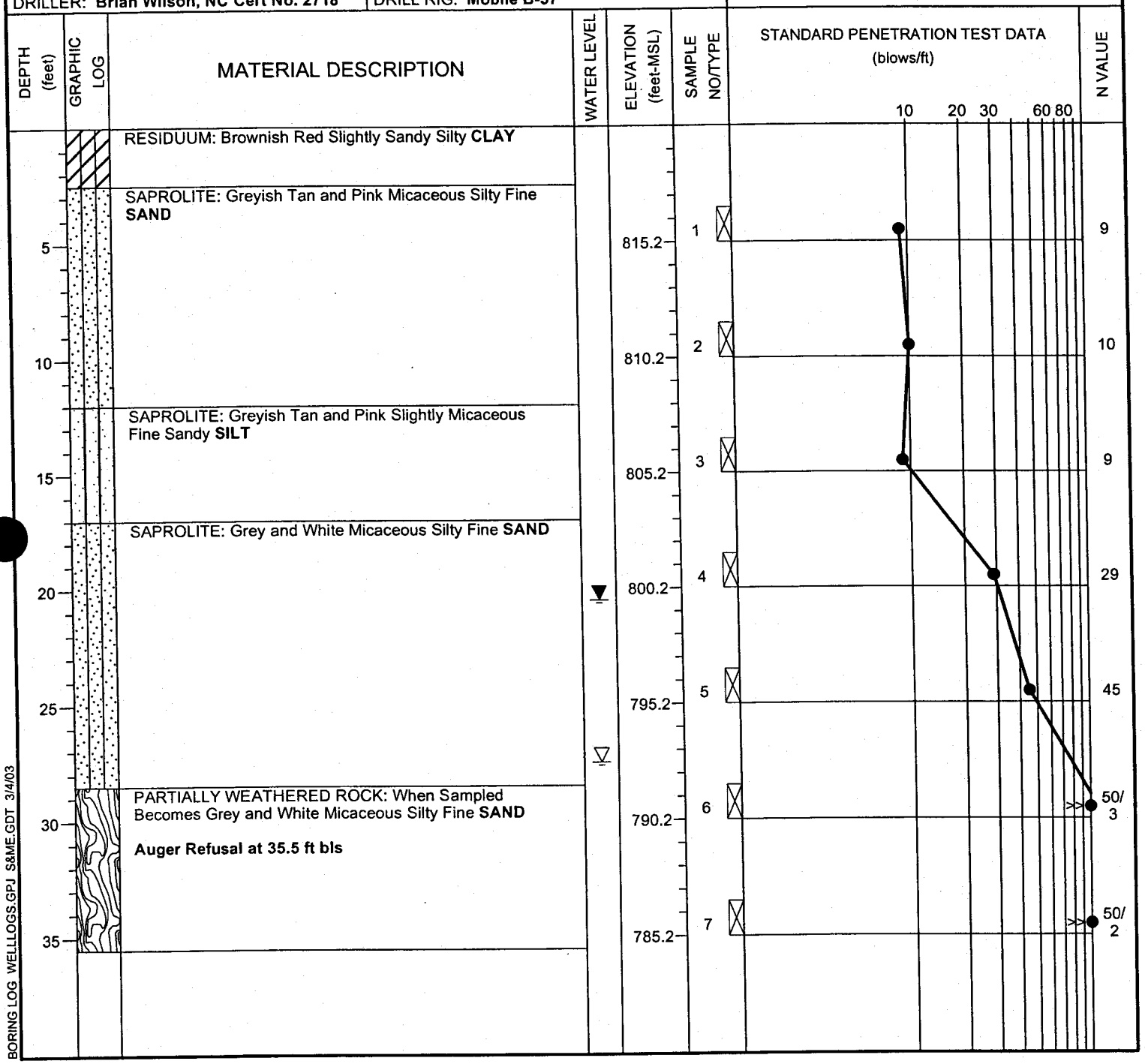
Jay C. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG MS-2**
DATE DRILLED: 1/6/03	ELEVATION: 820.2	NOTES: **Bag Sample Collected at 30 ft bls.** **Auger Refusal Encountered at 35.5 ft bls.**
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 35.5	
LOGGED BY: Julie Petersen	WATER LEVEL: 20.5 ft bls at 24 hrs.	
DRILLER: Brian Wilson, NC Cert No. 2718	DRILL RIG: Mobile B-57	



BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

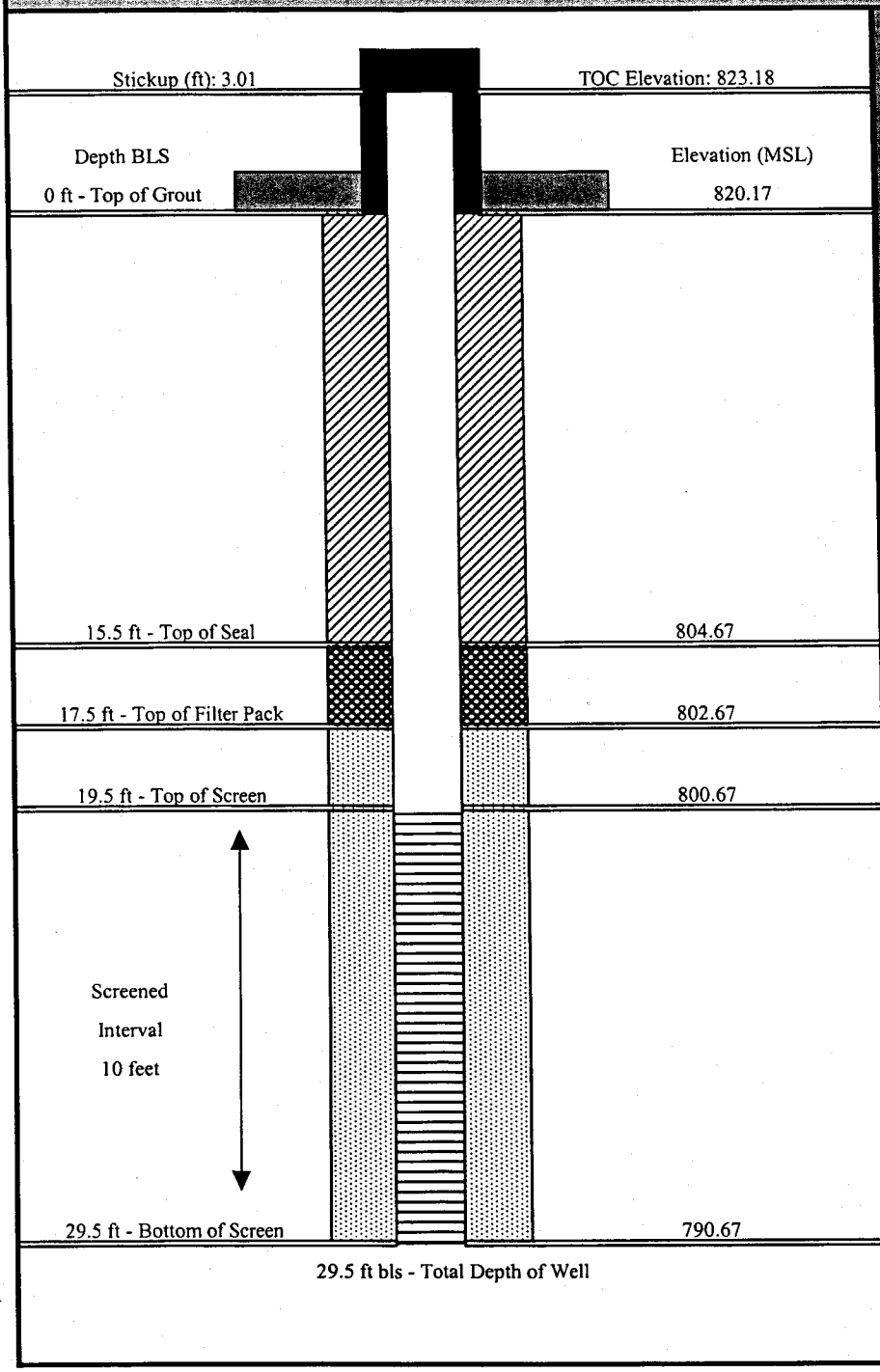
S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: MS-2 **TOTAL DEPTH: 29.5 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/06/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
20.5 ft bls at 24-hrs	680048.9	1413358.8	823.18	820.17



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 19.5 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
19.5 to 29.5 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 15.5 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
15.5 to 17.5 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
17.5 to 29.5 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-2)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/06/2003
5. TOTAL DEPTH 29.5 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 23.5 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   ***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 19.5 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 15.5 Ft.	Neat Cement	Pour
From	15.5	To 17.5 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	19.5	To 29.5 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

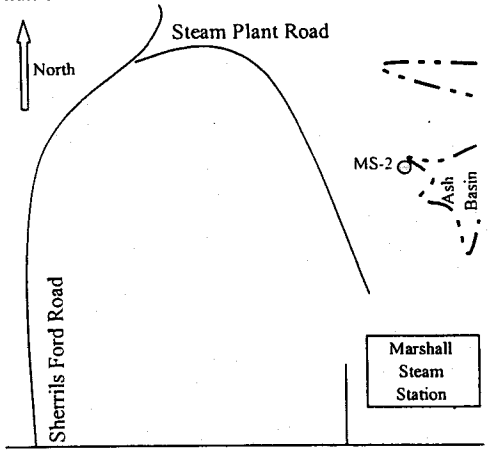
	Depth		Size	Material
From	17.5	To 29.5 Ft.	#1	Silica Sand
From		To Ft.		

16. REMARKS: _____

DEPTH From	To	DRILLING LOG Formation Descrpition
0 to 2.5		Silty Clay
2.5 to 12		Silty Fine Sand
12 to 17		Fine Sandy Silt
17 to 28.5		Silty Fine Sand
28.5 to 29.5		PWR

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

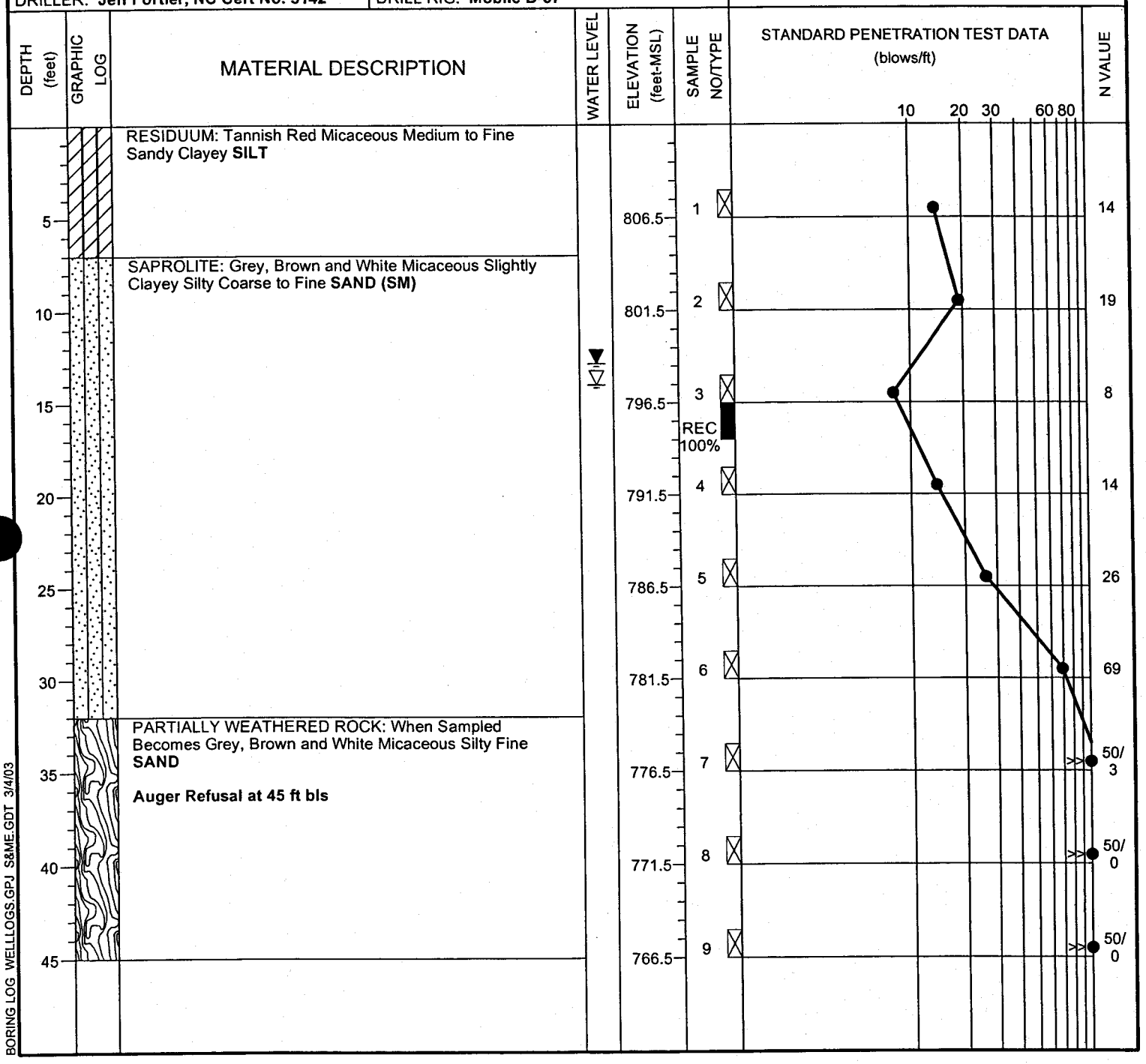
Brian E. Wilson — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2/6/03 — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	BORING LOG MS-3
DATE DRILLED: 12/3/02	ELEVATION: 811.5	NOTES: Bag Sample Collected at 20 ft bls. Auger Refusal Encountered at 45 ft bls.
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 45.0	
LOGGED BY: Julie Petersen	WATER LEVEL: 12.85 ft bls at 24 hrs.	
DRILLER: Jeff Fortier, NC Cert No. 3142	DRILL RIG: Mobile B-57	



BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

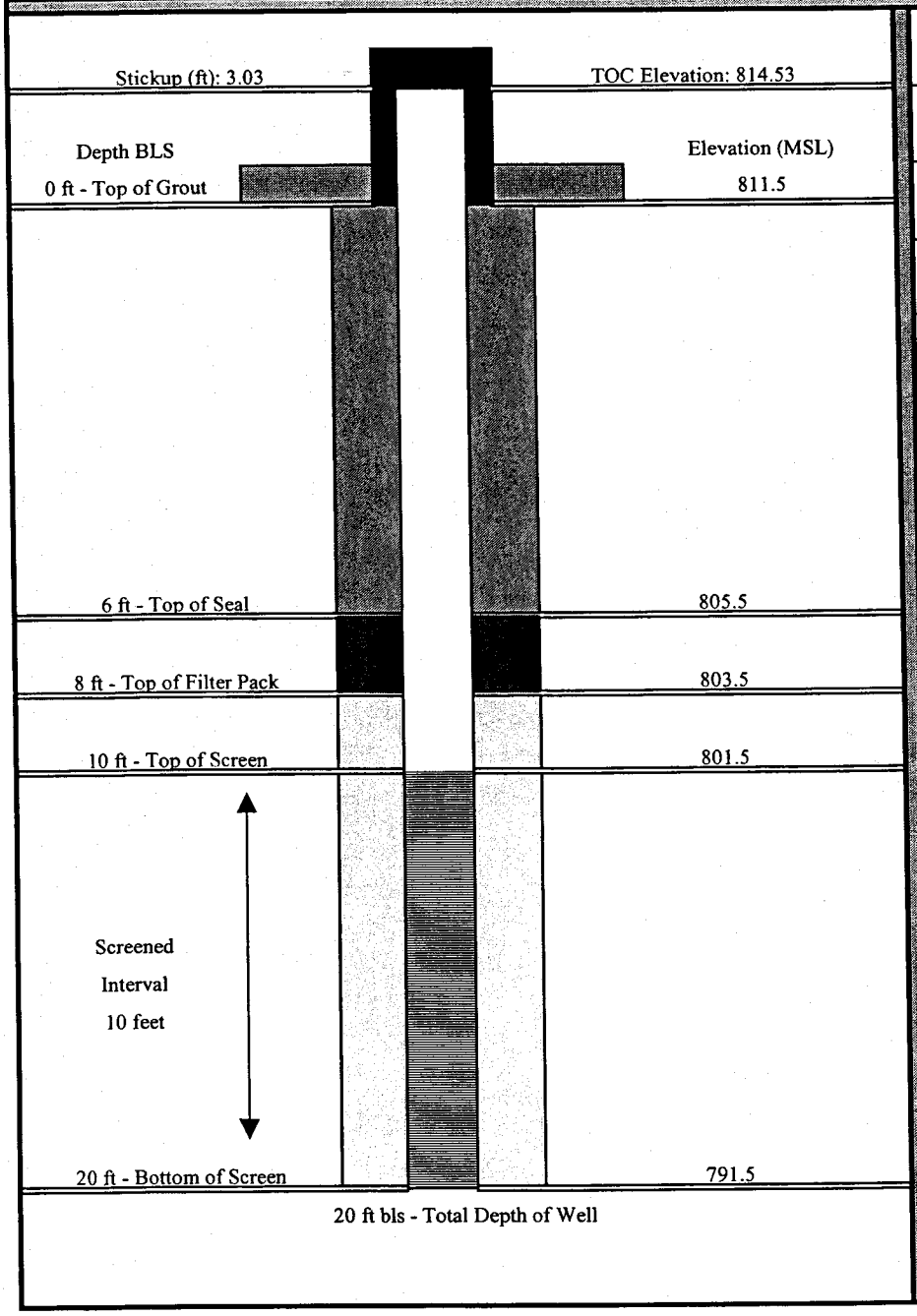
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: MS-3 **TOTAL DEPTH: 20 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/03/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jeff Fortier, 3142			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
12.85 ft bls at 24-hrs	679780.7	1413390.6	814.53	811.5



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 10 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	10 to 20 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 6 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	6 to 8 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	8 to 20 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes
NOTES:	**For Lithologic Information See Attached Boring Log**

WELL CONSTRUCTION RECORD

(MS-3)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jeff Fortier **CERTIFICATION #** 3142/2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ (if applicable) **ASSOCIATED WQ PERMIT#** _____ (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use: observation well

2. WELL LOCATION:
   Nearest Town: Terrell County: Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting: ☐ Ridge ☐ Slope ☑ Valley ☐ Flat (check appropriate box)

   Latitude/longitude of well location _____ (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map (check box)

3. OWNER: Duke Power
   Address: 526 South Church Street (Street or Route No.)
   Charlotte NC 28202 (City or Town / State / Zip Code)
   (704) 373-7900 (Area code - Phone Number)

4. DATE DRILLED 12/03/2002
5. TOTAL DEPTH 20 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 17 ft. (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 10	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 6	Ft.	Neat Cement	Pour
From 6	To 8	Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From 10	To 20	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

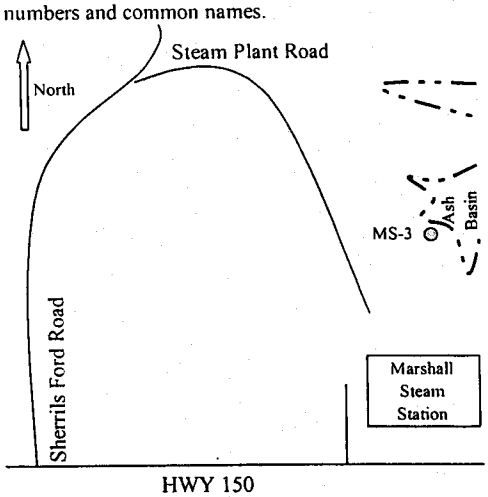
	Depth		Size	Material
From 8	To 20	Ft.	#1	Silica Sand
From	To	Ft.		

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Clayey Silt
7	20	Silty Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

Brian E. Wilson #2718 — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2-7-02 — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG MS-4**
DATE DRILLED: **1/8/03**	ELEVATION: **844.6**	NOTES: **Bag Samples Collected at 50 and 60 ft bls.** **Auger Refusal Encountered at 79.5 ft bls.**
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **79.5**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **39.2 ft bls at 24 hrs.**	
DRILLER: **Brian Wilson, NC Cert No. 2718**	DRILL RIG: **Mobile B-57**	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft)	N VALUE
5	RESIDUUM: Red Micaceous Slightly Sandy Clayey **SILT (MH)**	839.6	1		24
10	SAPROLITE: Brownish Red Micaceous Fine Sandy **SILT** with Some Manganese Staining	834.6	2		15
15		829.6	3		13
20	SAPROLITE: Brown, Grey and White to Brownish Grey and White Very Micaceous Silty Fine **SAND** with Some Manganese Staining	824.6	4		12
25		819.6	5		12
30		814.6	6		13
35		809.6	7		14
40		804.6	8		12
45		799.6	REC 100% 9		20
50	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Tan and White Silty Medium to Fine **SAND**	794.6	10		50/5
55		789.6	11		50/5
60	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey, Brown and White Micaceous Silty Medium to Fine **SAND** with Rock Fragments	784.6	12		50/5
65	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Tan and White Slightly Micaceous Silty Medium to Fine **SAND** with Rock Fragments	779.6	13		50/2
70	**Auger Refusal at 79.5 ft bls**	774.6	14		50/3
75		769.6	15		50/1
			16		50/1

STANDARD PENETRATION TEST DATA (blows/ft): 10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/5/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

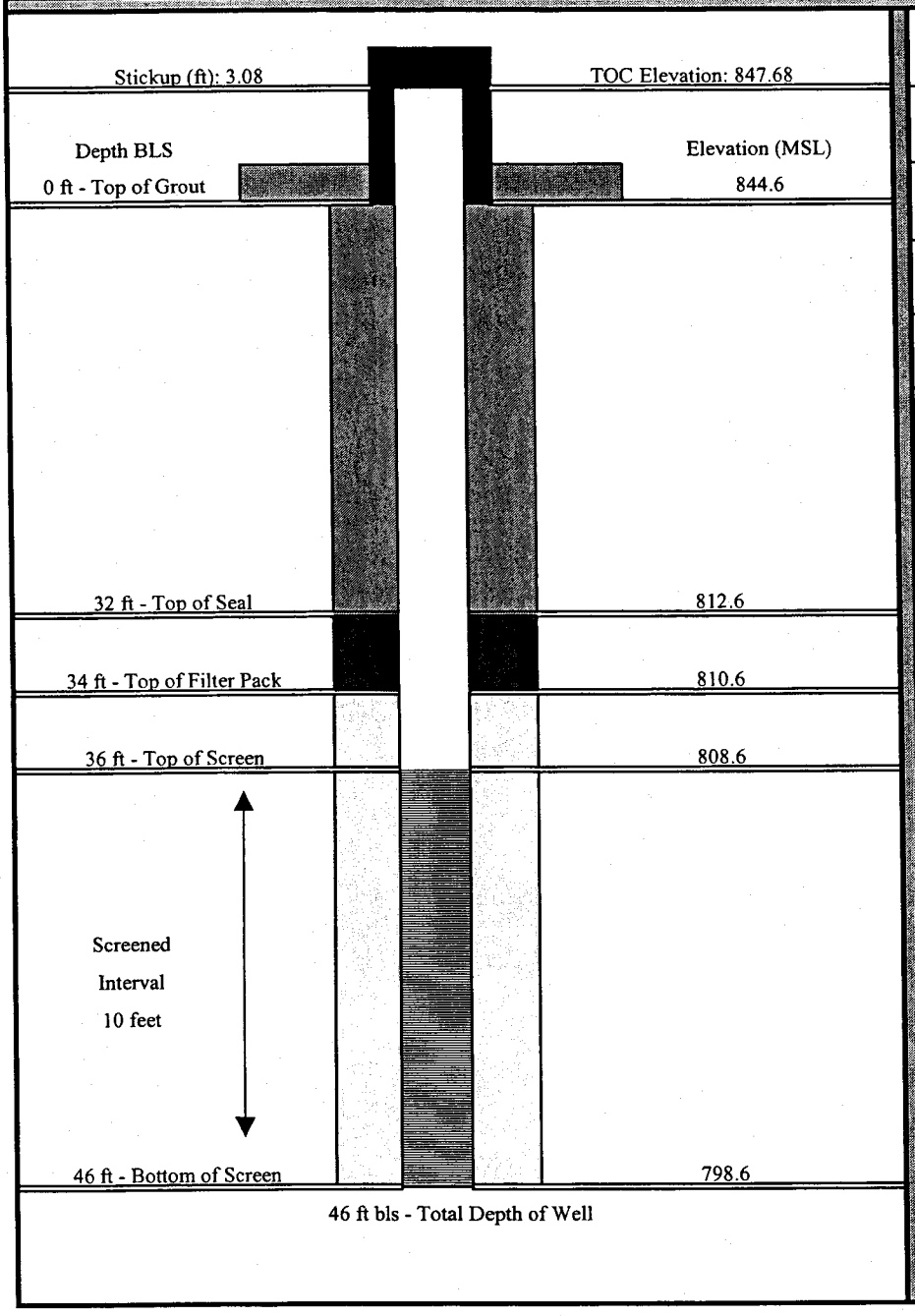
S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: MS-4 **TOTAL DEPTH: 46 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/08/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
39.2 ft bls at 24-hrs	679168.9	1412970.3	847.68	844.6



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 36 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
36 to 46 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 32 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
32 to 34 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
34 to 46 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-4)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☑ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/08/2003
5. TOTAL DEPTH 46 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 42 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 36 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 32 Ft.	Neat Cement	Pour
From	32	To 34 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	36	To 46 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

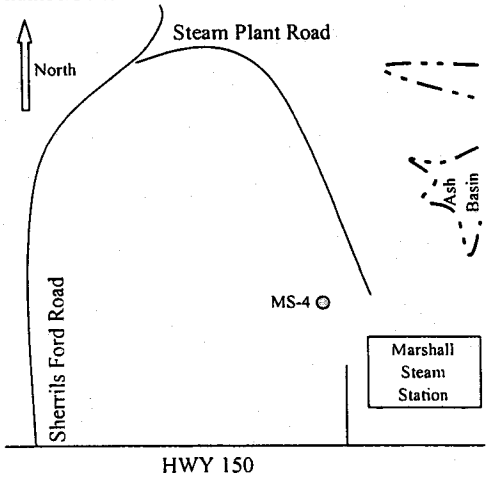
	Depth		Size	Material
From	34	To 46 Ft.	#1	Silica Sand
From		To Ft.		

16. REMARKS: _____

DEPTH From	To	DRILLING LOG Formation Descrpition
0 to 9		Silty Clay
9 to 17		Slightly Sandy Silt
17 to 46		Silty Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

Brian E. Wilson — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2/6/03 — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG MS-5**
DATE DRILLED: 12/18/02	ELEVATION: 839.1	NOTES: **Bag Samples Collected at 40 and 50 ft bls.**
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 90.0	
LOGGED BY: Julie Petersen	WATER LEVEL: 31.61 ft bls at 24 hrs.	
DRILLER: Jay Little, NC Cert No. 2717	DRILL RIG: Diedrich D-50	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	Rootmat/Topsoil			
5	RESIDUUM: Tannish Red Micaceous Clayey **SILT**	834.1	1	21
10	SAPROLITE: Greyish Tan and Brown Micaceous Fine Sandy **SILT**	829.1	2	11
15	SAPROLITE: Greyish Tan Silty Fine **SAND**	824.1	3	12
20	SAPROLITE: Greyish Tan Micaceous Silty Fine **SAND** with Manganese Staining	819.1	4	12
25		814.1	5	12
30	SAPROLITE: Greyish Tan and Brown Micaceous Slightly Clayey Silty Coarse to Fine **SAND** with Manganese Staining **(SM)**	809.1	6	38
35		804.1	REC 100% 7	36
40		799.1	8	36
45	SAPROLITE: Tannish Brown Micaceous Slightly Sandy **SILT** with Manganese Staining	794.1	9	17
50	SAPROLITE: Greyish Brown and White Micaceous Silty Medium to Fine **SAND** with Manganese Staining.	789.1	10	60
55	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown and White Micaceous Silty Medium to Fine **SAND**	784.1	11	50/5
60		779.1	12	50/3
65		774.1	13	50/3
70		769.1	14	50/3
75		764.1	15	50/3
80		759.1	16	50/2
85	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey, Black and White Micaceous Silty Fine **SAND** with Rock Fragments	754.1	17	50/3
90		749.1	18	50/1

STANDARD PENETRATION TEST DATA (blows/ft) — 10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: MS-5 **TOTAL DEPTH: 38 ft bls**

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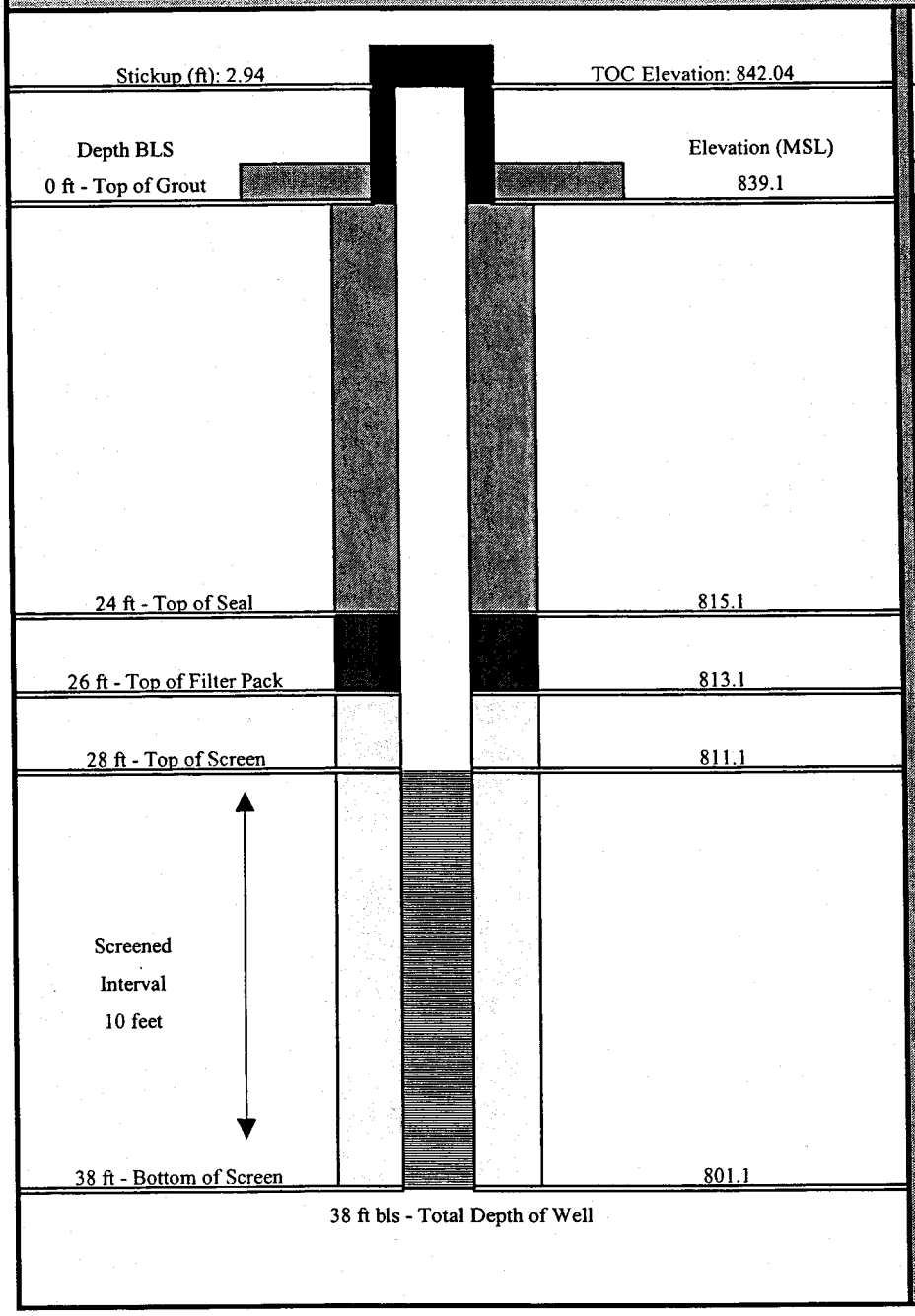
S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	12/18/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
31.61 ft bls at 24-hrs	679223.2	1412595.4	842.04	839.1



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 28 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL 28 to 38 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL 0 to 24 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 24 to 26 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 26 to 38 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: **For Lithologic Information See Attached Boring Log**

WELL CONSTRUCTION RECORD

(MS-5)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☑ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/18/2002
5. TOTAL DEPTH 38 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 35 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 28 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 24 Ft.	Neat Cement	Pour
From	24	To 26 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	28	To 38 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

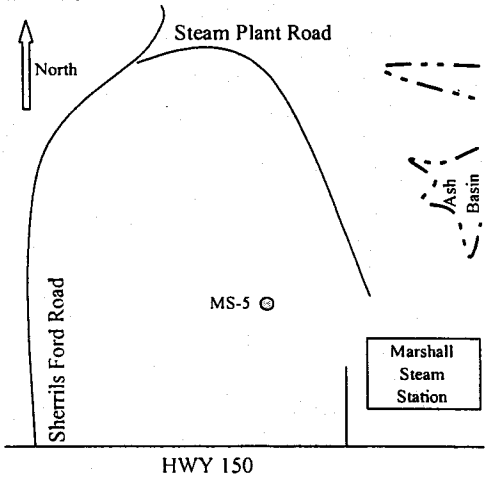
	Depth		Size	Material
From	26	To 38 Ft.	#1	Silica Sand
From		To Ft.		

16. REMARKS: _____

DEPTH From	To	DRILLING LOG Formation Descrpition
0	to 7	Clayey Silt
7	to 12	Fine Sandy Silt
12	to 27	Silty Fine Sand
27	to 38	Silty Med/Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

Jay A. Little 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT: **Marshall Steam Station**
Terrell, North Carolina
1264-02-578

BORING LOG MS-6

DATE DRILLED: **12/17/02**
DRILLING METHOD: **4¼" H.S.A.**
LOGGED BY: **Julie Petersen**
DRILLER: **Jay Little, NC Cert No. 2717**

ELEVATION: **839.2**
BORING DEPTH: **61.0**
WATER LEVEL: **26.89 ft bls at 24 hrs.**
DRILL RIG: **Diedrich D-50**

NOTES: **Bag Samples Collected Every 10 ft from 30 to 60 ft bls.**
Auger Refusal Encountered at 61 ft bls.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	RESIDUUM: Greyish Tan Miaceous Fine Sandy **SILT**			
5	RESIDUUM: Tannish Brown Miaceous Fine Sandy Silty **CLAY**	834.2	1	10
10	RESIDUUM: Reddish Brown and Tan Micaceous Clayey Fine Sandy **SILT**	829.2	2	15
	SAPROLITE: Tannish Grey Miaceous Fine Sandy **SILT**			
15	SAPROLITE: Brownish Tan Micaceous Fine Sandy **SILT**	824.2	3	10
20	SAPROLITE: Greyish Tan Silty Fine **SAND**	819.2	4	9
25		814.2	5	8
30	SAPROLITE: Grey and White Micaceous Silty Medium to Fine **SAND**	809.2	6	10
35		804.2	7	18
40	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey and White Miaceous Silty Medium to Fine **SAND**	799.2	REC 50% 8	50/3
45		794.2	9	50/2
50	PARTIALLY WEATHERED ROCK: When Sampled Becomes Red, Tan and White Silty Medium to Fine **SAND**	789.2	10	50/5
55	PARTIALLY WEATHERED ROCK: When Sampled Becomes Red, Grey and White Slightly Micaceous Silty Medium to Fine **SAND**	784.2	11	50/4
60	**Auger Refusal at 61 ft bls**	779.2	12	50/3

WATER LEVEL: ▼ 26.89 ft bls at 24 hrs.

STANDARD PENETRATION TEST DATA (blows/ft): 10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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ENVIRONMENTAL SERVICES
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Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: MS-6 **TOTAL DEPTH: 38 ft bls**

S&ME
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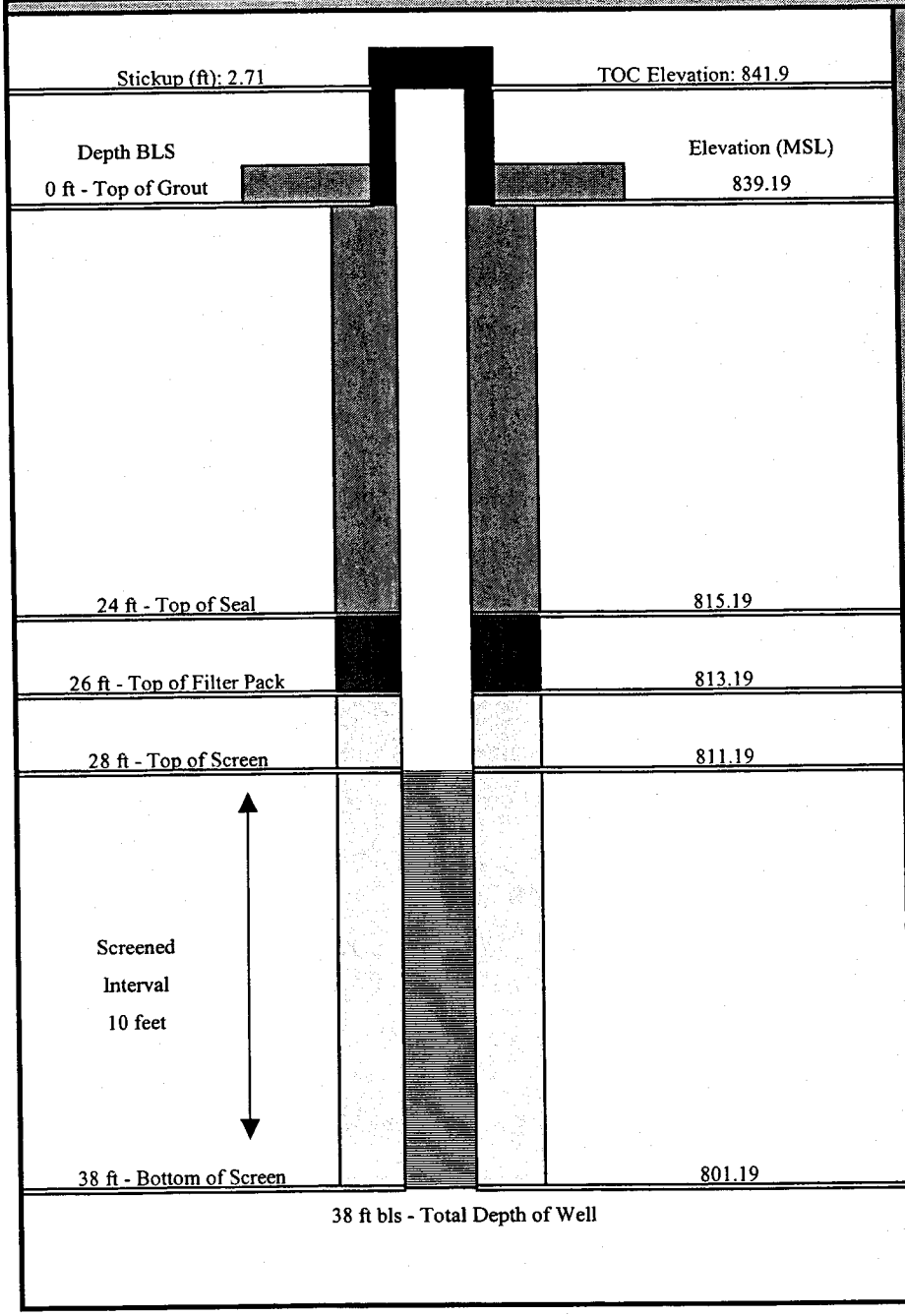
S&ME PROJECT AND NO:		WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072		Observation	12/17/2002
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:		DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717		4.25 HSA

STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
26.89 ft bls at 24-hrs	679732.8	1412500.7	841.9	839.19



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 28 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
28 to 38 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 24 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
24 to 26 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
26 to 38 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-6)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little — CERTIFICATION # 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. — PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ (if applicable) — ASSOCIATED WQ PERMIT# _____ (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use: observation well

2. WELL LOCATION:
   Nearest Town: Terrell County: Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address: 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 12/17/2002
5. TOTAL DEPTH 38 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 31.36 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 28	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 24	Ft.	Neat Cement	Pour
From 24	To 26	Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From 28	To 38	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

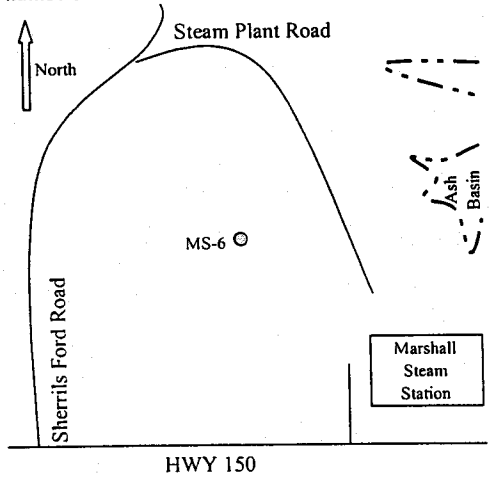
	Depth		Size	Material
From 26	To 38	Ft.	#1	Silica Sand
From	To	Ft.		

16. REMARKS: _____

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	0.5	Fine Sandy Silt
0.5	9	Silty Clay
9	17	Fine Sandy Silt
17	27	Silty Fine Sand
27	38	Silty Med/Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

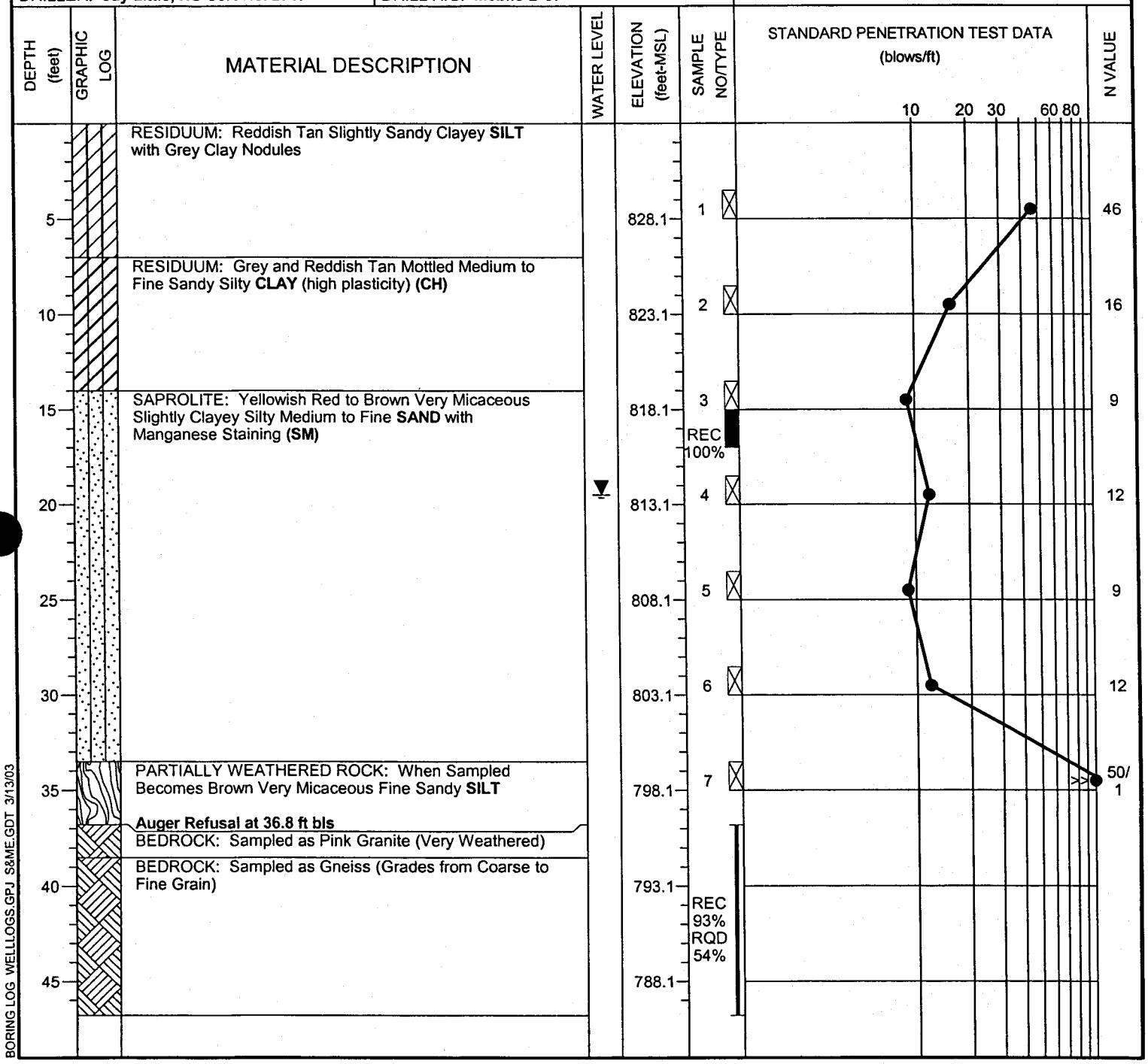
Jay A. Little — 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG MS-7**
DATE DRILLED: **1/3/03**	ELEVATION: **833.1**	NOTES: **Bag Samples Collected at 20 and 30 ft bls.** **Auger Refusal Encountered at 36.8 ft bls.**
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **46.8**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **19.5 ft bls at 24 hrs.**	
DRILLER: **Jay Little, NC Cert No. 2717**	DRILL RIG: **Mobile B-57**	



BORING LOG WELLLOGS.GPJ S&ME.GDT 3/13/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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Charlotte, NC 28273

Start - 36.8 ft bls

End - 46.8 ft bls

36.8 ft to 38.5 - Pink Granite (very weathered)
38.5 to 46.8 - Gneiss (grades from coarse to fine grain)

REC = 93%
RQD = 54%

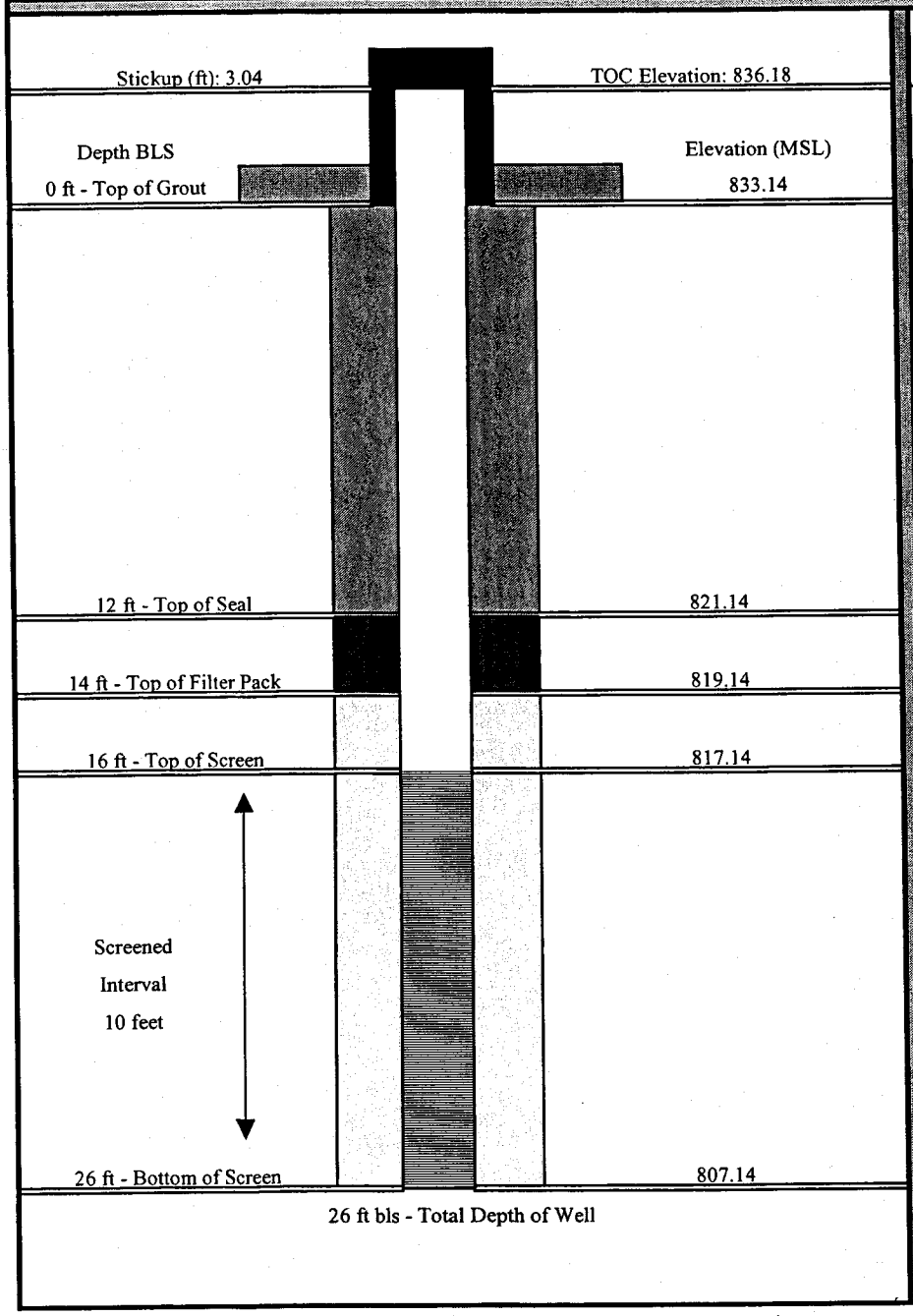
SCALE: As Shown CHECKED BY: DRAWN BY: JRP DATE: 1/27/03	S&ME ENVIRONMENTAL SERVICES • ENGINEERING • TESTING	**ROCK CORE MS-7** Marshall Steam Station - FGD Scrubber Landfill Terrell, North Carolina JOB NO. 1264-02-578	FIGURE NO.

MONITORING WELL CONSTRUCTION

WELL ID: MS-7 **TOTAL DEPTH: 26 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/03/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
19.5 ft bls at 24-hrs	680161.5	1412251.3	836.18	833.14



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 16 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL 16 to 26 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL 0 to 12 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 12 to 14 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 14 to 26 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: **For Lithologic Information See Attached Boring Log**

WELL CONSTRUCTION RECORD

(MS-7)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin: Jay Little — CERTIFICATION #: 2717

WELL CONTRACTOR COMPANY NAME: S&ME, Inc. — PHONE #: 704-523-4726

STATE WELL CONSTRUCTION PERMIT# (if applicable): _____ — ASSOCIATED WQ PERMIT# (if applicable): _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use: observation well

2. WELL LOCATION:
   Nearest Town: Terrell — County: Catawba
   Marshall Steam Station
   (Street Name. Numbers. Community. Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☑ Flat
   (check appropriate box)

   Latitude/longitude of well location _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address: 526 South Church Street
   (Street or Route No.)
   Charlotte — NC — 28202
   City or Town — State — Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED: 01/03/2003
5. TOTAL DEPTH: 26 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 22.5 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): n/a — METHOD OF TEST: n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type: n/a — Amount: n/a
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 16	Ft.	2-inch	Sch. 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	0	To 12	Ft.	Neat Cement	Pour
From	12	To 14	Ft.	Bentonite	Pour

14. SCREEN:

	Depth			Diameter		Slot Size		Material
From	16	To 26	Ft.	2-inch	in.	0.01	in.	PVC
From		To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

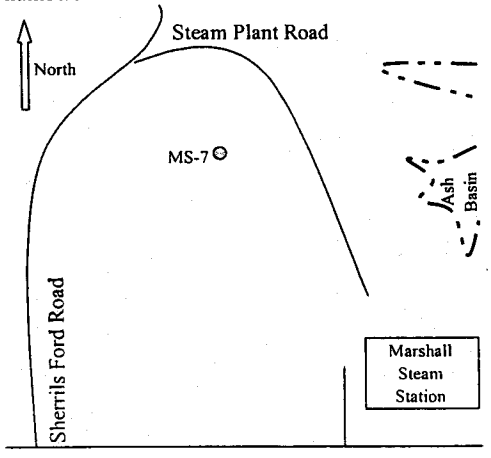
	Depth			Size	Material
From	14	To 26	Ft.	#1	Silica Sand
From		To	Ft.		

16. REMARKS: _____

From	To	Drilling Log: Formation Description
0	7	Clayey Silt
7	14	Silty Clay
14	26	Slightly Sandy Silt

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

Jay G. Little — 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT: **Marshall Steam Station**
Terrell, North Carolina
1264-02-578

BORING LOG MS-8

DATE DRILLED: **1/14/03**
DRILLING METHOD: **4¼" H.S.A.**
LOGGED BY: **Julie Petersen**
DRILLER: **Brian Wilson, NC Cert No. 2718**

ELEVATION: **848.3**
BORING DEPTH: **52.0**
WATER LEVEL: **27.2 ft bls at 24 hrs.**
DRILL RIG: **Mobile B-57**

NOTES: **Bag Samples Collected at 30 and 40 ft bls.**
Auger Refusal Encountered at 52 ft bls.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	RESIDUUM: Yellowish Red Fine Sandy Silty **CLAY**	843.3	1	32
5	RESIDUUM: Yellow and Red Mottled Micaceous Fine Sandy Silty **CLAY**	838.3	2	17
10	SAPROLITE: Greyish Tan and Pinkish White Very Micaceous Slightly Clayey Silty Coarse to Fine **SAND (SM)**	833.3	3	9
15		828.3	4	8
20		823.3	5	7
25	SAPROLITE: Greyish Tan and Pinkish White Very Micaceous Silty Medium to Fine **SAND** with Some Manganese Staining	818.3	REC 100% 6	8
30		813.3	7	26
35		808.3	8	50/5
40	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Tan and Pinkish White Very Micaceous Silty Medium to Fine **SAND** with Some Manganese Staining	803.3	9	50/2
45	PARTIALLY WEATHERED ROCK: When Sampled Becomes Red and White Silty Medium to Fine **SAND** **Auger Refusal at 52 ft bls**	798.3	10	50/2
50				

STANDARD PENETRATION TEST DATA (blows/ft)
10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/5/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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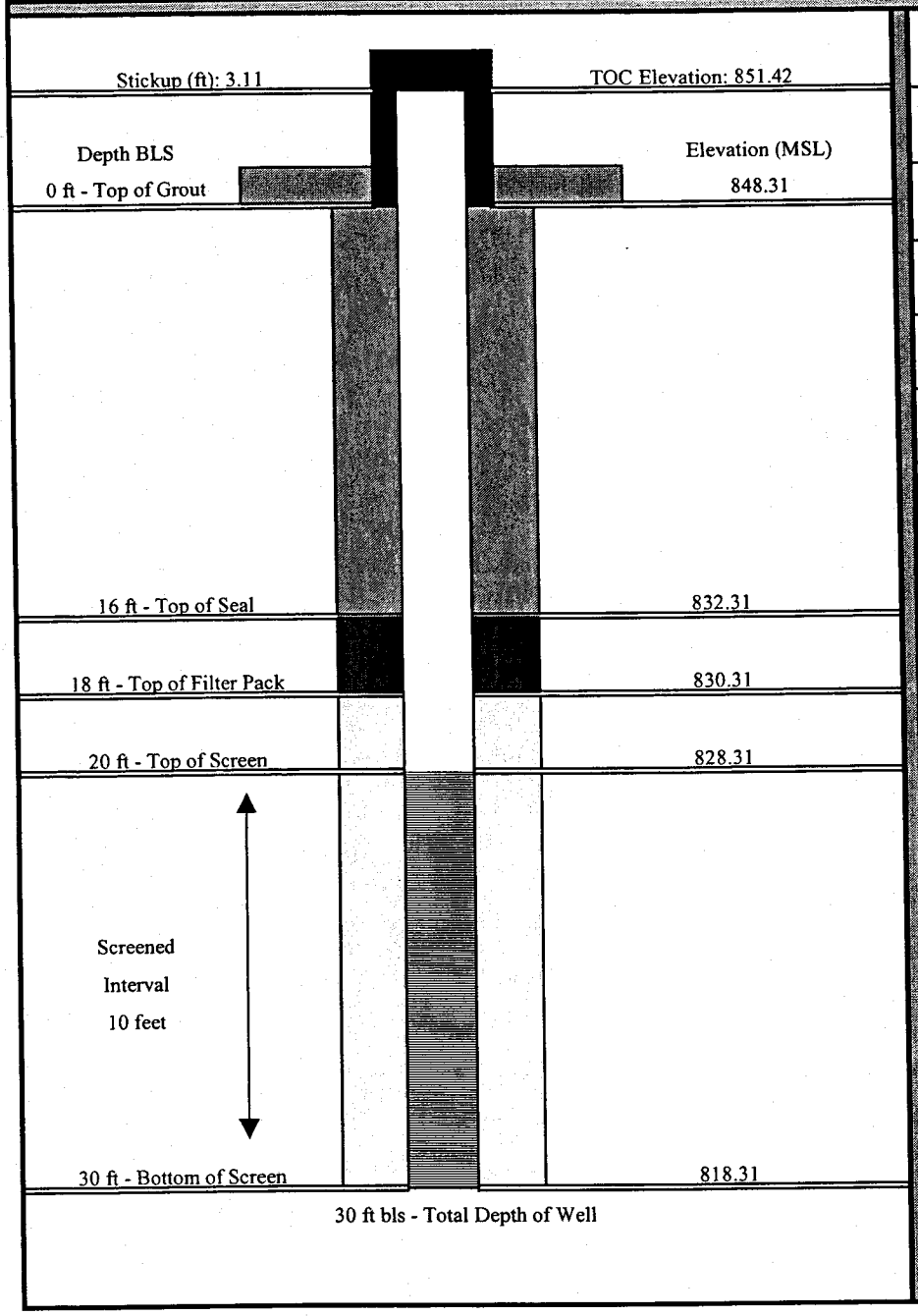
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

WELL ID: MS-8 **TOTAL DEPTH: 30 ft bls**

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/14/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
27.2 ft bls at 24-hrs	680717.9	1412028.0	851.42	848.31



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 20 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	20 to 30 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 16 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	16 to 18 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	18 to 30 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes
NOTES:	**For Lithologic Information See Attached Boring Log**

WELL CONSTRUCTION RECORD

(MS-8)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☑ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	12	Silty Clay
12	27	Fine Sandy Silt
27	30	Silty Med/Fine Sand

4. DATE DRILLED 01/14/2003
5. TOTAL DEPTH 30 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 30 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 20	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 16	Ft.	Neat Cement	Pour
From 16	To 18	Ft.	Bentonite	Pour

14. SCREEN:

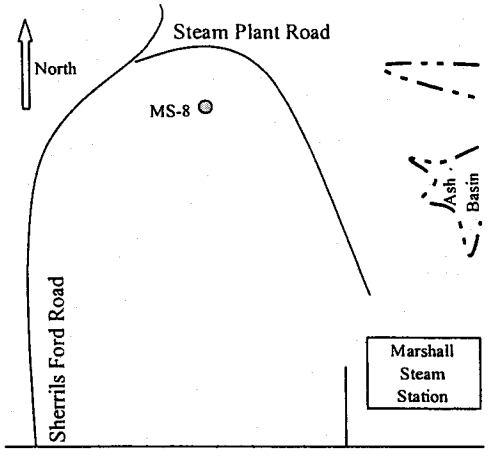
	Depth		Diameter	Slot Size	Material
From 20	To 30	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 18	To 30	Ft.	#1	Silica Sand
From	To	Ft.		

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

Brian E. Wilson 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT: **Marshall Steam Station**
Terrell, North Carolina
1264-02-578

BORING LOG MS-9

DATE DRILLED: **1/16/03**
ELEVATION: **865.4**
DRILLING METHOD: **4¼" H.S.A.**
BORING DEPTH: **74.0**
LOGGED BY: **Julie Petersen**
WATER LEVEL: **44.5 ft bls at 24 hrs.**
DRILLER: **Brian Wilson, NC Cert No. 2718**
DRILL RIG: **Mobile B-57**

NOTES: **Bag Sample Collected at 60 ft bls.**
Auger Refusal Encountered at 74 ft bls.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	RESIDUUM: Red Slightly Sandy Silty **CLAY**			
5	RESIDUUM: Yellowish Red Miaceous Fine Sandy **SILT**	860.4	1	23
10	SAPROLITE: Greyish Brown and Pinkish White Micaceous Silty Very Fine **SAND** with Some Manganese Staining	855.4	2	13
15		850.4	3	13
20		845.4	4	18
25		840.4	5	17
30		835.4	6	16
35		830.4	7	11
40		825.4	8	13
45		820.4	9	16
50		815.4	10	30
55	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown and Pinkish White Micaceous Silty Fine **SAND**	810.4	11	50/4
60	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey, Brown and White Micaceous Silty Medium to Fine **SAND** with Rock Fragments	805.4	12	50/3
65	**Auger Refusal at 74 ft bls**	800.4	13	50/5
70		795.4	14	50/1
			15	50/2

STANDARD PENETRATION TEST DATA (blows/ft)
10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

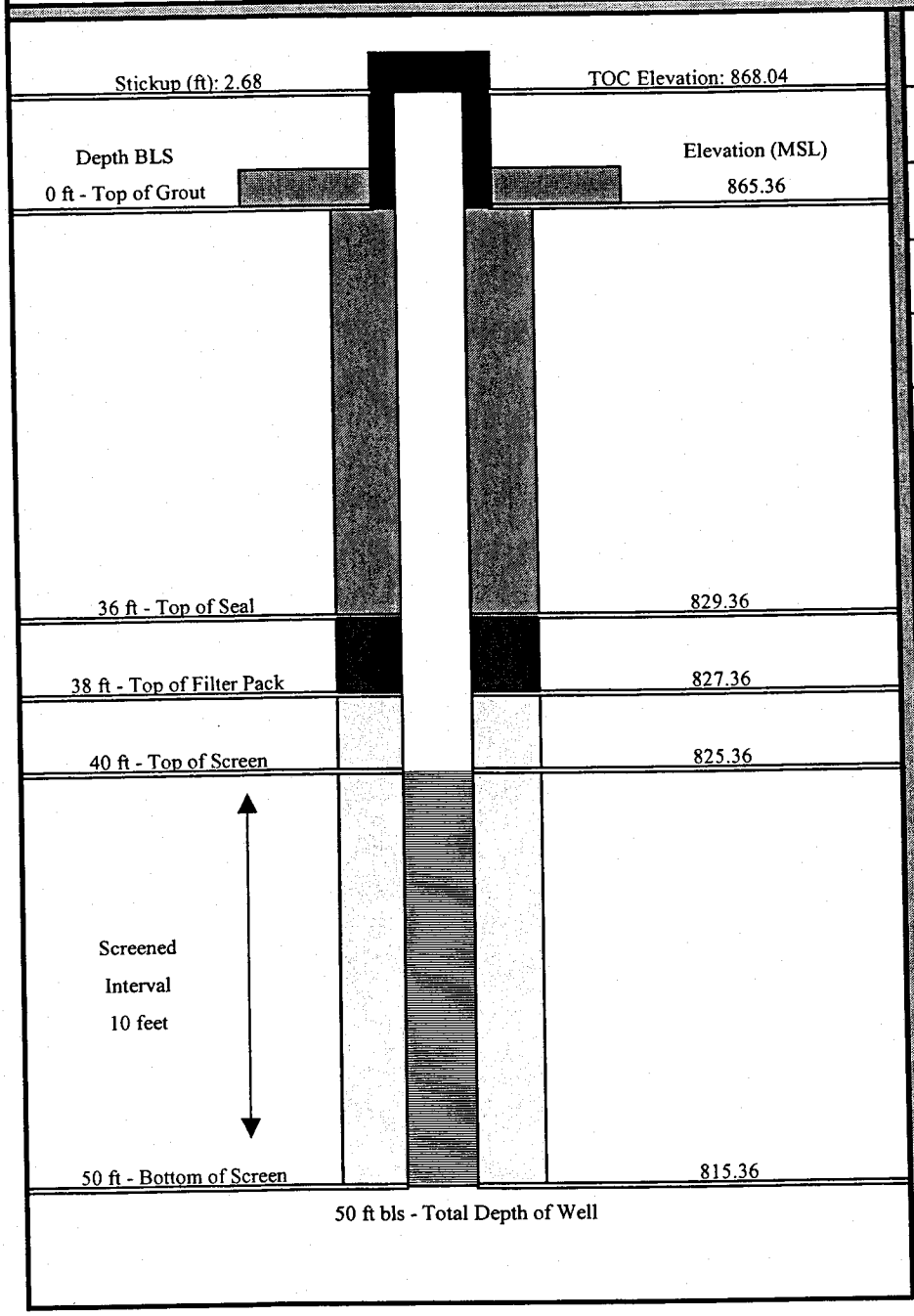
S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

WELL ID: MS-9 **TOTAL DEPTH: 50 ft bls**

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	01/16/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
44.5 ft bls at 24-hrs	681384.5	1412181.7	868.04	865.36



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 40 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL	40 to 50 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL	0 to 36 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	36 to 38 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	38 to 50 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes
NOTES:	**For Lithologic Information See Attached Boring Log**

WELL CONSTRUCTION RECORD

(MS-9)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☑ Ridge ☐ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 01/16/2003
5. TOTAL DEPTH 50 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 48.5 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	4	Silty Clay
4	9	Fine Sandy Silt
9	50	Silty Very Fine Sand

11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth From	To		Diameter	Wall Thickness or Weight/Ft.	Material
	0	40	Ft.	2-inch	Sch. 40	PVC
			Ft.			
			Ft.			

13. GROUT:

	Depth From	To		Material	Method
	0	36	Ft.	Neat Cement	Pour
	36	38	Ft.	Bentonite	Pour

14. SCREEN:

	Depth From	To		Diameter		Slot Size		Material
	40	50	Ft.	2-inch	in.	0.01	in.	PVC
			Ft.		in.		in.	

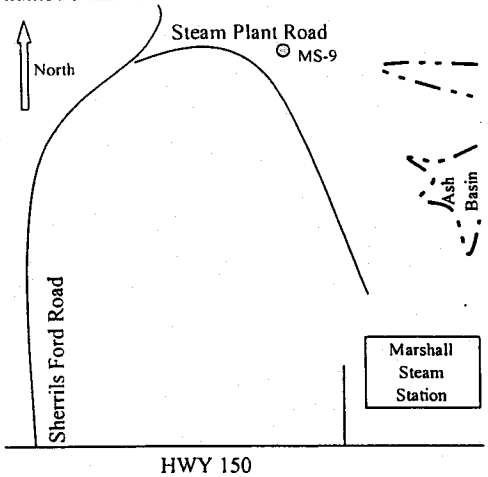
15. SAND/GRAVEL PACK:

	Depth From	To		Size	Material
	38	50	Ft.	#1	Silica Sand
			Ft.		

16. REMARKS: _____

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

Brian E. Wilson — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2-7-03 — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG MS-10**
DATE DRILLED: **7/7/03**	ELEVATION: **848.3**	NOTES: **Auger Refusal Encountered at 44 ft bls.**
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **44.0**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **12 ft bls at 24 hrs.**	
DRILLER: **Jay Little, NC Cert No. 2717**	DRILL RIG: **Mobile B-57**	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
5	RESIDUUM: Tan Silty Fine Sandy **CLAY**	843.3	1		17
10	RESIDUUM: Grey Very Micaceous Slightly Sandy Silty **CLAY**	838.3	2		3
15	SAPROLITE: Tan, Brown and Grey Very Micaceous Fine Sandy **SILT** with Manganese Staining	833.3	3		4
20		828.3	4		4
25		823.3	5		7
30	SAPROLITE: Reddish Tan, Brown and Grey Very Micaceous Silty Fine **SAND** with Manganese Staining	818.3	6		10
35		813.3	7		10
40	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey and White Very Micaceous Silty Medium to Fine **SAND** **Auger Refusal at 44 ft bls**	808.3	8		50/6
			9		50/1

BORING LOG WELLLOGS.GPJ S&ME.GDT 8/1/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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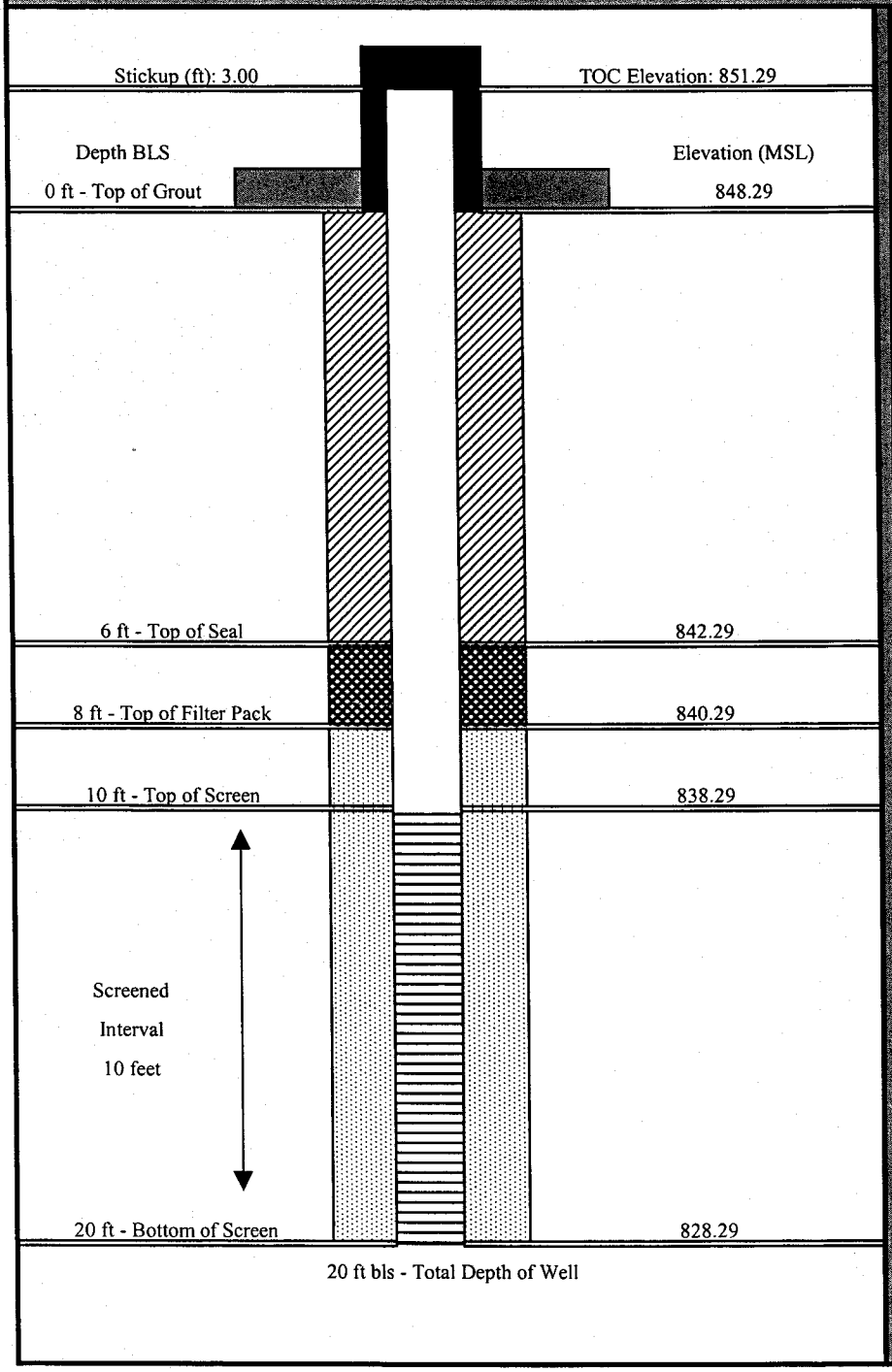
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: MS-10 **TOTAL DEPTH: 20 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
MSS-FGD Scrubber Landfill, 1264-02-578			Observation	07/08/2003
DRILLING CONTRACTOR:		**DRILLER AND LICENCE NO.:**		**DRILLING METHOD:**
S&ME, Inc.		Jay Little, 2717		4.25 HSA
STATIC WATER LEVEL:	**NORTHING:**	**EASTING:**	**TOP OF CASING ELEV.:**	**GROUND SURFACE ELEV.:**
12 ft bls at 24-hrs	681027.6	1411622.5	851.29	848.29



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 10 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL 10 to 20 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL 0 to 6 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 6 to 8 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 8 to 20 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: **For Lithologic Information See Attached Boring Log**

WELL CONSTRUCTION RECORD

(MS-10)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 07/08/2003
5. TOTAL DEPTH 20 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 12 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   ***Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.**
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 10	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 6	Ft.	Neat Cement	Pour
From 6	To 8	Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From 10	To 20	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

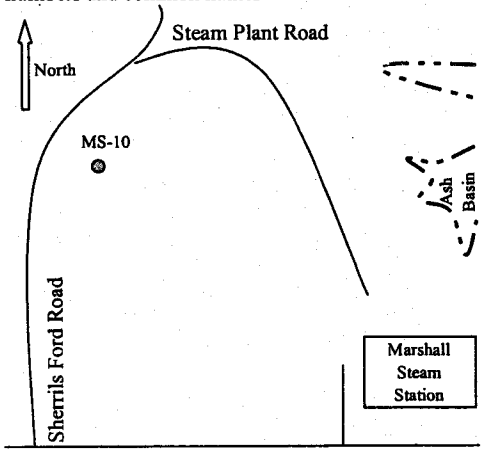
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 8	To 20	Ft.	#1	Silica Sand
From	To	Ft.		

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Fine Sandy Clay
7	12	Silty Clay
12	20	Fine Sandy Silt

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

Jay C. Little 7-17-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT: **Marshall Steam Station**
Terrell, North Carolina
1264-02-578

BORING LOG MS-11

DATE DRILLED: **7/8/03**
ELEVATION: **856.9**
NOTES: **Auger Refusal Encountered at 59 ft bls.**

DRILLING METHOD: **4¼" H.S.A.**
BORING DEPTH: **59.0**

LOGGED BY: **Julie Petersen**
WATER LEVEL: **33 ft bls at 24 hrs.**

DRILLER: **Jay Little, NC Cert No. 2717**
DRILL RIG: **Mobile B-57**

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	Rootmat/Topsoil			
	RESIDUUM: Red Micaceous Fine Sandy Silty **CLAY**	851.9	1	18
5				
	RESIDUUM: Tannish Red Micaceous Fine Sandy **SILT**	846.9	2	11
10				
	SAPROLITE: Reddish Tan Micaceous Slightly Clayey Silty Fine **SAND**	841.9	3	10
15				
		836.9	4	9
20				
	SAPROLITE: Reddish Tan Slightly Clayey Silty Coarse to Fine **SAND**	831.9	5	10
25				
	SAPROLITE: Reddish Tan Slightly Clayey Fine Sandy **SILT**	826.9	6	5
30				
	SAPROLITE: Brownish Tan Silty Medium to Fine **SAND** with Traces of Manganese Staining	821.9	7	14
35				
	SAPROLITE: Tan and White Silty Coarse to Fine **SAND** with Quartz Fragments	816.9	8	71
40				
	PARTIALLY WEATHERED ROCK: When Sampled Becomes Tan and White Silty Coarse to Fine **SAND** with Quartz Fragments	811.9	9	50/5
45				
	SAPROLITE: Tannish Red, Black and White Stratified Slightly Clayey Fine Sandy **SILT**	806.9	10	28
50				
		801.9	11	48
55				
	PARTIALLY WEATHERED ROCK: When Sampled Becomes Tannish Red, Black and White Stratified Slightly Clayey Medium to Fine Sandy **SILT**		12	50/3
	Auger Refusal at 59 ft bls			

STANDARD PENETRATION TEST DATA (blows/ft)
10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 8/1/03

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

S&ME
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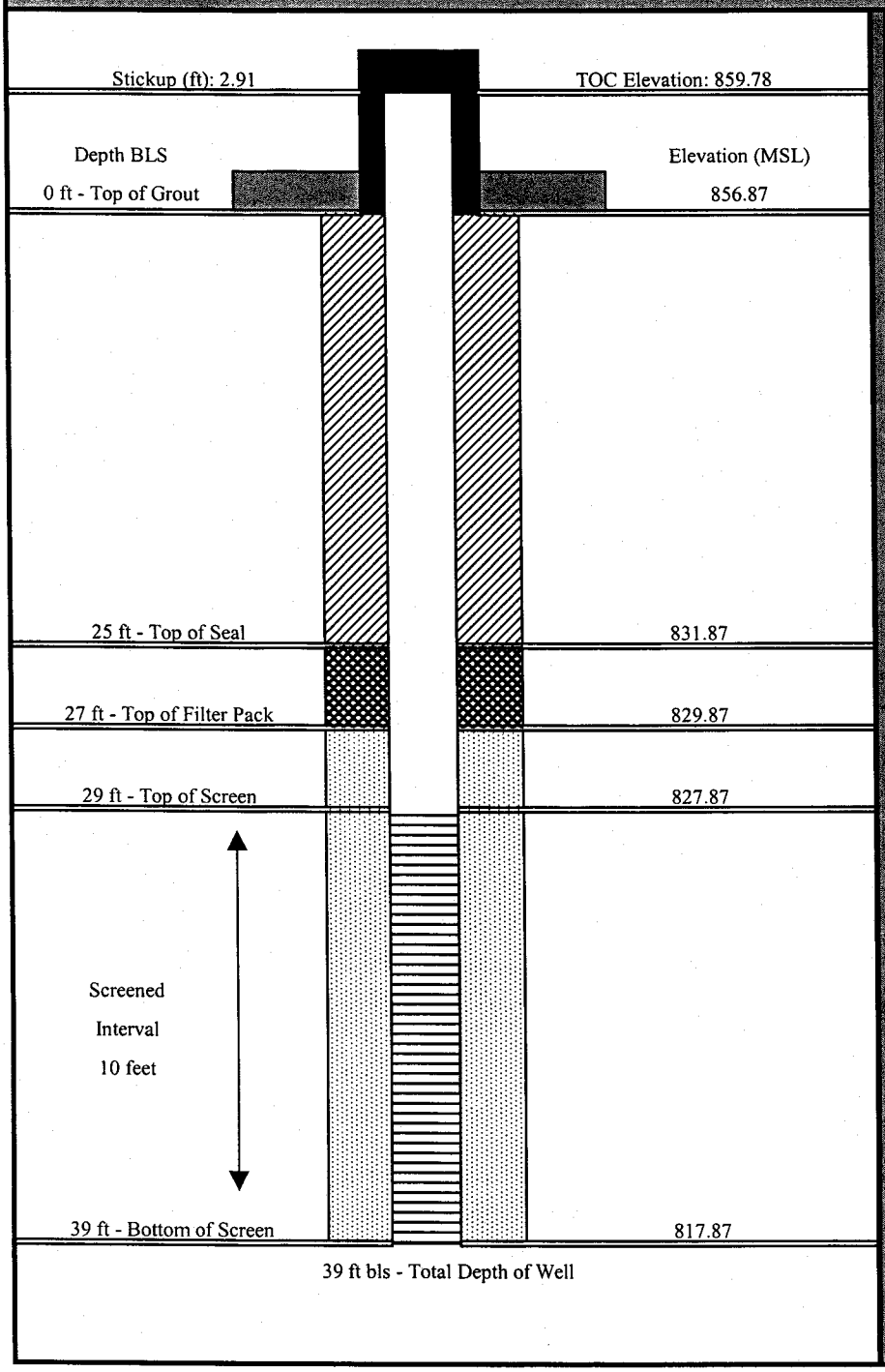
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

WELL ID: MS-11 **TOTAL DEPTH: 39 ft bls**

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
MSS-FGD Scrubber Landfill, 1264-02-578			Observation	07/09/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Jay Little, 2717			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
33 ft bls at 24-hrs	680297.5	1411564.8	859.78	856.87



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 29 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
29 to 39 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 25 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
25 to 27 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
37 to 39 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-11)

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little **CERTIFICATION #** 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# (if applicable) **ASSOCIATED WQ PERMIT#** (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use: observation well
2. WELL LOCATION:
   Nearest Town: Terrell County: Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)
   Topographic/Land setting
   ☐ Ridge ☑ Slope ☐ Valley ☐ Flat
   (check appropriate box)
   Latitude/longitude of well location
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)
3. OWNER: Duke Power
   Address: 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number
4. DATE DRILLED 07/09/2003
5. TOTAL DEPTH 39 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 33 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 29 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 25 Ft.	Neat Cement	Pour
From	25	To 27 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	29	To 39 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

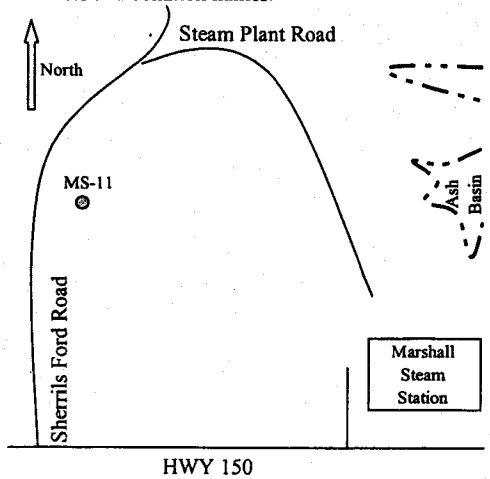
	Depth		Size	Material
From	27	To 39 Ft.	#1	Silica Sand
From		To Ft.		

16. REMARKS:

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Silty Clay
7	12	Fine Sandy Silt
12	22	Silty Fine Sand
22	27	Silty Coarse/Fine Sand
27	32	Fine Sandy Silt
32	37	Silty Med/Fine Sand
37	39	Silty Coarse/Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



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

Jay C. Little 7-17-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG OW-1**
DATE DRILLED: **2/12/03**	ELEVATION:	NOTES:
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **26.0**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **20.01 ft bls at 24 hrs.**	
DRILLER: **Brian Wilson, NC Cert No. 2718**	DRILL RIG: **Mobile B-57**	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
		RESIDUUM: Red Slightly Sandy Silty **CLAY**					
5		RESIDUUM: Red and Grey Fine Sandy Silty **CLAY** (high plasiticy)			1		20
10					2		11
15		SAPROLITE: Grey and White Very Micaceous Silty Coarse to Fine **SAND**			3		6
20			▼		4		12
25		SAPROLITE: Grey, Tan and White Very Micaceous Silty Coarse to Fine **SAND**			5		46

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

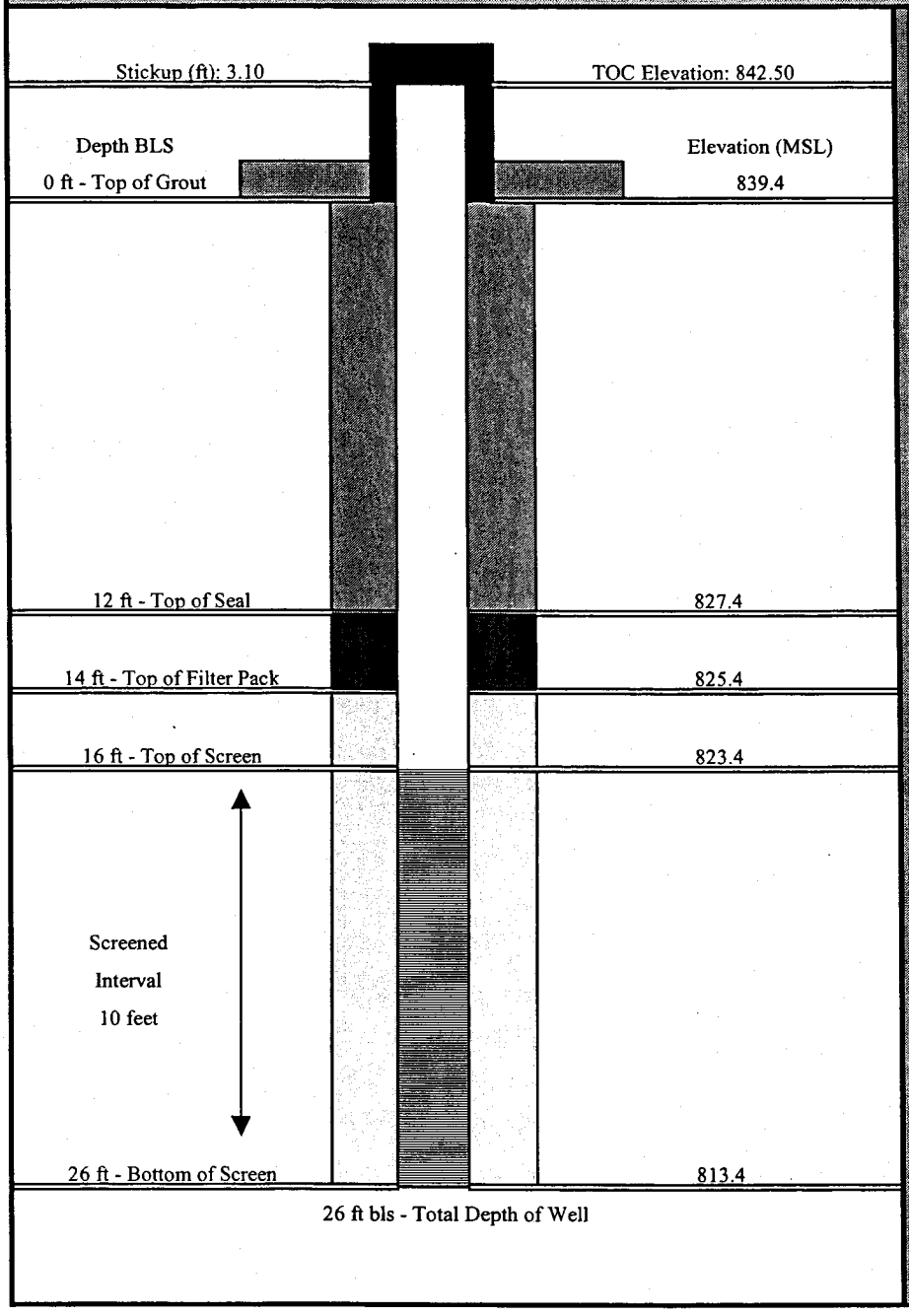
MONITORING WELL CONSTRUCTION

WELL ID: OW-1 **TOTAL DEPTH: 26 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:		WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072		Observation	02/12/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:		DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718		4.25 HSA

STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
20.01 ft bls at 24-hrs	680557.4	1411953.2	842.5	839.4



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 16 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
16 to 26 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 12 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
12 to 14 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
14 to 26 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

OW-1

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin: Brian Wilson — CERTIFICATION #: 2718

WELL CONTRACTOR COMPANY NAME: S&ME, Inc. — PHONE #: 704-523-4726

STATE WELL CONSTRUCTION PERMIT# (if applicable): _____ — ASSOCIATED WQ PERMIT# (if applicable): _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use: observation well

2. WELL LOCATION:
   Nearest Town: Terrell — County: Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☑ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address: 526 South Church Street
   (Street or Route No.)
   Charlotte — NC — 28202
   City or Town — State — Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED: 02/12/2003
5. TOTAL DEPTH: 26 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 23 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): n/a — METHOD OF TEST: n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type: n/a — Amount: n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 16 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 12 Ft.	Neat Cement	Pour
From	12	To 14 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	16	To 26 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

15. SAND/GRAVEL PACK:

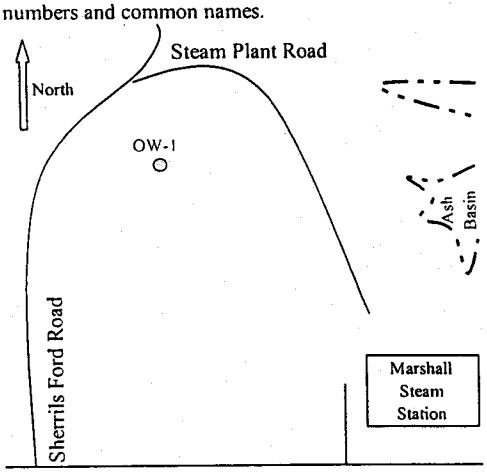
	Depth		Size	Material
From	14	To 26 Ft.	#1	Silica Sand
From		To Ft.		

16. REMARKS: _____

DEPTH From	To	DRILLING LOG Formation Descrpition
0	to 12	Silty Clay
12	to 26	Silty Coarse to Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY 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

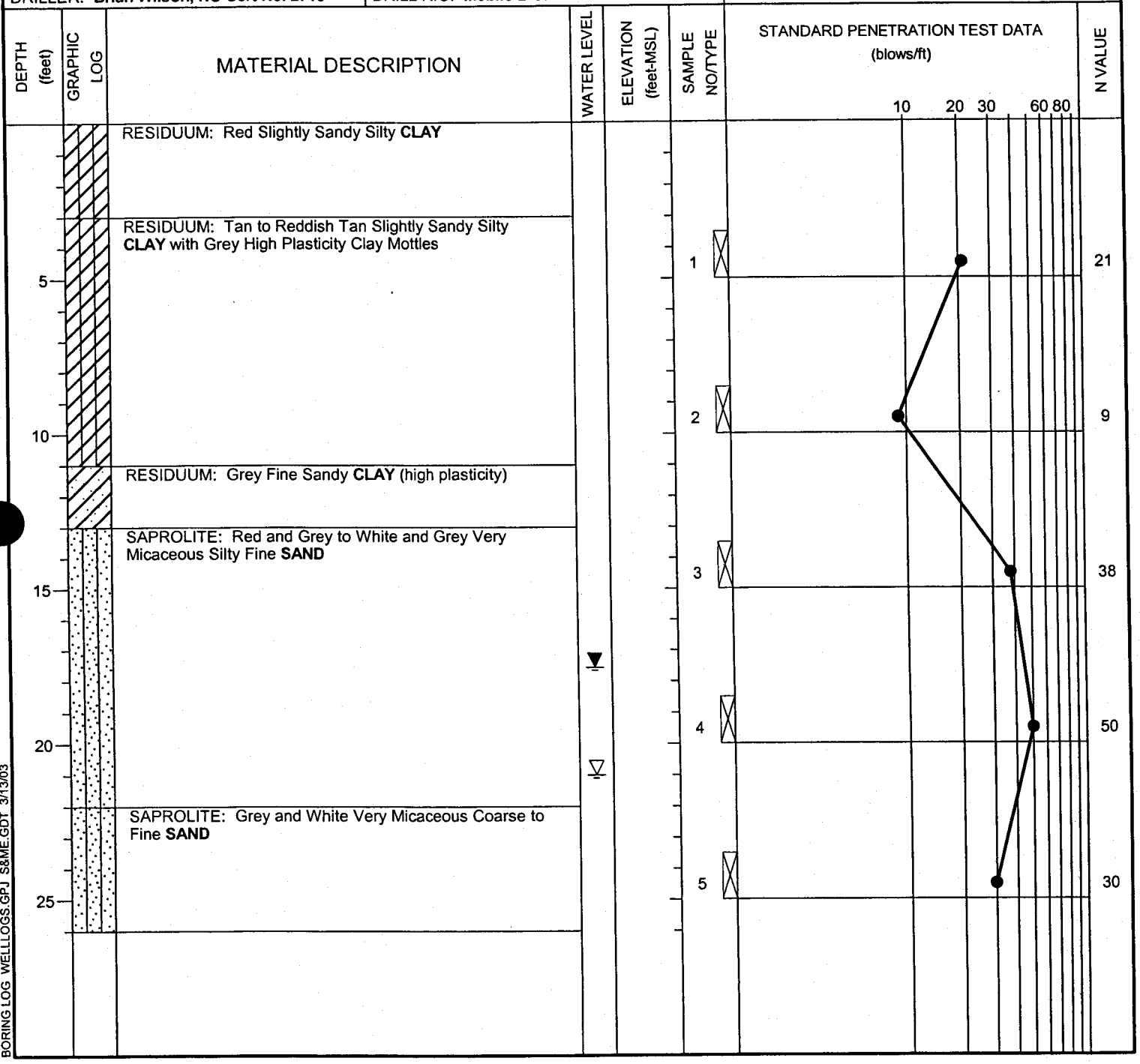
Brian E. Wilson — 2/17/03

SIGNATURE OF PERSON CONSTRUCTING THE WELL — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG OW-2**
DATE DRILLED: **2/12/03**	ELEVATION:	NOTES:
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **26.0**	
LOGGED BY: **Julie Petersen**	WATER LEVEL: **17.56 ft bls at 24 hrs.**	
DRILLER: **Brian Wilson, NC Cert No. 2718**	DRILL RIG: **Mobile B-57**	



BORING LOG WELLLOGS.GPJ S&ME.GDT 3/13/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.

2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

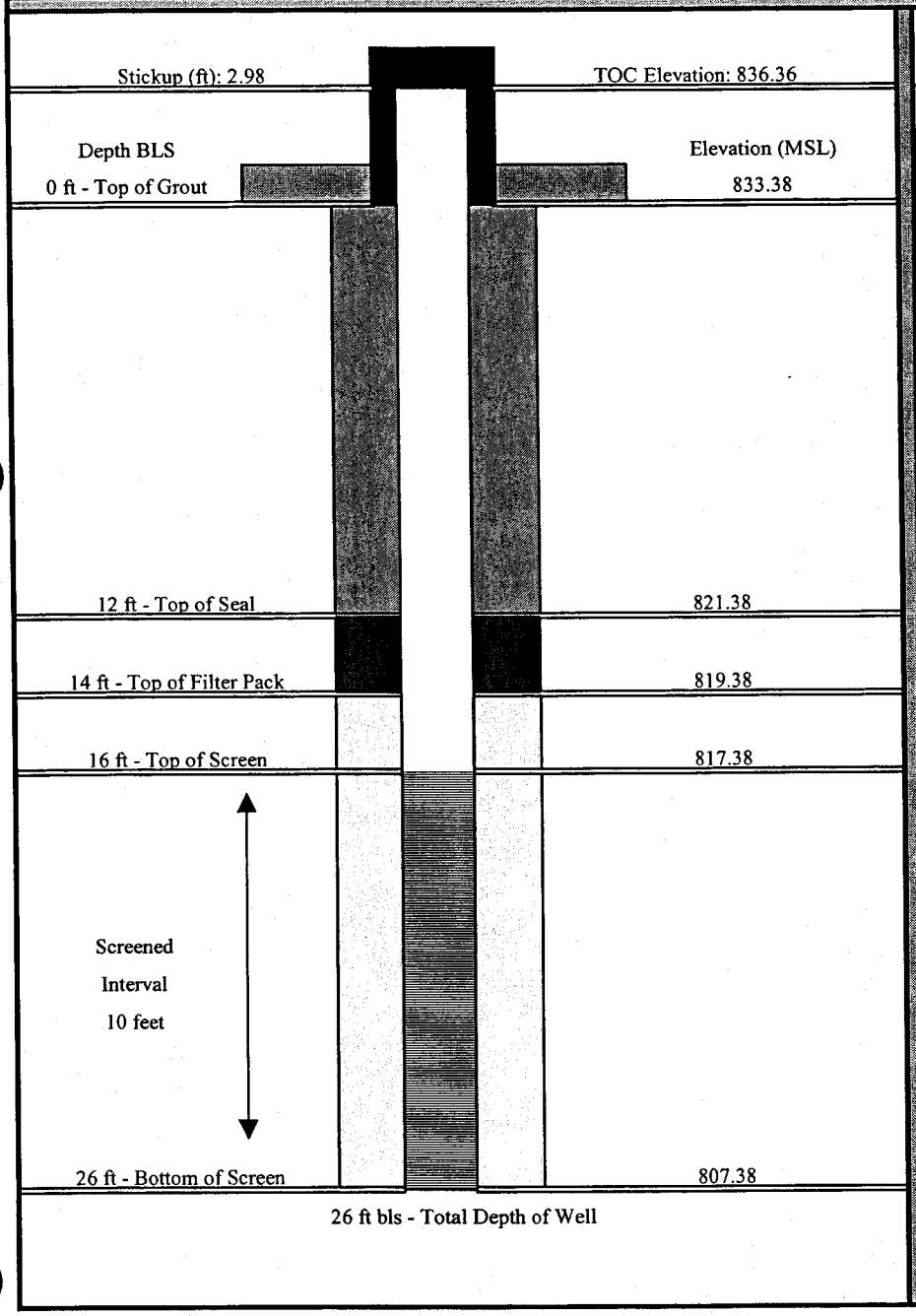
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: OW-2 **TOTAL DEPTH: 26 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	02/12/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
17.55 ft bls at 24-hrs	680264.2	1412126.2	836.36	833.38



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 16 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
16 to 26 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 12 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
12 to 14 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
14 to 26 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

OW-2

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson **CERTIFICATION #** 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use observation well

2. WELL LOCATION:
   Nearest Town: Terrell County Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☐ Valley ☑ Flat
   (check appropriate box)

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address 526 South Church Street
   (Street or Route No.)
   Charlotte NC 28202
   City or Town State Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED 02/12/2003
5. TOTAL DEPTH 26 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 24 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type n/a Amount n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 16	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 12	Ft.	Neat Cement	Pour
From 12	To 14	Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From 16	To 26	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

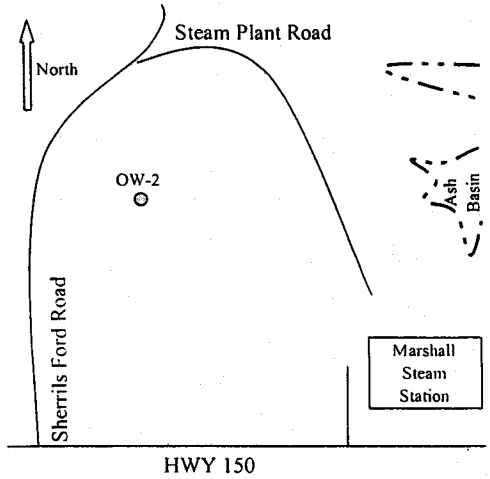
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 14	To 26	Ft.	#1	Silica Sand
From	To	Ft.		

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	to 11	Silty Clay
11	to 13	High Plasticity Clay
13	to 22	Silty Fine Sand
22	to 26	Silty Coarse to Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____

I DO HERE BY 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

Brian E. Wilson — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2/17/03 — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

PROJECT: Marshall Steam Station Terrell, North Carolina 1264-02-578	**BORING LOG OW-3**
DATE DRILLED: **2/11/03**	ELEVATION:
DRILLING METHOD: **4¼" H.S.A.**	BORING DEPTH: **27.0**
LOGGED BY: **Julie Petersen**	WATER LEVEL: **17.89 ft bls at 24 hrs.**
DRILLER: **Brian Wilson, NC Cert No. 2718**	DRILL RIG: **Mobile B-57**

NOTES:

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
5		RESIDUUM: Red Silty Fine Sandy **CLAY**			1		12
10		RESIDUUM: Yellowish Red and Brown Fine Sandy **SILT**			2		7
15		SAPROLITE: Pink and White Silty Medium to Fine **SAND** with Grey High Plasticity Clay Seams	▼		3		12
20		SAPROLITE: Brown Micaceous Medium to Fine Sandy **SILT** with Pink Quartz Fragments			4		7
25		SAPROLITE: Pink and White Silty Medium to Fine **SAND**	▽		5		24

BORING LOG WELLLOGS.GPJ S&ME.GDT 3/4/03

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

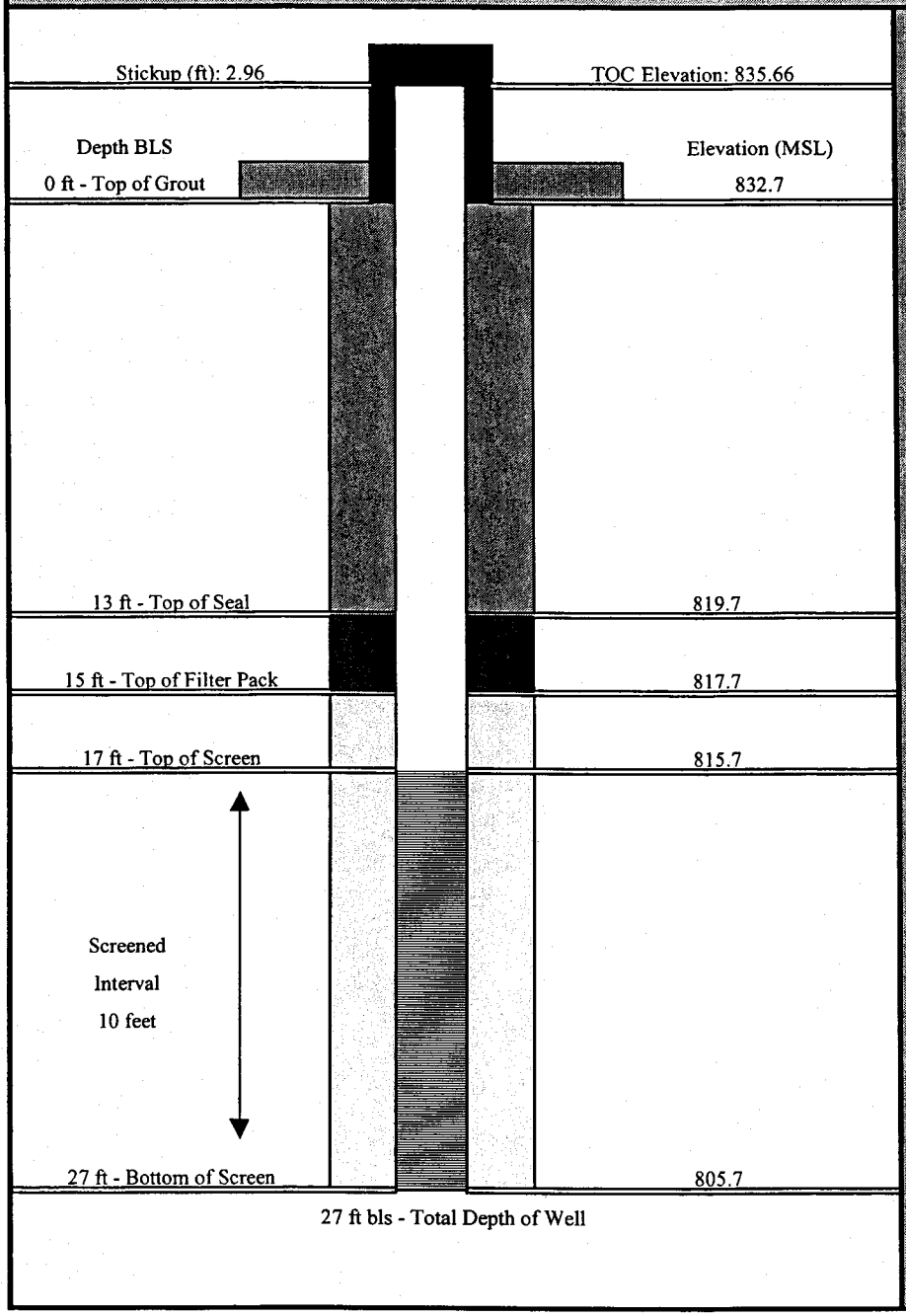
S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES
9751 Southern Pine Blvd.
Charlotte, NC 28273

MONITORING WELL CONSTRUCTION

WELL ID: OW-3 **TOTAL DEPTH: 27 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

S&ME PROJECT AND NO:			WELL USE / TYPE:	INSTALLATION DATE:
Marshall Steam Station - Beneficial Fill, 1264-03-072			Observation	02/11/2003
DRILLING CONTRACTOR:	DRILLER AND LICENCE NO.:			DRILLING METHOD:
S&ME, Inc.	Brian Wilson, 2718			4.25 HSA
STATIC WATER LEVEL:	NORTHING:	EASTING:	TOP OF CASING ELEV.:	GROUND SURFACE ELEV.:
17.89 ft bls at 24-hrs	679540.0	1412086.5	835.66	832.7



PAD TYPE:
2'x2' Concrete

PROTECTIVE CASING:
4"x4" Lockable Steel

CASING TYPE:
2-inch Sch. 40 PVC

CASING INTERVAL:
0 to 17 ft bls

SCREEN TYPE:
2-inch 0.010 Slot Sch. 40 PVC

SCREEN INTERVAL
17 to 27 ft bls

GROUT TYPE:
Neat Cement

GROUT INTERVAL
0 to 13 ft bls

SEAL TYPE:
Bentonite

SEAL INTERVAL:
13 to 15 ft bls

FILTER PACK:
#1 Filter Sand

FILTER PACK INTERVAL:
15 to 27 ft bls

DEVELOPMENT:
Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

OW-3

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

WELL CONTRACTOR (INDIVIDUAL) NAME (prin: Brian Wilson — CERTIFICATION #: 2718

WELL CONTRACTOR COMPANY NAME: S&ME, Inc. — PHONE #: 704-523-4726

STATE WELL CONSTRUCTION PERMIT# (if applicable): — ASSOCIATED WQ PERMIT# (if applicable):

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☑ If Other, List Use: observation well

2. WELL LOCATION:
   Nearest Town: Terrell — County: Catawba
   Marshall Steam Station
   (Street Name, Numbers, Community, Sudivision, Lot No.,Zip Code)

   Topographic/Land setting
   ☐ Ridge ☐ Slope ☑ Valley ☐ Flat
   (check appropriate box)

   Latitude/longitude of well location
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

3. OWNER: Duke Power
   Address: 526 South Church Street
   (Street or Route No.)
   Charlotte — NC — 28202
   City or Town — State — Zip Code
   (704) 373-7900
   Area code - Phone Number

4. DATE DRILLED: 02/11/2003
5. TOTAL DEPTH: 27 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 25 ft.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
   *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): n/a — METHOD OF TEST: n/a
10. WATER ZONES (depth): n/a
11. DISINFECTION: Type: n/a — Amount: n/a
12. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 17 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 13 Ft.	Neat Cement	Pour
From	13	To 15 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	17	To 27 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

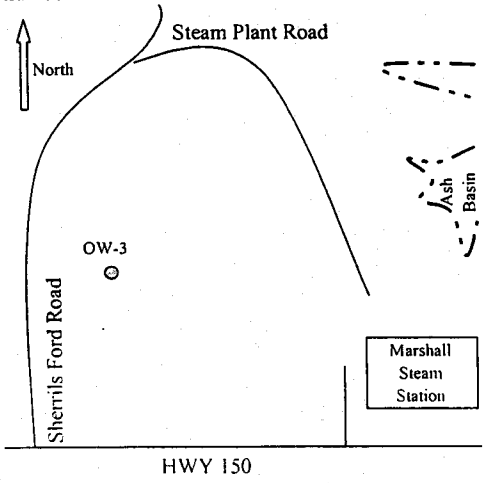
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From	15	To 27 Ft.	#1	Silica Sand
From		To Ft.		

DEPTH From	To	DRILLING LOG Formation Descrpition
0	to 9	Sandy Clay
9	to 14	Fine Sandy Silt
14	to 19	Silty Med/Fine Sand
19	to 22	Fine Sandy Silt
22	to 27	Silty Med/Fine Sand

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS:

I DO HERE BY 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

Brian E. Wilson — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2/17/03 — DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

2

APPENDIX II

FIELD AND LABORATORY DATA

Slug Test Data Sheets
Soil Laboratory Data Sheets

SLUG TEST DATA SHEETS

FIELD PERMEABILTY TESTING PROCEDURES

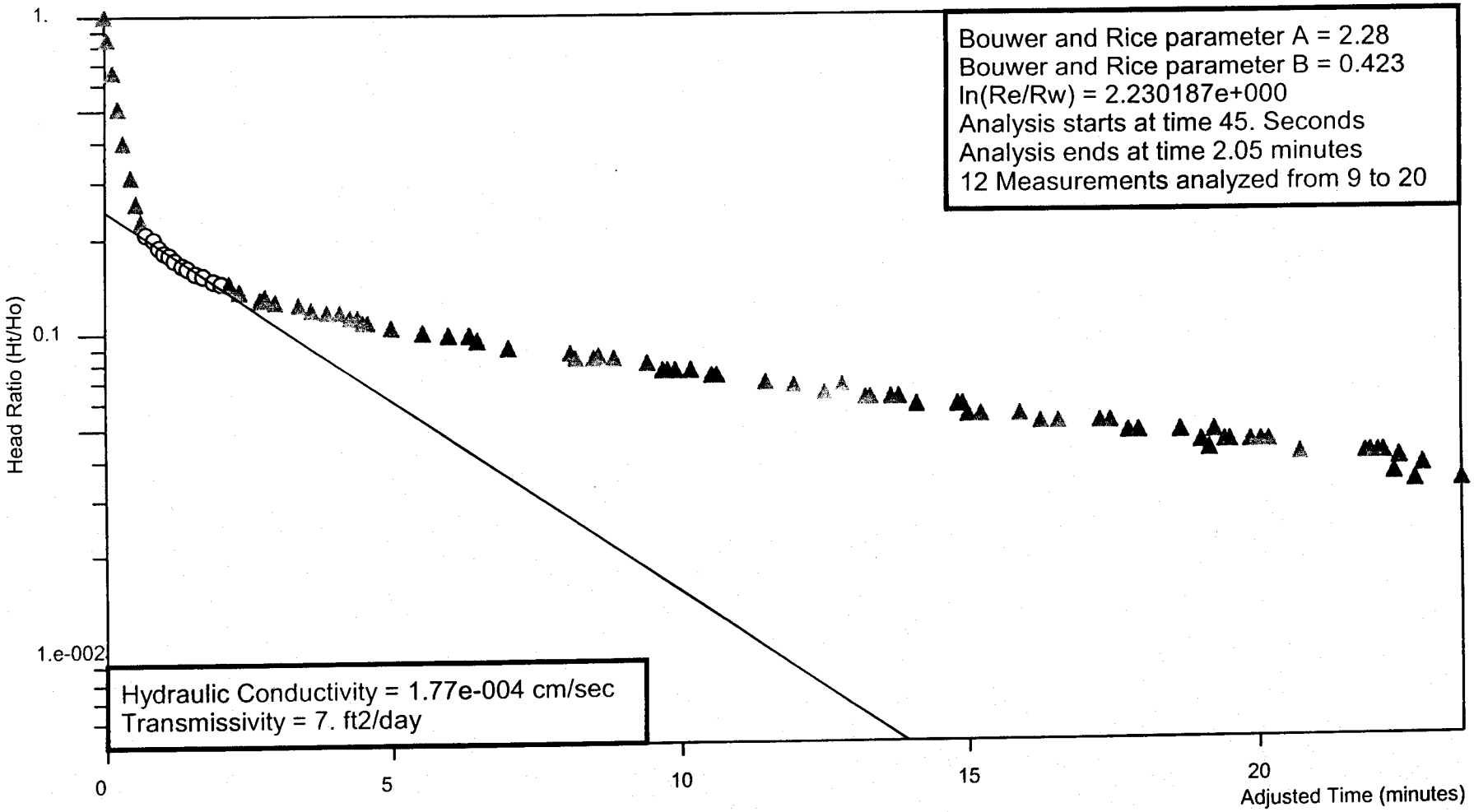
Field Permeability Testing: Following limited well development, rising head permeability (slug) tests were performed. The tests consisted of initially obtaining the established groundwater level measurement. The casing was then bailed to remove water from the well. The rise of water level was measured and recorded at selected intervals. The in-situ permeability was then calculated based on procedures outlined in the Bouwer and Rice Method: "A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells", 1976 and the "Bouwer and Rice Slug Test - An Update", 1989.

SLUG OUT B-3 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

B-3



Ho is 0.553 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT B-3

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	B-3
Aquifer Thickness:	14. feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	50.2 feet
Water Table to Screen Bottom:	8.97 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 90 time and drawdown measurements
Maximum head is 0.553 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	50.7	0.553	1.
2	5.e-002	5.e-002	50.7	0.47	0.85
3	0.15	0.15	50.6	0.366	0.662
4	0.25	0.25	50.5	0.285	0.515
5	0.35	0.35	50.4	0.219	0.396
6	0.45	0.45	50.4	0.173	0.313
7	0.55	0.55	50.3	0.144	0.26
8	0.65	0.65	50.3	0.126	0.228
9	0.75	0.75	50.3	0.114	0.206
10	0.85	0.85	50.3	0.11	0.199
11	0.95	0.95	50.3	0.104	0.188
12	1.05	1.05	50.3	1.e-001	0.181
13	1.15	1.15	50.3	9.7e-002	0.175
14	1.25	1.25	50.3	9.4e-002	0.17
15	1.35	1.35	50.3	9.1e-002	0.165
16	1.45	1.45	50.3	8.9e-002	0.161
17	1.6	1.6	50.3	8.6e-002	0.156
18	1.7	1.7	50.3	8.4e-002	0.152
19	1.9	1.9	50.3	8.1e-002	0.146
20	2.05	2.05	50.3	7.9e-002	0.143
21	2.15	2.15	50.3	7.9e-002	0.143
22	2.35	2.35	50.3	7.5e-002	0.136
23	2.7	2.7	50.3	7.1e-002	0.128
24	2.8	2.8	50.3	7.2e-002	0.13
25	2.95	2.95	50.3	7.e-002	0.127
26	3.35	3.35	50.3	6.8e-002	0.123
27	3.6	3.6	50.3	6.6e-002	0.119
28	3.85	3.85	50.3	6.4e-002	0.116
29	4.1	4.1	50.3	6.4e-002	0.116
30	4.25	4.25	50.3	6.2e-002	0.112
31	4.4	4.4	50.3	6.2e-002	0.112
32	4.5	4.5	50.3	6.e-002	0.108
33	4.6	4.6	50.3	6.e-002	0.108
34	5.	5.	50.2	5.8e-002	0.105
35	5.5	5.5	50.2	5.6e-002	0.101

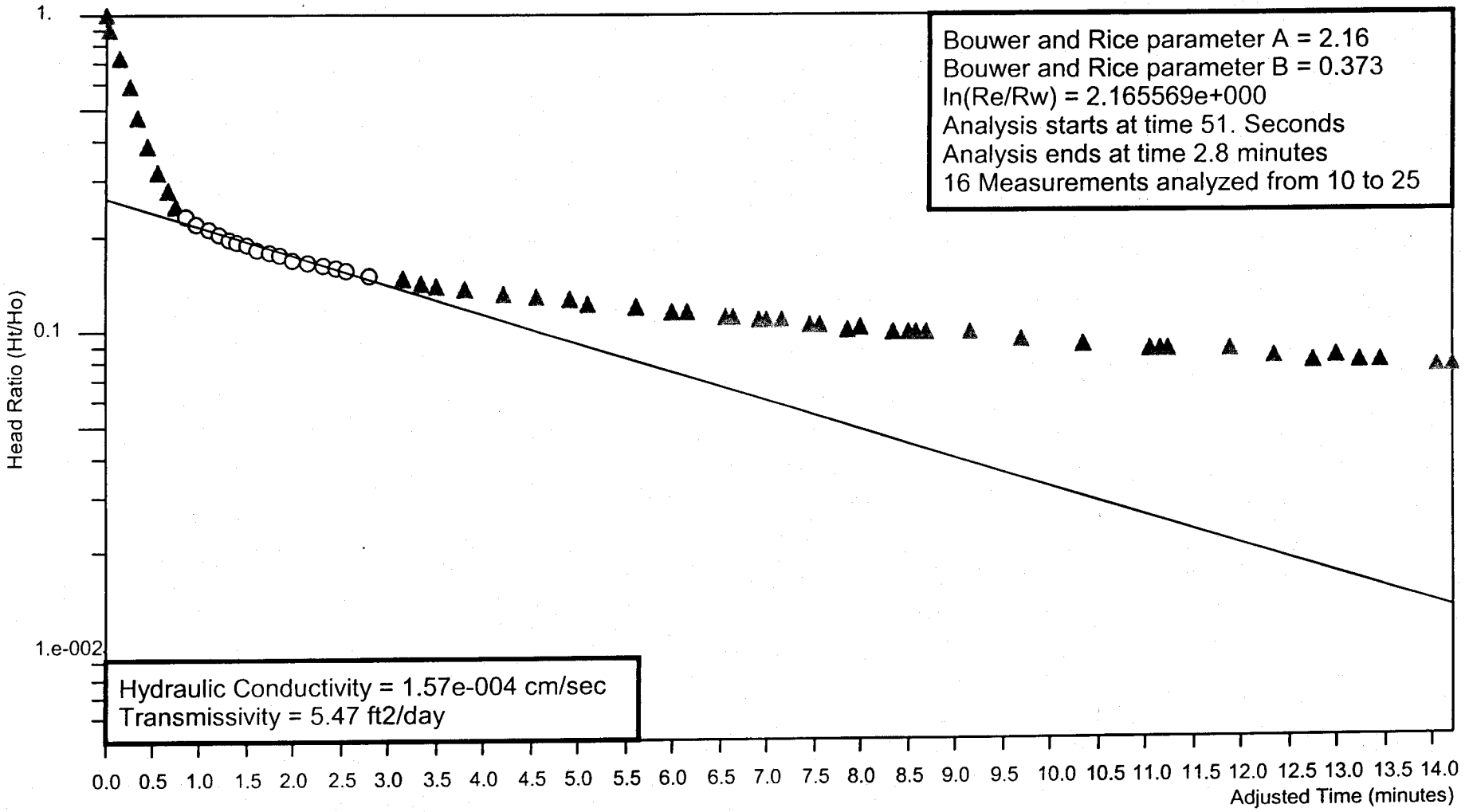
36	5.95	5.95	50.2	5.4e-002	9.76e-002
37	6.3	6.3	50.2	5.4e-002	9.76e-002
38	6.45	6.45	50.2	5.2e-002	9.4e-002
39	7.	7.	50.2	5.e-002	9.04e-002
40	8.05	8.05	50.2	4.8e-002	8.68e-002
41	8.15	8.15	50.2	4.6e-002	8.32e-002
42	8.45	8.45	50.2	4.6e-002	8.32e-002
43	8.55	8.55	50.2	4.7e-002	8.5e-002
44	8.8	8.8	50.2	4.6e-002	8.32e-002
45	9.4	9.4	50.2	4.4e-002	7.96e-002
46	9.65	9.65	50.2	4.2e-002	7.59e-002
47	9.75	9.75	50.2	4.2e-002	7.59e-002
48	9.9	9.9	50.2	4.2e-002	7.59e-002
49	10.2	10.2	50.2	4.2e-002	7.59e-002
50	10.5	10.5	50.2	4.e-002	7.23e-002
51	10.6	10.6	50.2	4.e-002	7.23e-002
52	11.4	11.4	50.2	3.8e-002	6.87e-002
53	11.9	11.9	50.2	3.7e-002	6.69e-002
54	12.5	12.5	50.2	3.5e-002	6.33e-002
55	12.8	12.8	50.2	3.7e-002	6.69e-002
56	13.2	13.2	50.2	3.4e-002	6.15e-002
57	13.3	13.3	50.2	3.4e-002	6.15e-002
58	13.6	13.6	50.2	3.4e-002	6.15e-002
59	13.8	13.8	50.2	3.4e-002	6.15e-002
60	14.1	14.1	50.2	3.2e-002	5.79e-002
61	14.8	14.8	50.2	3.2e-002	5.79e-002
62	14.9	14.9	50.2	3.2e-002	5.79e-002
63	15.	15.	50.2	3.e-002	5.42e-002
64	15.2	15.2	50.2	3.e-002	5.42e-002
65	15.9	15.9	50.2	3.e-002	5.42e-002
66	16.2	16.2	50.2	2.8e-002	5.06e-002
67	16.5	16.5	50.2	2.8e-002	5.06e-002
68	17.2	17.2	50.2	2.8e-002	5.06e-002
69	17.4	17.4	50.2	2.8e-002	5.06e-002
70	17.7	17.7	50.2	2.6e-002	4.7e-002
71	17.9	17.9	50.2	2.6e-002	4.7e-002
72	18.6	18.6	50.2	2.6e-002	4.7e-002
73	19.	19.	50.2	2.4e-002	4.34e-002
74	19.1	19.1	50.2	2.3e-002	4.16e-002
75	19.2	19.2	50.2	2.6e-002	4.7e-002
76	19.4	19.4	50.2	2.4e-002	4.34e-002
77	19.5	19.5	50.2	2.4e-002	4.34e-002
78	19.8	19.8	50.2	2.4e-002	4.34e-002
79	20.	20.	50.2	2.4e-002	4.34e-002
80	20.1	20.1	50.2	2.4e-002	4.34e-002
81	20.7	20.7	50.2	2.2e-002	3.98e-002
82	21.8	21.8	50.2	2.2e-002	3.98e-002
83	21.9	21.9	50.2	2.2e-002	3.98e-002
84	22.	22.	50.2	2.2e-002	3.98e-002
85	22.1	22.1	50.2	2.2e-002	3.98e-002
86	22.3	22.3	50.2	1.9e-002	3.44e-002
87	22.4	22.4	50.2	2.1e-002	3.8e-002
88	22.6	22.6	50.2	1.8e-002	3.25e-002
89	22.8	22.8	50.2	2.e-002	3.62e-002
90	23.4	23.4	50.2	1.8e-002	3.25e-002

SLUG OUT B-4 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

B-4



Ho is 0.584 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT B-4

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	B-4
Aquifer Thickness:	12.3 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	54.7 feet
Water Table to Screen Bottom:	7.31 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 63 time and drawdown measurements
Maximum head is 0.584 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	55.3	0.584	1.
2	5.e-002	5.e-002	55.3	0.522	0.894
3	0.15	0.15	55.2	0.424	0.726
4	0.25	0.25	55.1	0.344	0.589
5	0.35	0.35	55.	0.276	0.473
6	0.45	0.45	55.	0.223	0.382
7	0.55	0.55	54.9	0.186	0.318
8	0.65	0.65	54.9	0.162	0.277
9	0.75	0.75	54.9	0.146	0.25
10	0.85	0.85	54.9	0.136	0.233
11	0.95	0.95	54.9	0.128	0.219
12	1.1	1.1	54.9	0.122	0.209
13	1.2	1.2	54.9	0.118	0.202
14	1.3	1.3	54.9	0.114	0.195
15	1.4	1.4	54.9	0.111	0.19
16	1.5	1.5	54.8	0.109	0.187
17	1.6	1.6	54.8	0.106	0.182
18	1.75	1.75	54.8	0.103	0.176
19	1.85	1.85	54.8	0.101	0.173
20	2.	2.	54.8	9.8e-002	0.168
21	2.15	2.15	54.8	9.6e-002	0.164
22	2.3	2.3	54.8	9.4e-002	0.161
23	2.45	2.45	54.8	9.2e-002	0.158
24	2.55	2.55	54.8	9.e-002	0.154
25	2.8	2.8	54.8	8.8e-002	0.151
26	3.15	3.15	54.8	8.5e-002	0.146
27	3.35	3.35	54.8	8.3e-002	0.142
28	3.5	3.5	54.8	8.1e-002	0.139
29	3.8	3.8	54.8	7.9e-002	0.135
30	4.2	4.2	54.8	7.7e-002	0.132
31	4.55	4.55	54.8	7.5e-002	0.128
32	4.9	4.9	54.8	7.3e-002	0.125
33	5.1	5.1	54.8	7.1e-002	0.122
34	5.6	5.6	54.8	6.9e-002	0.118
35	6.	6.	54.8	6.7e-002	0.115

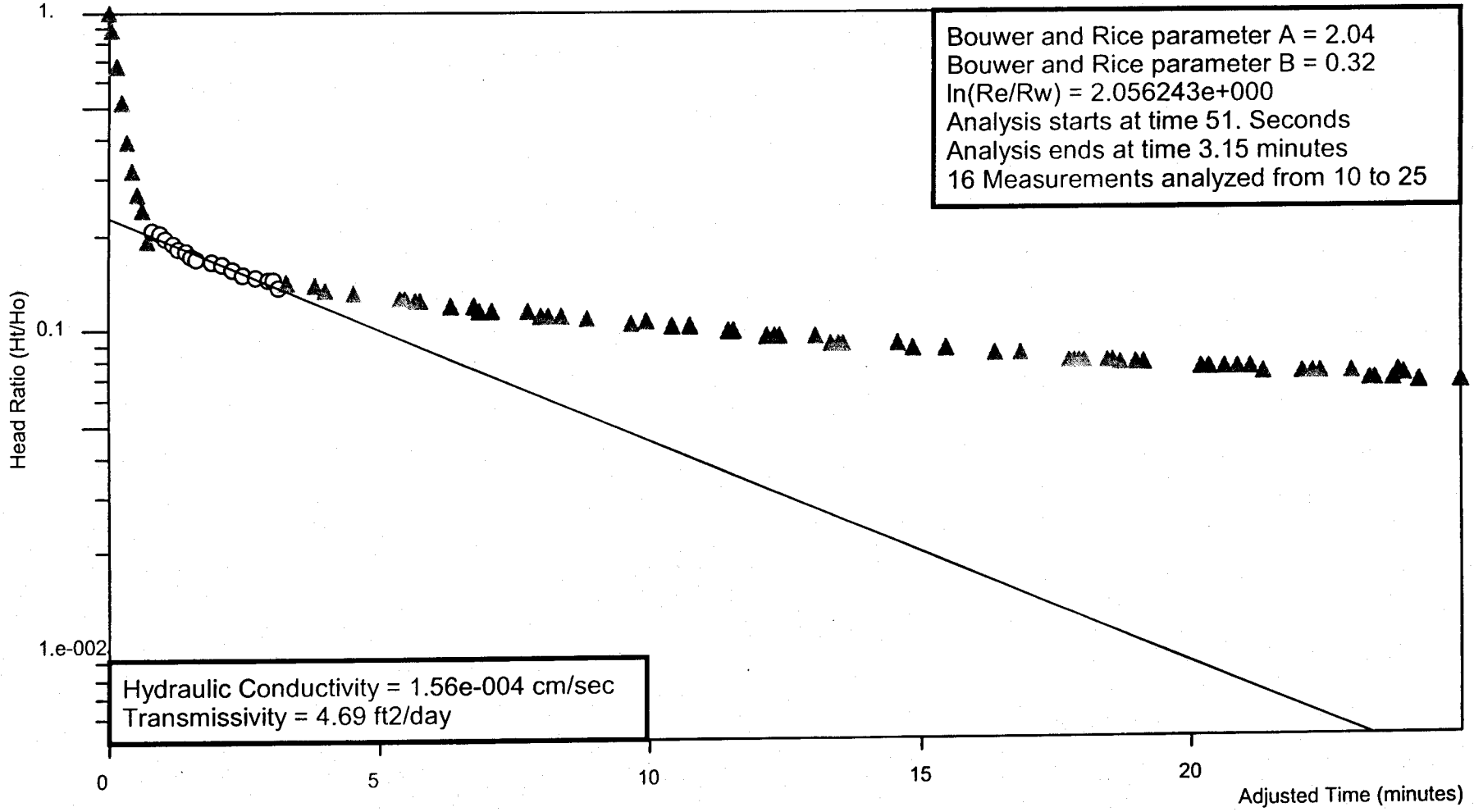
36	6.15	6.15	54.8	6.7e-002	0.115
37	6.55	6.55	54.8	6.5e-002	0.111
38	6.65	6.65	54.8	6.5e-002	0.111
39	6.9	6.9	54.8	6.3e-002	0.108
40	7.	7.	54.8	6.3e-002	0.108
41	7.15	7.15	54.8	6.3e-002	0.108
42	7.45	7.45	54.8	6.1e-002	0.104
43	7.55	7.55	54.8	6.1e-002	0.104
44	7.85	7.85	54.8	5.9e-002	0.101
45	8.	8.	54.8	6.e-002	0.103
46	8.35	8.35	54.8	5.8e-002	9.93e-002
47	8.5	8.5	54.8	5.7e-002	9.76e-002
48	8.6	8.6	54.8	5.7e-002	9.76e-002
49	8.7	8.7	54.8	5.7e-002	9.76e-002
50	9.15	9.15	54.8	5.7e-002	9.76e-002
51	9.7	9.7	54.8	5.4e-002	9.25e-002
52	10.4	10.4	54.8	5.2e-002	8.9e-002
53	11.1	11.1	54.8	5.e-002	8.56e-002
54	11.2	11.2	54.8	5.e-002	8.56e-002
55	11.3	11.3	54.8	5.e-002	8.56e-002
56	11.9	11.9	54.8	5.e-002	8.56e-002
57	12.4	12.4	54.8	4.8e-002	8.22e-002
58	12.8	12.8	54.8	4.6e-002	7.88e-002
59	13.	13.	54.8	4.8e-002	8.22e-002
60	13.3	13.3	54.8	4.6e-002	7.88e-002
61	13.5	13.5	54.8	4.6e-002	7.88e-002
62	14.1	14.1	54.8	4.4e-002	7.53e-002
63	14.2	14.2	54.8	4.4e-002	7.53e-002

SLUG OUT B-6 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

B-6



Ho is 0.531 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT B-6

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	B-6
Aquifer Thickness:	10.6 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	44.3 feet
Water Table to Screen Bottom:	5.62 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 86 time and drawdown measurements
Maximum head is 0.531 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	44.8	0.531	1.
2	5.e-002	5.e-002	44.8	0.471	0.887
3	0.15	0.15	44.7	0.363	0.684
4	0.25	0.25	44.6	0.275	0.518
5	0.35	0.35	44.5	0.21	0.395
6	0.45	0.45	44.5	0.168	0.316
7	0.55	0.55	44.4	0.142	0.267
8	0.65	0.65	44.4	0.128	0.241
9	0.75	0.75	44.4	0.101	0.19
10	0.85	0.85	44.4	0.11	0.207
11	0.95	0.95	44.4	0.108	0.203
12	1.05	1.05	44.4	0.103	0.194
13	1.2	1.2	44.4	0.1	0.188
14	1.3	1.3	44.4	9.6e-002	0.181
15	1.45	1.45	44.4	9.4e-002	0.177
16	1.55	1.55	44.4	9.1e-002	0.171
17	1.65	1.65	44.4	8.9e-002	0.168
18	1.9	1.9	44.4	8.7e-002	0.164
19	2.1	2.1	44.4	8.5e-002	0.16
20	2.3	2.3	44.4	8.3e-002	0.156
21	2.5	2.5	44.4	8.e-002	0.151
22	2.75	2.75	44.4	7.8e-002	0.147
23	2.95	2.95	44.4	7.6e-002	0.143
24	3.05	3.05	44.4	7.6e-002	0.143
25	3.15	3.15	44.4	7.2e-002	0.136
26	3.3	3.3	44.4	7.5e-002	0.141
27	3.8	3.8	44.4	7.3e-002	0.137
28	4.	4.	44.4	7.1e-002	0.134
29	4.55	4.55	44.4	6.9e-002	0.13
30	5.4	5.4	44.4	6.7e-002	0.126
31	5.5	5.5	44.4	6.7e-002	0.126
32	5.65	5.65	44.4	6.5e-002	0.122
33	5.75	5.75	44.4	6.5e-002	0.122
34	6.35	6.35	44.4	6.3e-002	0.119
35	6.75	6.75	44.4	6.3e-002	0.119

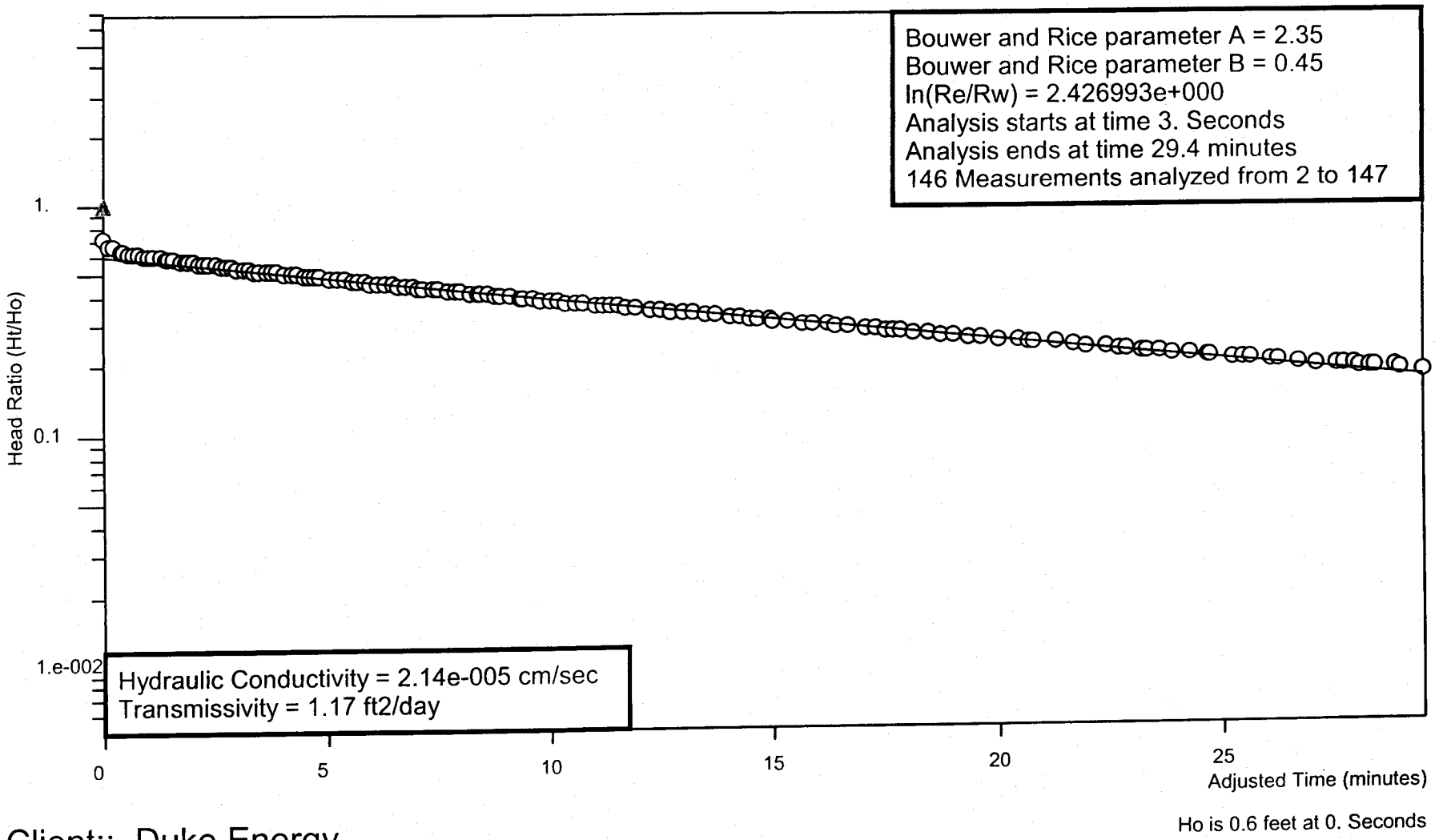
36	6.85	6.85	44.4	6.1e-002	0.115
37	7.1	7.1	44.4	6.1e-002	0.115
38	7.75	7.75	44.4	6.1e-002	0.115
39	8.	8.	44.3	5.9e-002	0.111
40	8.15	8.15	44.3	5.9e-002	0.111
41	8.35	8.35	44.3	5.9e-002	0.111
42	8.85	8.85	44.3	5.7e-002	0.107
43	9.65	9.65	44.3	5.5e-002	0.104
44	9.95	9.95	44.3	5.6e-002	0.105
45	10.4	10.4	44.3	5.4e-002	0.102
46	10.8	10.8	44.3	5.4e-002	0.102
47	11.4	11.4	44.3	5.2e-002	9.79e-002
48	11.6	11.6	44.3	5.2e-002	9.79e-002
49	12.2	12.2	44.3	5.e-002	9.42e-002
50	12.3	12.3	44.3	5.e-002	9.42e-002
51	12.4	12.4	44.3	5.e-002	9.42e-002
52	13.	13.	44.3	5.e-002	9.42e-002
53	13.3	13.3	44.3	4.8e-002	9.04e-002
54	13.5	13.5	44.3	4.8e-002	9.04e-002
55	13.6	13.6	44.3	4.8e-002	9.04e-002
56	14.6	14.6	44.3	4.8e-002	9.04e-002
57	14.8	14.8	44.3	4.6e-002	8.66e-002
58	15.5	15.5	44.3	4.6e-002	8.66e-002
59	16.4	16.4	44.3	4.4e-002	8.29e-002
60	16.8	16.8	44.3	4.4e-002	8.29e-002
61	17.7	17.7	44.3	4.2e-002	7.91e-002
62	17.8	17.8	44.3	4.2e-002	7.91e-002
63	17.9	17.9	44.3	4.2e-002	7.91e-002
64	18.	18.	44.3	4.2e-002	7.91e-002
65	18.4	18.4	44.3	4.2e-002	7.91e-002
66	18.5	18.5	44.3	4.2e-002	7.91e-002
67	18.7	18.7	44.3	4.1e-002	7.72e-002
68	19.	19.	44.3	4.1e-002	7.72e-002
69	19.1	19.1	44.3	4.1e-002	7.72e-002
70	20.2	20.2	44.3	3.9e-002	7.34e-002
71	20.3	20.3	44.3	3.9e-002	7.34e-002
72	20.6	20.6	44.3	3.9e-002	7.34e-002
73	20.8	20.8	44.3	3.9e-002	7.34e-002
74	21.1	21.1	44.3	3.9e-002	7.34e-002
75	21.3	21.3	44.3	3.8e-002	7.16e-002
76	22.1	22.1	44.3	3.8e-002	7.16e-002
77	22.2	22.2	44.3	3.8e-002	7.16e-002
78	22.4	22.4	44.3	3.8e-002	7.16e-002
79	22.9	22.9	44.3	3.8e-002	7.16e-002
80	23.3	23.3	44.3	3.6e-002	6.78e-002
81	23.4	23.4	44.3	3.6e-002	6.78e-002
82	23.7	23.7	44.3	3.6e-002	6.78e-002
83	23.8	23.8	44.3	3.8e-002	7.16e-002
84	23.9	23.9	44.3	3.7e-002	6.97e-002
85	24.1	24.1	44.3	3.5e-002	6.59e-002
86	24.9	24.9	44.3	3.5e-002	6.59e-002

SLUG OUT B-7 February 19, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

B-7



Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT B-7

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 19, 2003
Client:	Duke Energy

Well Label:	B-7
Aquifer Thickness:	19.2 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	49.1 feet
Water Table to Screen Bottom:	14.2 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 147 time and drawdown measurements
Maximum head is 0.6 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	49.8	0.6	1.
2	5.e-002	5.e-002	49.6	0.438	0.73
3	0.15	0.15	49.6	0.404	0.673
4	0.25	0.25	49.5	0.397	0.662
5	0.4	0.4	49.5	0.379	0.632
6	0.5	0.5	49.5	0.377	0.628
7	0.6	0.6	49.5	0.374	0.623
8	0.7	0.7	49.5	0.371	0.618
9	0.8	0.8	49.5	0.368	0.613
10	0.95	0.95	49.5	0.364	0.607
11	1.05	1.05	49.5	0.362	0.603
12	1.15	1.15	49.5	0.359	0.598
13	1.3	1.3	49.5	0.358	0.597
14	1.4	1.4	49.5	0.352	0.587
15	1.5	1.5	49.5	0.352	0.587
16	1.6	1.6	49.5	0.35	0.583
17	1.75	1.75	49.5	0.346	0.577
18	1.85	1.85	49.5	0.344	0.573
19	1.95	1.95	49.5	0.342	0.57
20	2.05	2.05	49.5	0.34	0.567
21	2.15	2.15	49.5	0.338	0.563
22	2.25	2.25	49.5	0.336	0.56
23	2.4	2.4	49.5	0.333	0.555
24	2.55	2.55	49.5	0.331	0.552
25	2.65	2.65	49.5	0.329	0.548
26	2.75	2.75	49.5	0.327	0.545
27	2.9	2.9	49.5	0.325	0.542
28	3.	3.	49.5	0.322	0.537
29	3.15	3.15	49.5	0.32	0.533
30	3.3	3.3	49.5	0.318	0.53
31	3.4	3.4	49.5	0.312	0.52
32	3.5	3.5	49.5	0.314	0.523
33	3.65	3.65	49.5	0.311	0.518
34	3.8	3.8	49.5	0.309	0.515
35	3.9	3.9	49.5	0.307	0.512

36	4.05	4.05	49.5	0.305	0.508
37	4.2	4.2	49.5	0.302	0.503
38	4.35	4.35	49.5	0.3	0.5
39	4.5	4.5	49.4	0.298	0.497
40	4.6	4.6	49.4	0.296	0.493
41	4.75	4.75	49.4	0.294	0.49
42	4.85	4.85	49.4	0.292	0.487
43	5.05	5.05	49.4	0.289	0.482
44	5.25	5.25	49.4	0.286	0.477
45	5.4	5.4	49.4	0.284	0.473
46	5.55	5.55	49.4	0.282	0.47
47	5.7	5.7	49.4	0.28	0.467
48	5.85	5.85	49.4	0.278	0.463
49	5.95	5.95	49.4	0.276	0.46
50	6.15	6.15	49.4	0.274	0.457
51	6.3	6.3	49.4	0.272	0.453
52	6.45	6.45	49.4	0.27	0.45
53	6.6	6.6	49.4	0.268	0.447
54	6.75	6.75	49.4	0.266	0.443
55	6.9	6.9	49.4	0.264	0.44
56	7.	7.	49.4	0.262	0.437
57	7.15	7.15	49.4	0.26	0.433
58	7.35	7.35	49.4	0.258	0.43
59	7.5	7.5	49.4	0.256	0.427
60	7.7	7.7	49.4	0.254	0.423
61	7.85	7.85	49.4	0.252	0.42
62	8.	8.	49.4	0.25	0.417
63	8.2	8.2	49.4	0.248	0.413
64	8.35	8.35	49.4	0.245	0.408
65	8.45	8.45	49.4	0.243	0.405
66	8.6	8.6	49.4	0.243	0.405
67	8.75	8.75	49.4	0.241	0.402
68	8.9	8.9	49.4	0.239	0.398
69	9.1	9.1	49.4	0.237	0.395
70	9.3	9.3	49.4	0.236	0.393
71	9.4	9.4	49.4	0.234	0.39
72	9.6	9.6	49.4	0.232	0.387
73	9.75	9.75	49.4	0.23	0.383
74	10.	10.	49.4	0.228	0.38
75	10.2	10.2	49.4	0.226	0.377
76	10.4	10.4	49.4	0.224	0.373
77	10.6	10.6	49.4	0.222	0.37
78	10.7	10.7	49.4	0.22	0.367
79	11.	11.	49.4	0.218	0.363
80	11.2	11.2	49.4	0.216	0.36
81	11.4	11.4	49.4	0.214	0.357
82	11.5	11.5	49.4	0.214	0.357
83	11.7	11.7	49.4	0.212	0.353
84	11.9	11.9	49.4	0.209	0.348
85	12.3	12.3	49.4	0.206	0.343
86	12.5	12.5	49.4	0.204	0.34
87	12.7	12.7	49.4	0.202	0.337
88	13.	13.	49.4	0.2	0.333
89	13.2	13.2	49.3	0.198	0.33
90	13.5	13.5	49.3	0.196	0.327
91	13.7	13.7	49.3	0.194	0.323
92	14.	14.	49.3	0.191	0.318

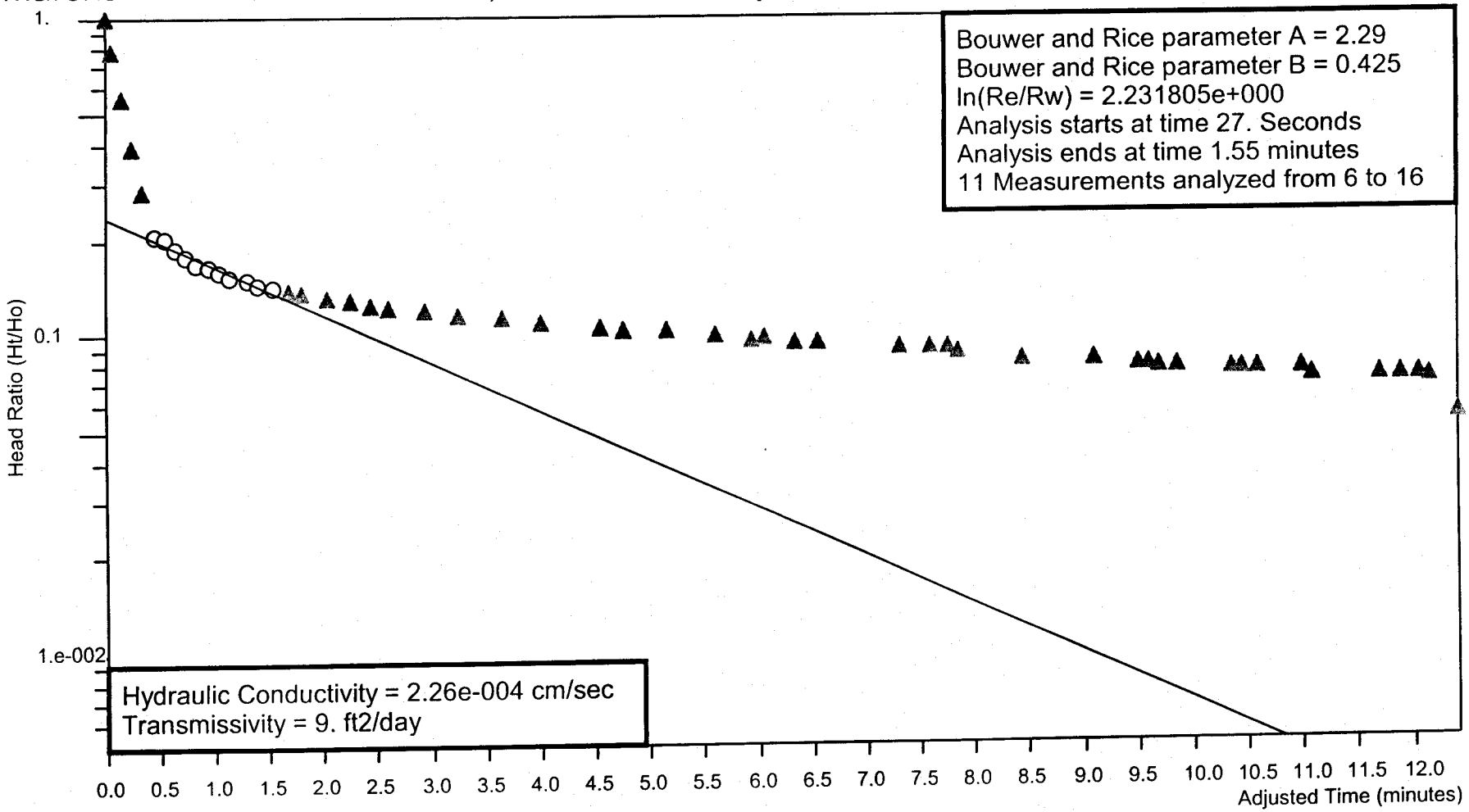
93	14.3	14.3	49.3	0.189	0.315
94	14.5	14.5	49.3	0.187	0.312
95	14.7	14.7	49.3	0.185	0.308
96	14.9	14.9	49.3	0.185	0.308
97	15.	15.	49.3	0.183	0.305
98	15.3	15.3	49.3	0.18	0.3
99	15.7	15.7	49.3	0.178	0.297
100	15.9	15.9	49.3	0.176	0.293
101	16.2	16.2	49.3	0.174	0.29
102	16.4	16.4	49.3	0.172	0.287
103	16.7	16.7	49.3	0.17	0.283
104	17.1	17.1	49.3	0.168	0.28
105	17.3	17.3	49.3	0.166	0.277
106	17.5	17.5	49.3	0.164	0.273
107	17.7	17.7	49.3	0.164	0.273
108	17.9	17.9	49.3	0.162	0.27
109	18.1	18.1	49.3	0.16	0.267
110	18.5	18.5	49.3	0.158	0.263
111	18.8	18.8	49.3	0.156	0.26
112	19.	19.	49.3	0.154	0.257
113	19.4	19.4	49.3	0.152	0.253
114	19.7	19.7	49.3	0.15	0.25
115	20.	20.	49.3	0.148	0.247
116	20.5	20.5	49.3	0.146	0.243
117	20.7	20.7	49.3	0.144	0.24
118	20.8	20.8	49.3	0.144	0.24
119	21.3	21.3	49.3	0.142	0.237
120	21.7	21.7	49.3	0.139	0.232
121	22.	22.	49.3	0.137	0.228
122	22.4	22.4	49.3	0.135	0.225
123	22.7	22.7	49.3	0.133	0.222
124	22.9	22.9	49.3	0.133	0.222
125	23.2	23.2	49.3	0.131	0.218
126	23.3	23.3	49.3	0.131	0.218
127	23.6	23.6	49.3	0.129	0.215
128	23.9	23.9	49.3	0.127	0.212
129	24.3	24.3	49.3	0.125	0.208
130	24.7	24.7	49.3	0.123	0.205
131	24.8	24.8	49.3	0.123	0.205
132	25.2	25.2	49.3	0.121	0.202
133	25.5	25.5	49.3	0.119	0.198
134	25.6	25.6	49.3	0.119	0.198
135	26.1	26.1	49.3	0.117	0.195
136	26.3	26.3	49.3	0.117	0.195
137	26.7	26.7	49.3	0.114	0.19
138	27.1	27.1	49.3	0.112	0.187
139	27.6	27.6	49.3	0.11	0.183
140	27.7	27.7	49.3	0.11	0.183
141	27.9	27.9	49.3	0.111	0.185
142	28.1	28.1	49.3	0.107	0.178
143	28.3	28.3	49.3	0.109	0.182
144	28.4	28.4	49.3	0.109	0.182
145	28.8	28.8	49.3	0.107	0.178
146	28.9	28.9	49.3	0.105	0.175
147	29.4	29.4	49.3	0.103	0.172

SLUG OUT MS-2 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-2



Ho is 0.572 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-2

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	MS-2
Aquifer Thickness:	14. feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	23.5 feet
Water Table to Screen Bottom:	9.02 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 54 time and drawdown measurements
Maximum head is 0.572 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	24.1	0.572	1.
2	5.e-002	5.e-002	23.9	0.455	0.795
3	0.15	0.15	23.8	0.32	0.559
4	0.25	0.25	23.7	0.225	0.393
5	0.35	0.35	23.7	0.163	0.285
6	0.45	0.45	23.6	0.118	0.206
7	0.55	0.55	23.6	0.115	0.201
8	0.65	0.65	23.6	0.108	0.189
9	0.75	0.75	23.6	0.101	0.177
10	0.85	0.85	23.6	9.6e-002	0.168
11	0.95	0.95	23.6	9.3e-002	0.163
12	1.05	1.05	23.6	9.e-002	0.157
13	1.15	1.15	23.6	8.7e-002	0.152
14	1.3	1.3	23.6	8.5e-002	0.149
15	1.4	1.4	23.6	8.3e-002	0.145
16	1.55	1.55	23.6	8.1e-002	0.142
17	1.7	1.7	23.6	7.9e-002	0.138
18	1.8	1.8	23.6	7.7e-002	0.135
19	2.05	2.05	23.6	7.5e-002	0.131
20	2.25	2.25	23.6	7.3e-002	0.128
21	2.45	2.45	23.6	7.1e-002	0.124
22	2.6	2.6	23.6	7.e-002	0.122
23	2.95	2.95	23.6	6.8e-002	0.119
24	3.25	3.25	23.6	6.6e-002	0.115
25	3.65	3.65	23.6	6.4e-002	0.112
26	4.	4.	23.6	6.2e-002	0.108
27	4.55	4.55	23.6	6.e-002	0.105
28	4.75	4.75	23.5	5.9e-002	0.103
29	5.15	5.15	23.5	5.8e-002	0.101
30	5.6	5.6	23.5	5.6e-002	9.79e-002
31	5.95	5.95	23.5	5.4e-002	9.44e-002
32	6.05	6.05	23.5	5.5e-002	9.62e-002
33	6.35	6.35	23.5	5.3e-002	9.27e-002
34	6.55	6.55	23.5	5.3e-002	9.27e-002
35	7.3	7.3	23.5	5.1e-002	8.92e-002

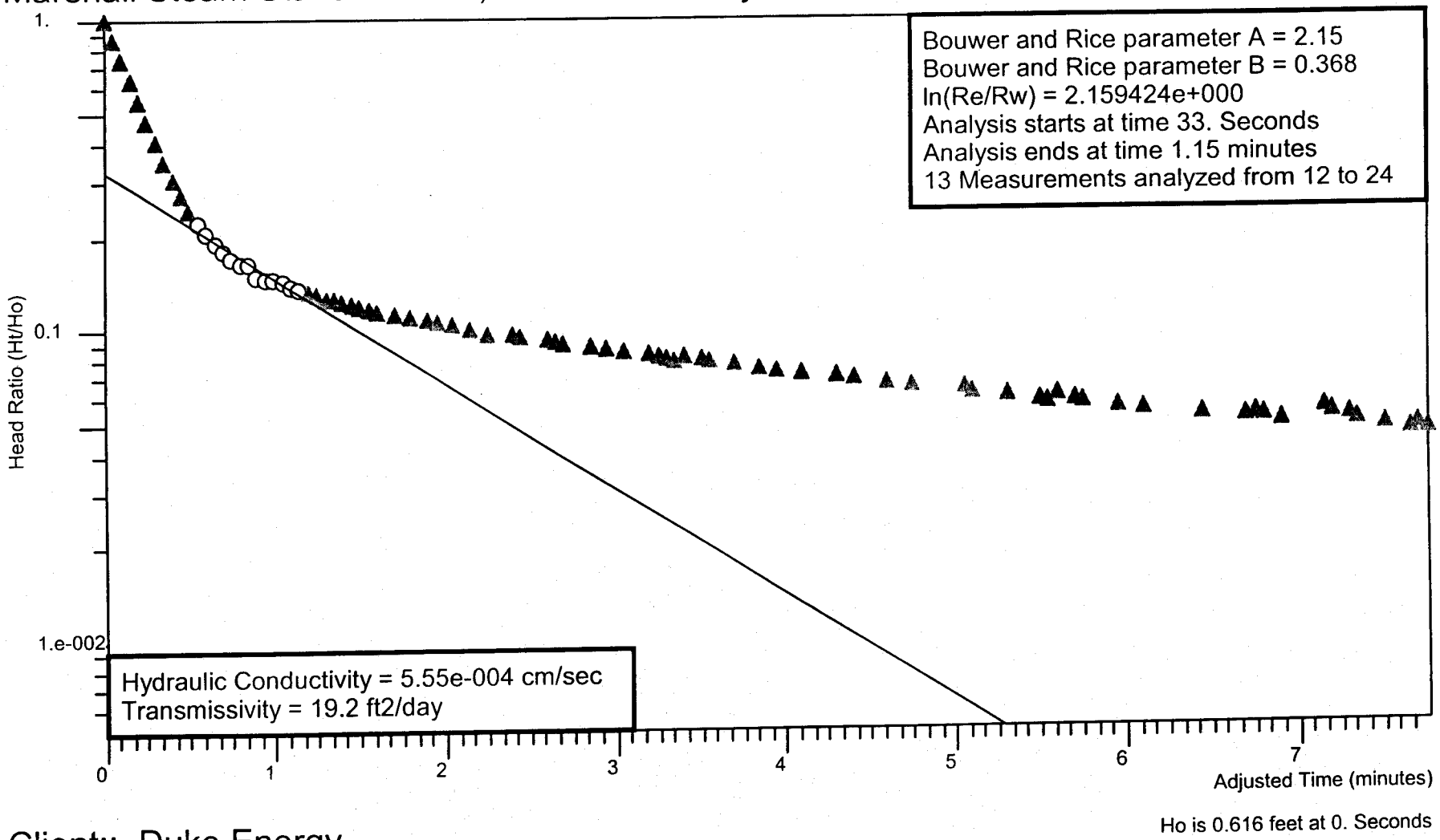
36	7.6	7.6	23.5	5.1e-002	8.92e-002
37	7.75	7.75	23.5	5.1e-002	8.92e-002
38	7.85	7.85	23.5	4.9e-002	8.57e-002
39	8.45	8.45	23.5	4.7e-002	8.22e-002
40	9.1	9.1	23.5	4.7e-002	8.22e-002
41	9.5	9.5	23.5	4.5e-002	7.87e-002
42	9.6	9.6	23.5	4.5e-002	7.87e-002
43	9.7	9.7	23.5	4.4e-002	7.69e-002
44	9.85	9.85	23.5	4.4e-002	7.69e-002
45	10.3	10.3	23.5	4.3e-002	7.52e-002
46	10.4	10.4	23.5	4.3e-002	7.52e-002
47	10.6	10.6	23.5	4.3e-002	7.52e-002
48	11.	11.	23.5	4.3e-002	7.52e-002
49	11.1	11.1	23.5	4.1e-002	7.17e-002
50	11.7	11.7	23.5	4.1e-002	7.17e-002
51	11.9	11.9	23.5	4.1e-002	7.17e-002
52	12.	12.	23.5	4.1e-002	7.17e-002
53	12.1	12.1	23.5	4.e-002	6.99e-002
54	12.4	12.4	23.5	3.1e-002	5.42e-002

SLUG OUT MS-4 February 19, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-4



Ho is 0.616 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-4

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 19, 2003
Client:	Duke Energy

Well Label:	MS-4
Aquifer Thickness:	12.2 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	41.9 feet
Water Table to Screen Bottom:	7.18 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 86 time and drawdown measurements
Maximum head is 0.616 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	42.5	0.616	1.
2	5.e-002	5.e-002	42.4	0.53	0.86
3	0.1	0.1	42.4	0.457	0.742
4	0.15	0.15	42.3	0.395	0.641
5	0.2	0.2	42.2	0.34	0.552
6	0.25	0.25	42.2	0.294	0.477
7	0.3	0.3	42.2	0.253	0.411
8	0.35	0.35	42.1	0.217	0.352
9	0.4	0.4	42.1	0.189	0.307
10	0.45	0.45	42.1	0.167	0.271
11	0.5	0.5	42.	0.15	0.244
12	0.55	0.55	42.	0.137	0.222
13	0.6	0.6	42.	0.127	0.206
14	0.65	0.65	42.	0.118	0.192
15	0.7	0.7	42.	0.112	0.182
16	0.75	0.75	42.	0.106	0.172
17	0.8	0.8	42.	0.102	0.166
18	0.85	0.85	42.	0.101	0.164
19	0.9	0.9	42.	9.2e-002	0.149
20	0.95	0.95	42.	9.1e-002	0.148
21	1.	1.	42.	9.e-002	0.146
22	1.05	1.05	42.	8.8e-002	0.143
23	1.1	1.1	42.	8.5e-002	0.138
24	1.15	1.15	42.	8.4e-002	0.136
25	1.2	1.2	42.	8.2e-002	0.133
26	1.25	1.25	42.	8.e-002	0.13
27	1.3	1.3	42.	7.8e-002	0.127
28	1.35	1.35	42.	7.7e-002	0.125
29	1.4	1.4	42.	7.6e-002	0.123
30	1.45	1.45	42.	7.5e-002	0.122
31	1.5	1.5	42.	7.3e-002	0.119
32	1.55	1.55	42.	7.2e-002	0.117
33	1.6	1.6	42.	7.e-002	0.114
34	1.7	1.7	42.	6.9e-002	0.112
35	1.8	1.8	42.	6.8e-002	0.11

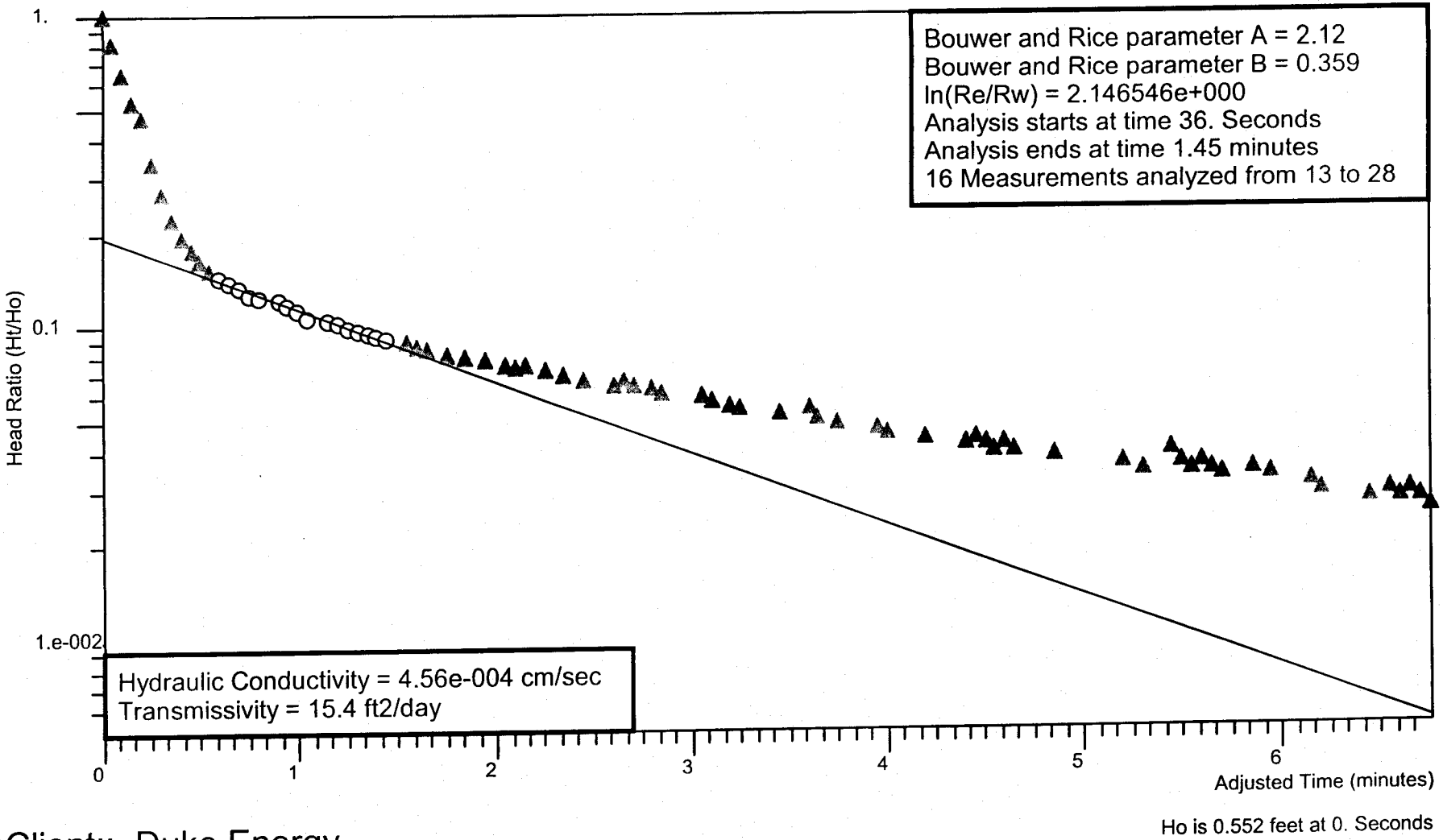
36	1.9	1.9	42.	6.7e-002	0.109
37	1.95	1.95	42.	6.5e-002	0.106
38	2.05	2.05	42.	6.4e-002	0.104
39	2.15	2.15	42.	6.2e-002	0.101
40	2.25	2.25	42.	6.e-002	9.74e-002
41	2.4	2.4	42.	5.9e-002	9.58e-002
42	2.45	2.45	42.	5.8e-002	9.42e-002
43	2.6	2.6	42.	5.7e-002	9.25e-002
44	2.65	2.65	42.	5.6e-002	9.09e-002
45	2.7	2.7	42.	5.5e-002	8.93e-002
46	2.85	2.85	42.	5.4e-002	8.77e-002
47	2.95	2.95	42.	5.3e-002	8.6e-002
48	3.05	3.05	42.	5.2e-002	8.44e-002
49	3.2	3.2	42.	5.1e-002	8.28e-002
50	3.25	3.25	42.	5.e-002	8.12e-002
51	3.3	3.3	41.9	4.9e-002	7.95e-002
52	3.35	3.35	41.9	4.8e-002	7.79e-002
53	3.4	3.4	42.	5.e-002	8.12e-002
54	3.5	3.5	41.9	4.9e-002	7.95e-002
55	3.55	3.55	41.9	4.8e-002	7.79e-002
56	3.7	3.7	41.9	4.7e-002	7.63e-002
57	3.85	3.85	41.9	4.6e-002	7.47e-002
58	3.95	3.95	41.9	4.5e-002	7.31e-002
59	4.1	4.1	41.9	4.4e-002	7.14e-002
60	4.3	4.3	41.9	4.3e-002	6.98e-002
61	4.4	4.4	41.9	4.2e-002	6.82e-002
62	4.6	4.6	41.9	4.1e-002	6.66e-002
63	4.75	4.75	41.9	4.e-002	6.49e-002
64	5.05	5.05	41.9	3.9e-002	6.33e-002
65	5.1	5.1	41.9	3.8e-002	6.17e-002
66	5.3	5.3	41.9	3.7e-002	6.01e-002
67	5.5	5.5	41.9	3.6e-002	5.84e-002
68	5.55	5.55	41.9	3.5e-002	5.68e-002
69	5.6	5.6	41.9	3.7e-002	6.01e-002
70	5.7	5.7	41.9	3.6e-002	5.84e-002
71	5.75	5.75	41.9	3.5e-002	5.68e-002
72	5.95	5.95	41.9	3.4e-002	5.52e-002
73	6.1	6.1	41.9	3.3e-002	5.36e-002
74	6.45	6.45	41.9	3.2e-002	5.19e-002
75	6.7	6.7	41.9	3.1e-002	5.03e-002
76	6.75	6.75	41.9	3.2e-002	5.19e-002
77	6.8	6.8	41.9	3.1e-002	5.03e-002
78	6.9	6.9	41.9	3.e-002	4.87e-002
79	7.15	7.15	41.9	3.3e-002	5.36e-002
80	7.2	7.2	41.9	3.2e-002	5.19e-002
81	7.3	7.3	41.9	3.1e-002	5.03e-002
82	7.35	7.35	41.9	3.e-002	4.87e-002
83	7.5	7.5	41.9	2.9e-002	4.71e-002
84	7.65	7.65	41.9	2.8e-002	4.55e-002
85	7.7	7.7	41.9	2.9e-002	4.71e-002
86	7.75	7.75	41.9	2.8e-002	4.55e-002

SLUG OUT MS-5 February 19, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-5



Ho is 0.552 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-5

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 19, 2003
Client:	Duke Energy

Well Label:	MS-5
Aquifer Thickness:	11.9 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	34. feet
Water Table to Screen Bottom:	6.92 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 81 time and drawdown measurements
Maximum head is 0.552 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	34.6	0.552	1.
2	5.e-002	5.e-002	34.5	0.453	0.821
3	0.1	0.1	34.4	0.364	0.659
4	0.15	0.15	34.3	0.291	0.527
5	0.2	0.2	34.3	0.26	0.471
6	0.25	0.25	34.2	0.186	0.337
7	0.3	0.3	34.2	0.147	0.266
8	0.35	0.35	34.1	0.123	0.223
9	0.4	0.4	34.1	0.108	0.196
10	0.45	0.45	34.1	9.7e-002	0.176
11	0.5	0.5	34.1	9.e-002	0.163
12	0.55	0.55	34.1	8.4e-002	0.152
13	0.6	0.6	34.1	8.e-002	0.145
14	0.65	0.65	34.1	7.6e-002	0.138
15	0.7	0.7	34.1	7.3e-002	0.132
16	0.75	0.75	34.1	7.e-002	0.127
17	0.8	0.8	34.1	6.8e-002	0.123
18	0.9	0.9	34.1	6.7e-002	0.121
19	0.95	0.95	34.1	6.4e-002	0.116
20	1.	1.	34.1	6.2e-002	0.112
21	1.05	1.05	34.1	5.9e-002	0.107
22	1.15	1.15	34.1	5.7e-002	0.103
23	1.2	1.2	34.1	5.6e-002	0.101
24	1.25	1.25	34.1	5.4e-002	9.78e-002
25	1.3	1.3	34.1	5.3e-002	9.6e-002
26	1.35	1.35	34.1	5.2e-002	9.42e-002
27	1.4	1.4	34.1	5.1e-002	9.24e-002
28	1.45	1.45	34.1	5.e-002	9.06e-002
29	1.55	1.55	34.1	4.9e-002	8.88e-002
30	1.6	1.6	34.1	4.8e-002	8.7e-002
31	1.65	1.65	34.1	4.7e-002	8.51e-002
32	1.75	1.75	34.1	4.5e-002	8.15e-002
33	1.85	1.85	34.1	4.4e-002	7.97e-002
34	1.95	1.95	34.1	4.3e-002	7.79e-002
35	2.05	2.05	34.1	4.2e-002	7.61e-002

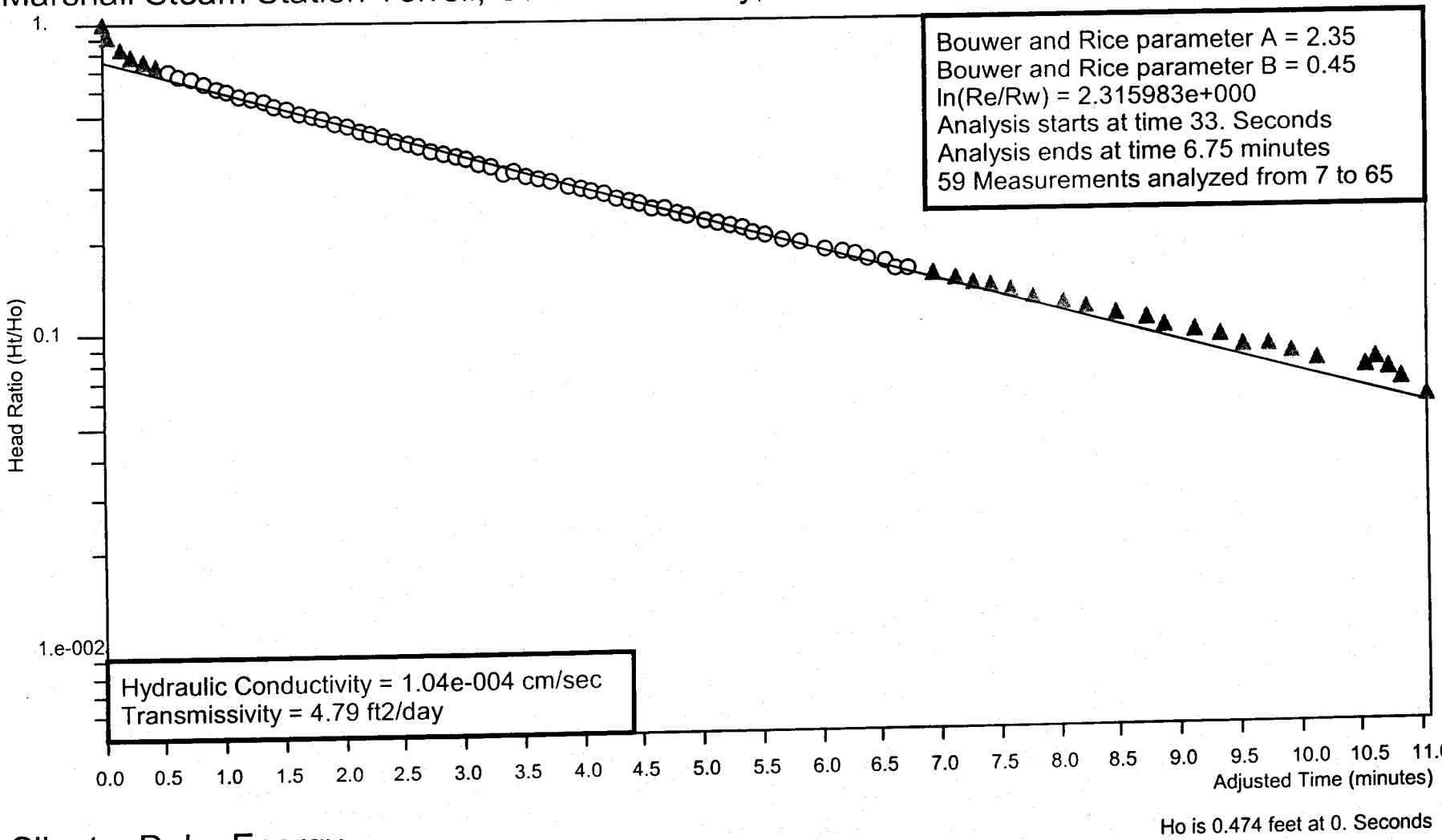
36	2.1	2.1	34.1	4.1e-002	7.43e-002
37	2.15	2.15	34.1	4.2e-002	7.61e-002
38	2.25	2.25	34.1	4.e-002	7.25e-002
39	2.35	2.35	34.1	3.9e-002	7.07e-002
40	2.45	2.45	34.1	3.7e-002	6.7e-002
41	2.6	2.6	34.1	3.6e-002	6.52e-002
42	2.65	2.65	34.1	3.7e-002	6.7e-002
43	2.7	2.7	34.1	3.6e-002	6.52e-002
44	2.8	2.8	34.1	3.5e-002	6.34e-002
45	2.85	2.85	34.1	3.4e-002	6.16e-002
46	3.05	3.05	34.1	3.3e-002	5.98e-002
47	3.1	3.1	34.1	3.2e-002	5.8e-002
48	3.2	3.2	34.1	3.1e-002	5.62e-002
49	3.25	3.25	34.	3.e-002	5.43e-002
50	3.45	3.45	34.	2.9e-002	5.25e-002
51	3.6	3.6	34.	3.e-002	5.43e-002
52	3.65	3.65	34.	2.8e-002	5.07e-002
53	3.75	3.75	34.	2.7e-002	4.89e-002
54	3.95	3.95	34.	2.6e-002	4.71e-002
55	4.	4.	34.	2.5e-002	4.53e-002
56	4.2	4.2	34.	2.4e-002	4.35e-002
57	4.4	4.4	34.	2.3e-002	4.17e-002
58	4.45	4.45	34.	2.4e-002	4.35e-002
59	4.5	4.5	34.	2.3e-002	4.17e-002
60	4.55	4.55	34.	2.2e-002	3.99e-002
61	4.6	4.6	34.	2.3e-002	4.17e-002
62	4.65	4.65	34.	2.2e-002	3.99e-002
63	4.85	4.85	34.	2.1e-002	3.8e-002
64	5.2	5.2	34.	2.e-002	3.62e-002
65	5.3	5.3	34.	1.9e-002	3.44e-002
66	5.45	5.45	34.	2.2e-002	3.99e-002
67	5.5	5.5	34.	2.e-002	3.62e-002
68	5.55	5.55	34.	1.9e-002	3.44e-002
69	5.6	5.6	34.	2.e-002	3.62e-002
70	5.65	5.65	34.	1.9e-002	3.44e-002
71	5.7	5.7	34.	1.8e-002	3.26e-002
72	5.85	5.85	34.	1.9e-002	3.44e-002
73	5.95	5.95	34.	1.8e-002	3.26e-002
74	6.15	6.15	34.	1.7e-002	3.08e-002
75	6.2	6.2	34.	1.6e-002	2.9e-002
76	6.45	6.45	34.	1.5e-002	2.72e-002
77	6.55	6.55	34.	1.6e-002	2.9e-002
78	6.6	6.6	34.	1.5e-002	2.72e-002
79	6.65	6.65	34.	1.6e-002	2.9e-002
80	6.7	6.7	34.	1.5e-002	2.72e-002
81	6.75	6.75	34.	1.4e-002	2.54e-002

SLUG OUT MS-6 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-6



Ho is 0.474 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-6

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	MS-6
Aquifer Thickness:	16.2 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	29.5 feet
Water Table to Screen Bottom:	11.2 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 87 time and drawdown measurements
Maximum head is 0.474 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	30.	0.474	1.
2	5.e-002	5.e-002	29.9	0.437	0.922
3	0.15	0.15	29.9	0.394	0.831
4	0.25	0.25	29.9	0.374	0.789
5	0.35	0.35	29.8	0.359	0.757
6	0.45	0.45	29.8	0.346	0.73
7	0.55	0.55	29.8	0.335	0.707
8	0.65	0.65	29.8	0.322	0.679
9	0.75	0.75	29.8	0.314	0.662
10	0.85	0.85	29.8	0.304	0.641
11	0.95	0.95	29.8	0.295	0.622
12	1.05	1.05	29.8	0.287	0.605
13	1.15	1.15	29.8	0.279	0.589
14	1.25	1.25	29.8	0.272	0.574
15	1.35	1.35	29.8	0.264	0.557
16	1.45	1.45	29.7	0.257	0.542
17	1.55	1.55	29.7	0.25	0.527
18	1.65	1.65	29.7	0.244	0.515
19	1.75	1.75	29.7	0.237	0.5
20	1.85	1.85	29.7	0.231	0.487
21	1.95	1.95	29.7	0.225	0.475
22	2.05	2.05	29.7	0.219	0.462
23	2.15	2.15	29.7	0.214	0.451
24	2.25	2.25	29.7	0.209	0.441
25	2.35	2.35	29.7	0.204	0.43
26	2.45	2.45	29.7	0.198	0.418
27	2.55	2.55	29.7	0.193	0.407
28	2.65	2.65	29.7	0.188	0.397
29	2.75	2.75	29.7	0.184	0.388
30	2.85	2.85	29.7	0.18	0.38
31	2.95	2.95	29.7	0.175	0.369
32	3.05	3.05	29.7	0.171	0.361
33	3.15	3.15	29.7	0.167	0.352
34	3.25	3.25	29.7	0.163	0.344
35	3.35	3.35	29.6	0.155	0.327

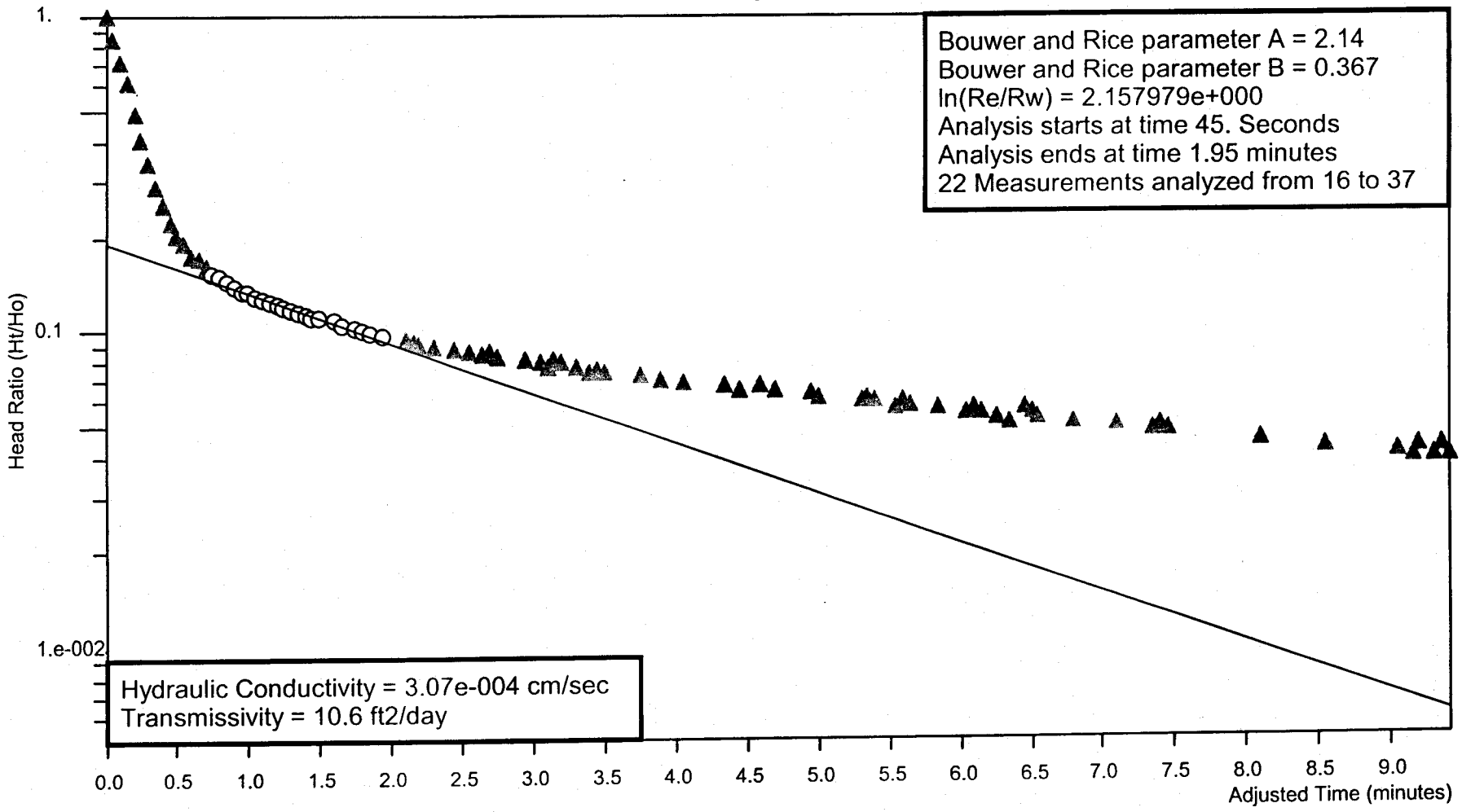
36	3.45	3.45	29.6	0.156	0.329
37	3.55	3.55	29.6	0.152	0.321
38	3.65	3.65	29.6	0.148	0.312
39	3.75	3.75	29.6	0.145	0.306
40	3.9	3.9	29.6	0.14	0.295
41	4.	4.	29.6	0.137	0.289
42	4.1	4.1	29.6	0.134	0.283
43	4.2	4.2	29.6	0.131	0.276
44	4.3	4.3	29.6	0.128	0.27
45	4.4	4.4	29.6	0.125	0.264
46	4.5	4.5	29.6	0.122	0.257
47	4.6	4.6	29.6	0.119	0.251
48	4.7	4.7	29.6	0.117	0.247
49	4.8	4.8	29.6	0.114	0.241
50	4.9	4.9	29.6	0.112	0.236
51	5.05	5.05	29.6	0.108	0.228
52	5.15	5.15	29.6	0.106	0.224
53	5.25	5.25	29.6	0.103	0.217
54	5.35	5.35	29.6	0.101	0.213
55	5.45	5.45	29.6	9.8e-002	0.207
56	5.55	5.55	29.6	9.6e-002	0.203
57	5.7	5.7	29.6	9.3e-002	0.196
58	5.85	5.85	29.6	9.e-002	0.19
59	6.05	6.05	29.6	8.6e-002	0.181
60	6.2	6.2	29.6	8.4e-002	0.177
61	6.3	6.3	29.6	8.2e-002	0.173
62	6.4	6.4	29.6	8.e-002	0.169
63	6.55	6.55	29.6	7.8e-002	0.165
64	6.65	6.65	29.6	7.3e-002	0.154
65	6.75	6.75	29.6	7.3e-002	0.154
66	6.95	6.95	29.6	7.1e-002	0.15
67	7.15	7.15	29.6	6.8e-002	0.143
68	7.3	7.3	29.6	6.6e-002	0.139
69	7.45	7.45	29.6	6.4e-002	0.135
70	7.6	7.6	29.6	6.2e-002	0.131
71	7.8	7.8	29.5	5.9e-002	0.124
72	8.05	8.05	29.5	5.6e-002	0.118
73	8.25	8.25	29.5	5.4e-002	0.114
74	8.5	8.5	29.5	5.1e-002	0.108
75	8.75	8.75	29.5	4.9e-002	0.103
76	8.9	8.9	29.5	4.7e-002	9.92e-002
77	9.15	9.15	29.5	4.5e-002	9.49e-002
78	9.35	9.35	29.5	4.3e-002	9.07e-002
79	9.55	9.55	29.5	4.e-002	8.44e-002
80	9.75	9.75	29.5	4.e-002	8.44e-002
81	9.95	9.95	29.5	3.8e-002	8.02e-002
82	10.2	10.2	29.5	3.6e-002	7.59e-002
83	10.6	10.6	29.5	3.4e-002	7.17e-002
84	10.7	10.7	29.5	3.6e-002	7.59e-002
85	10.8	10.8	29.5	3.3e-002	6.96e-002
86	10.9	10.9	29.5	3.1e-002	6.54e-002
87	11.1	11.1	29.5	2.7e-002	5.7e-002

SLUG OUT MS-7 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-7



Ho is 0.567 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-7

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	MS-7
Aquifer Thickness:	12.2 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	21.9 feet
Water Table to Screen Bottom:	7.15 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 92 time and drawdown measurements
Maximum head is 0.567 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	22.5	0.567	1.
2	5.e-002	5.e-002	22.4	0.482	0.85
3	0.1	0.1	22.3	0.405	0.714
4	0.15	0.15	22.2	0.348	0.614
5	0.2	0.2	22.2	0.281	0.496
6	0.25	0.25	22.1	0.231	0.407
7	0.3	0.3	22.1	0.194	0.342
8	0.35	0.35	22.1	0.164	0.289
9	0.4	0.4	22.	0.144	0.254
10	0.45	0.45	22.	0.127	0.224
11	0.5	0.5	22.	0.115	0.203
12	0.55	0.55	22.	0.109	0.192
13	0.6	0.6	22.	9.9e-002	0.175
14	0.65	0.65	22.	9.6e-002	0.169
15	0.7	0.7	22.	9.1e-002	0.16
16	0.75	0.75	22.	8.7e-002	0.153
17	0.8	0.8	22.	8.4e-002	0.148
18	0.85	0.85	22.	8.2e-002	0.145
19	0.9	0.9	22.	7.9e-002	0.139
20	0.95	0.95	22.	7.6e-002	0.134
21	1.	1.	22.	7.5e-002	0.132
22	1.05	1.05	22.	7.3e-002	0.129
23	1.1	1.1	22.	7.1e-002	0.125
24	1.15	1.15	22.	7.e-002	0.123
25	1.2	1.2	22.	6.9e-002	0.122
26	1.25	1.25	22.	6.7e-002	0.118
27	1.3	1.3	22.	6.6e-002	0.116
28	1.35	1.35	22.	6.5e-002	0.115
29	1.4	1.4	22.	6.4e-002	0.113
30	1.45	1.45	22.	6.3e-002	0.111
31	1.5	1.5	22.	6.2e-002	0.109
32	1.6	1.6	22.	6.1e-002	0.108
33	1.65	1.65	21.9	5.9e-002	0.104
34	1.75	1.75	21.9	5.8e-002	0.102
35	1.8	1.8	21.9	5.7e-002	0.101

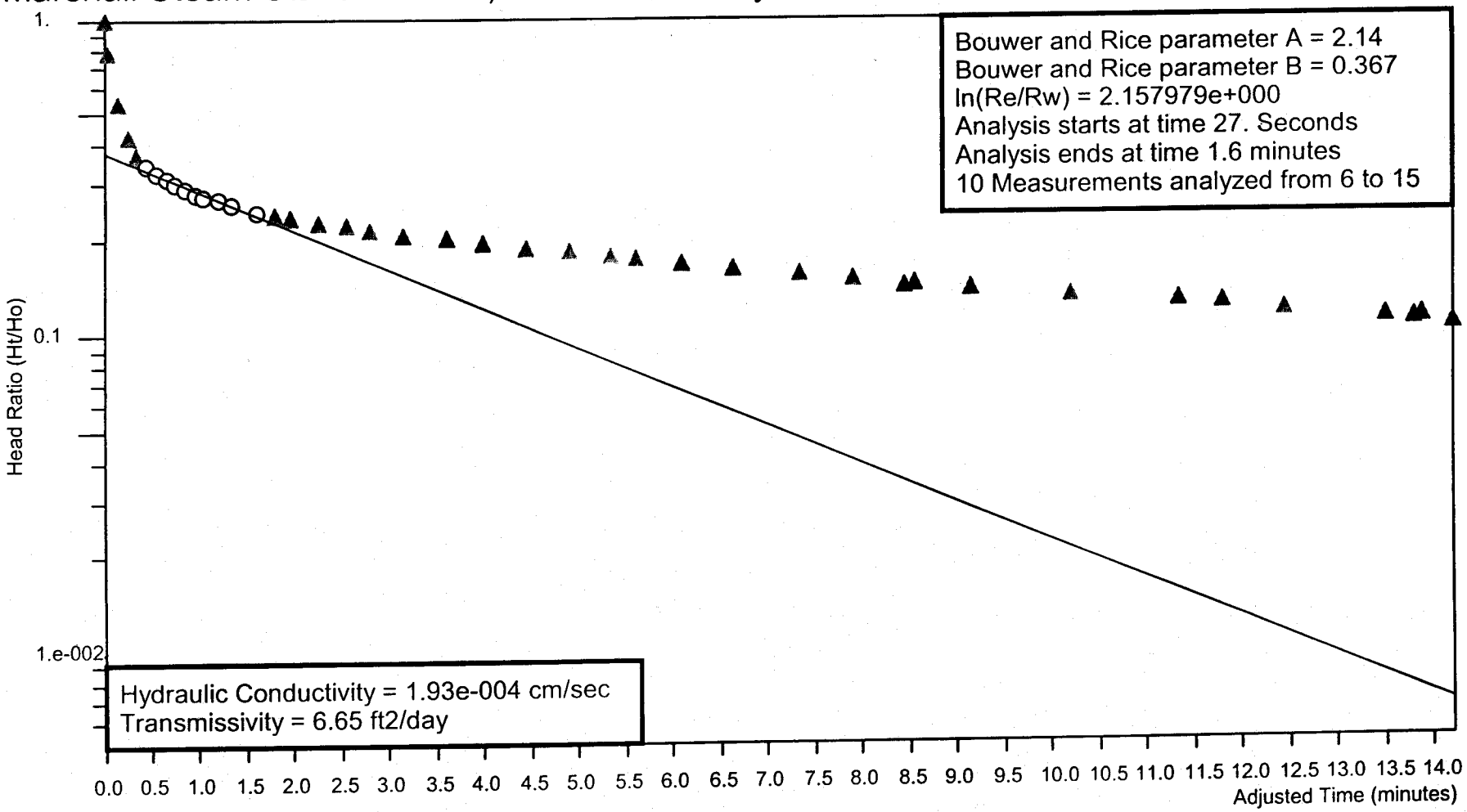
36	1.85	1.85	21.9	5.6e-002	9.88e-002
37	1.95	1.95	21.9	5.5e-002	9.7e-002
38	2.1	2.1	21.9	5.4e-002	9.52e-002
39	2.15	2.15	21.9	5.3e-002	9.35e-002
40	2.2	2.2	21.9	5.2e-002	9.17e-002
41	2.3	2.3	21.9	5.1e-002	8.99e-002
42	2.45	2.45	21.9	5.e-002	8.82e-002
43	2.55	2.55	21.9	4.9e-002	8.64e-002
44	2.65	2.65	21.9	4.8e-002	8.47e-002
45	2.7	2.7	21.9	4.9e-002	8.64e-002
46	2.75	2.75	21.9	4.7e-002	8.29e-002
47	2.95	2.95	21.9	4.6e-002	8.11e-002
48	3.05	3.05	21.9	4.5e-002	7.94e-002
49	3.1	3.1	21.9	4.4e-002	7.76e-002
50	3.15	3.15	21.9	4.6e-002	8.11e-002
51	3.2	3.2	21.9	4.5e-002	7.94e-002
52	3.3	3.3	21.9	4.4e-002	7.76e-002
53	3.4	3.4	21.9	4.2e-002	7.41e-002
54	3.45	3.45	21.9	4.3e-002	7.58e-002
55	3.5	3.5	21.9	4.2e-002	7.41e-002
56	3.75	3.75	21.9	4.1e-002	7.23e-002
57	3.9	3.9	21.9	4.e-002	7.05e-002
58	4.05	4.05	21.9	3.9e-002	6.88e-002
59	4.35	4.35	21.9	3.8e-002	6.7e-002
60	4.45	4.45	21.9	3.7e-002	6.53e-002
61	4.6	4.6	21.9	3.8e-002	6.7e-002
62	4.7	4.7	21.9	3.7e-002	6.53e-002
63	4.95	4.95	21.9	3.6e-002	6.35e-002
64	5.	5.	21.9	3.5e-002	6.17e-002
65	5.3	5.3	21.9	3.4e-002	6.e-002
66	5.35	5.35	21.9	3.5e-002	6.17e-002
67	5.4	5.4	21.9	3.4e-002	6.e-002
68	5.55	5.55	21.9	3.2e-002	5.64e-002
69	5.6	5.6	21.9	3.4e-002	6.e-002
70	5.65	5.65	21.9	3.3e-002	5.82e-002
71	5.85	5.85	21.9	3.2e-002	5.64e-002
72	6.05	6.05	21.9	3.1e-002	5.47e-002
73	6.1	6.1	21.9	3.2e-002	5.64e-002
74	6.15	6.15	21.9	3.1e-002	5.47e-002
75	6.25	6.25	21.9	3.e-002	5.29e-002
76	6.35	6.35	21.9	2.9e-002	5.11e-002
77	6.45	6.45	21.9	3.2e-002	5.64e-002
78	6.5	6.5	21.9	3.1e-002	5.47e-002
79	6.55	6.55	21.9	3.e-002	5.29e-002
80	6.8	6.8	21.9	2.9e-002	5.11e-002
81	7.1	7.1	21.9	2.8e-002	4.94e-002
82	7.35	7.35	21.9	2.7e-002	4.76e-002
83	7.4	7.4	21.9	2.8e-002	4.94e-002
84	7.45	7.45	21.9	2.7e-002	4.76e-002
85	8.1	8.1	21.9	2.5e-002	4.41e-002
86	8.55	8.55	21.9	2.4e-002	4.23e-002
87	9.05	9.05	21.9	2.3e-002	4.06e-002
88	9.15	9.15	21.9	2.2e-002	3.88e-002
89	9.2	9.2	21.9	2.4e-002	4.23e-002
90	9.3	9.3	21.9	2.2e-002	3.88e-002
91	9.35	9.35	21.9	2.4e-002	4.23e-002
92	9.4	9.4	21.9	2.2e-002	3.88e-002

SLUG OUT MS-8 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-8



Ho is 0.334 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-8

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	MS-8
Aquifer Thickness:	12.2 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	29.6 feet
Water Table to Screen Bottom:	7.15 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 42 time and drawdown measurements
Maximum head is 0.334 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	29.9	0.334	1.
2	5.e-002	5.e-002	29.9	0.265	0.793
3	0.15	0.15	29.8	0.181	0.542
4	0.25	0.25	29.7	0.142	0.425
5	0.35	0.35	29.7	0.124	0.371
6	0.45	0.45	29.7	0.115	0.344
7	0.55	0.55	29.7	0.108	0.323
8	0.65	0.65	29.7	0.105	0.314
9	0.75	0.75	29.7	1.e-001	0.299
10	0.85	0.85	29.7	9.7e-002	0.29
11	0.95	0.95	29.7	9.4e-002	0.281
12	1.05	1.05	29.7	9.1e-002	0.272
13	1.2	1.2	29.7	8.9e-002	0.266
14	1.35	1.35	29.7	8.6e-002	0.257
15	1.6	1.6	29.7	8.2e-002	0.246
16	1.8	1.8	29.7	8.e-002	0.24
17	1.95	1.95	29.7	7.8e-002	0.234
18	2.25	2.25	29.7	7.6e-002	0.228
19	2.55	2.55	29.7	7.4e-002	0.222
20	2.8	2.8	29.7	7.2e-002	0.216
21	3.15	3.15	29.7	6.9e-002	0.207
22	3.6	3.6	29.7	6.7e-002	0.201
23	4.	4.	29.7	6.5e-002	0.195
24	4.45	4.45	29.7	6.3e-002	0.189
25	4.9	4.9	29.7	6.1e-002	0.183
26	5.35	5.35	29.7	5.9e-002	0.177
27	5.6	5.6	29.7	5.8e-002	0.174
28	6.1	6.1	29.7	5.6e-002	0.168
29	6.65	6.65	29.7	5.4e-002	0.162
30	7.35	7.35	29.7	5.2e-002	0.156
31	7.9	7.9	29.6	5.e-002	0.15
32	8.45	8.45	29.6	4.7e-002	0.141
33	8.55	8.55	29.6	4.8e-002	0.144
34	9.15	9.15	29.6	4.6e-002	0.138
35	10.2	10.2	29.6	4.4e-002	0.132

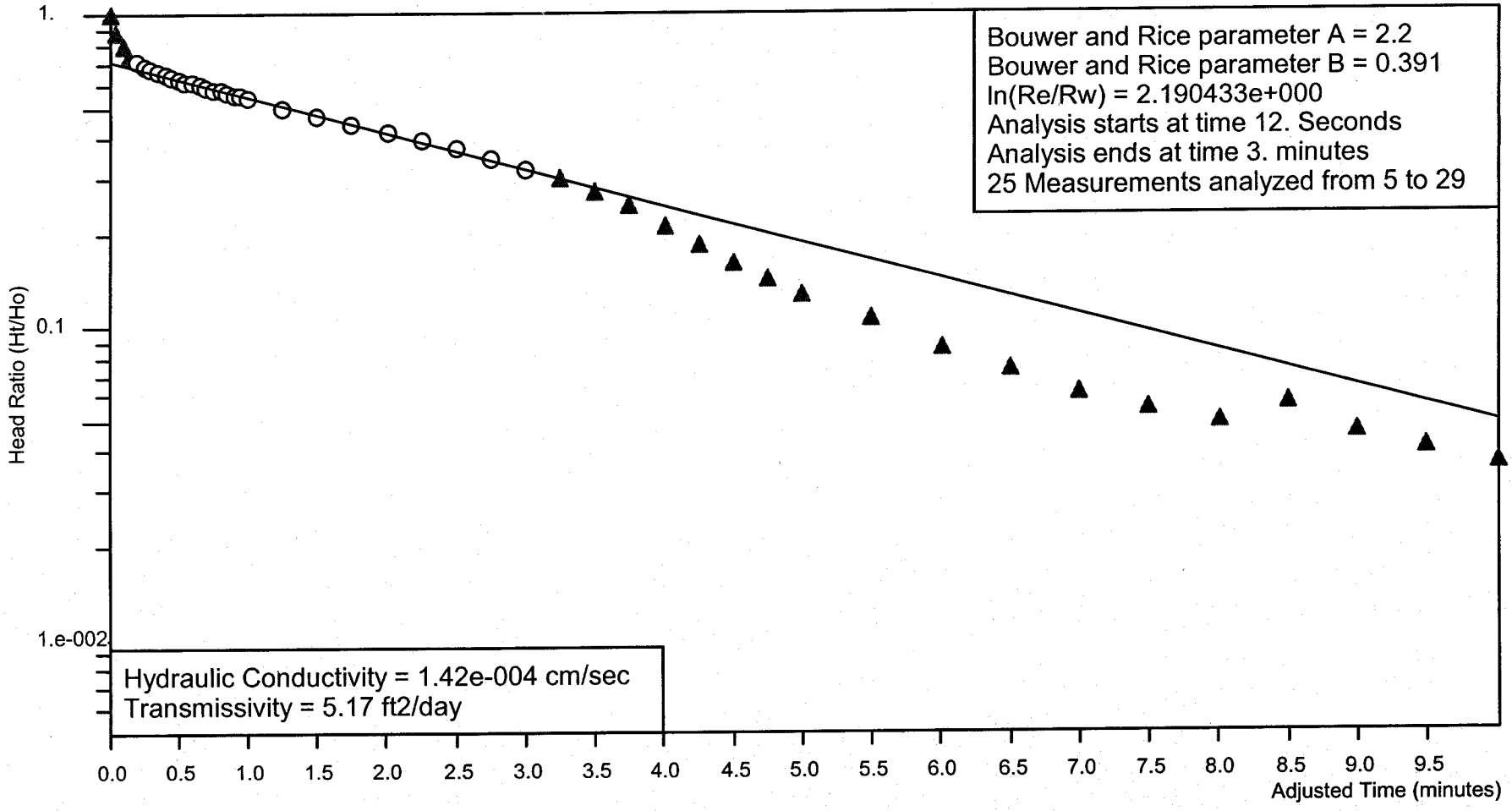
36	11.4	11.4	29.6	4.2e-002	0.126
37	11.8	11.8	29.6	4.1e-002	0.123
38	12.5	12.5	29.6	3.9e-002	0.117
39	13.5	13.5	29.6	3.7e-002	0.111
40	13.8	13.8	29.6	3.6e-002	0.108
41	13.9	13.9	29.6	3.7e-002	0.111
42	14.2	14.2	29.6	3.5e-002	0.105

SLUG OUT MS-10 7/18/03

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-10



Ho is 2.05 feet at 0. Seconds

Project Number: 1264-02-578 for Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-10

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	7/18/03
Client:	Duke Energy
Project Number:	1264-02-578

Well Label:	MS-10
Aquifer Thickness:	12.9 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	15.1 feet
Water Table to Screen Bottom:	7.88 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 47 time and drawdown measurements
Maximum head is 2.05 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown	Head (feet)	Head Ratio (feet)
1	0.	0.	17.2	2.05	1.
2	5.e-002	5.e-002	16.9	1.82	0.889
3	0.1	0.1	16.7	1.62	0.792
4	0.15	0.15	16.6	1.51	0.739
5	0.2	0.2	16.6	1.45	0.706
6	0.25	0.25	16.5	1.4	0.683
7	0.3	0.3	16.5	1.36	0.666
8	0.35	0.35	16.5	1.34	0.653
9	0.4	0.4	16.4	1.31	0.641
10	0.45	0.45	16.4	1.29	0.631
11	0.5	0.5	16.4	1.27	0.621
12	0.55	0.55	16.4	1.25	0.612
13	0.6	0.6	16.4	1.24	0.603
14	0.65	0.65	16.3	1.22	0.593
15	0.7	0.7	16.3	1.2	0.586
16	0.75	0.75	16.3	1.18	0.577
17	0.8	0.8	16.3	1.17	0.569
18	0.85	0.85	16.3	1.15	0.561
19	0.9	0.9	16.3	1.13	0.552
20	0.95	0.95	16.2	1.12	0.546
21	1.	1.	16.2	1.1	0.537
22	1.25	1.25	16.1	1.03	0.502
23	1.5	1.5	16.1	0.964	0.47
24	1.75	1.75	16.	0.906	0.442
25	2.	2.	16.	0.857	0.418
26	2.25	2.25	15.9	0.803	0.392
27	2.5	2.5	15.9	0.756	0.369
28	2.75	2.75	15.8	0.707	0.345
29	3.	3.	15.8	0.659	0.322
30	3.25	3.25	15.7	0.612	0.299
31	3.5	3.5	15.7	0.561	0.274

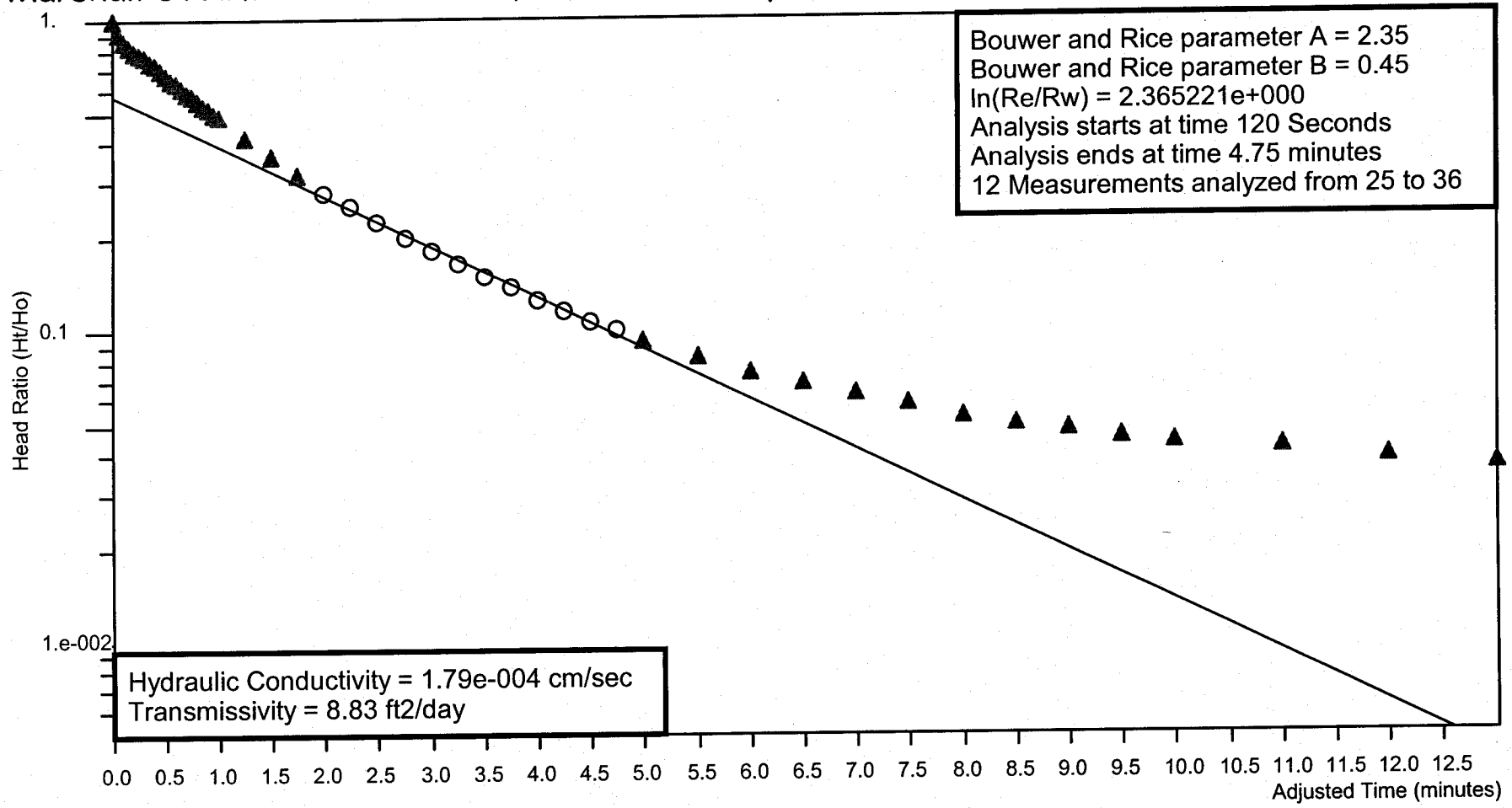
32	3.75	3.75	15.6	0.503	0.245
33	4.	4.	15.6	0.435	0.212
34	4.25	4.25	15.5	0.376	0.184
35	4.5	4.5	15.5	0.331	0.162
36	4.75	4.75	15.4	0.294	0.143
37	5.	5.	15.4	0.261	0.127
38	5.5	5.5	15.3	0.218	0.106
39	6.	6.	15.3	0.176	8.59e-002
40	6.5	6.5	15.3	0.152	7.42e-002
41	7.	7.	15.2	0.127	6.2e-002
42	7.5	7.5	15.2	0.113	5.51e-002
43	8.	8.	15.2	0.101	4.93e-002
44	8.5	8.5	15.2	0.117	5.71e-002
45	9.	9.	15.2	9.5e-002	4.64e-002
46	9.5	9.5	15.2	8.4e-002	4.1e-002
47	10.	10.	15.2	7.4e-002	3.61e-002

SLUG OUT MS-11 7/18/03

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

MS-11



Ho is 4.3 feet at 0. Seconds

Project Number: 1264-02-578 for Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT MS-11

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	7/18/03
Client:	Duke Energy
Project Number:	1264-02-578

Well Label:	MS-11
Aquifer Thickness:	17.4 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	29.6 feet
Water Table to Screen Bottom:	12.4 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 50 time and drawdown measurements
Maximum head is 4.3 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	33.9	4.3	1.
2	5.e-002	5.e-002	33.5	3.94	0.917
3	0.1	0.1	33.3	3.71	0.862
4	0.15	0.15	33.1	3.55	0.825
5	0.2	0.2	33.	3.43	0.799
6	0.25	0.25	32.9	3.35	0.779
7	0.3	0.3	32.8	3.27	0.761
8	0.35	0.35	32.7	3.19	0.742
9	0.4	0.4	32.6	3.09	0.718
10	0.45	0.45	32.5	2.98	0.694
11	0.5	0.5	32.4	2.88	0.67
12	0.55	0.55	32.3	2.79	0.648
13	0.6	0.6	32.2	2.69	0.626
14	0.65	0.65	32.2	2.61	0.606
15	0.7	0.7	32.1	2.52	0.587
16	0.75	0.75	32.	2.44	0.568
17	0.8	0.8	31.9	2.37	0.55
18	0.85	0.85	31.8	2.29	0.533
19	0.9	0.9	31.8	2.22	0.517
20	0.95	0.95	31.7	2.15	0.501
21	1.	1.	31.6	2.09	0.486
22	1.25	1.25	31.4	1.81	0.421
23	1.5	1.5	31.1	1.57	0.365
24	1.75	1.75	30.9	1.37	0.32
25	2.	2.	30.8	1.2	0.28
26	2.25	2.25	30.6	1.08	0.251
27	2.5	2.5	30.5	0.958	0.223
28	2.75	2.75	30.4	0.86	0.2
29	3.	3.	30.3	0.777	0.181
30	3.25	3.25	30.3	0.701	0.163
31	3.5	3.5	30.2	0.643	0.15

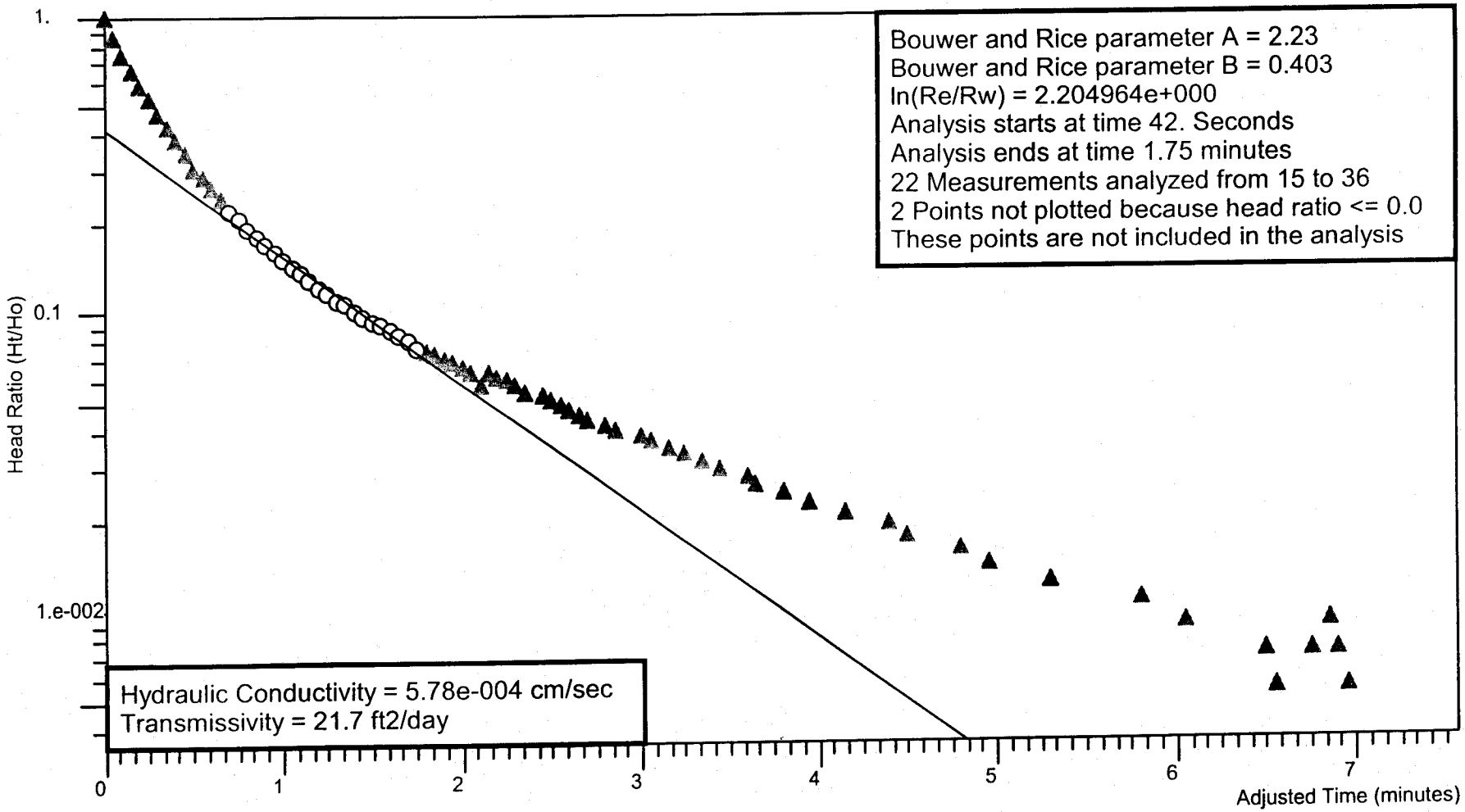
32	3.75	3.75	30.1	0.588	0.137
33	4.	4.	30.1	0.538	0.125
34	4.25	4.25	30.	0.497	0.116
35	4.5	4.5	30.	0.46	0.107
36	4.75	4.75	30.	0.429	9.97e-002
37	5.	5.	29.9	0.4	9.3e-002
38	5.5	5.5	29.9	0.355	8.25e-002
39	6.	6.	29.9	0.318	7.39e-002
40	6.5	6.5	29.8	0.291	6.77e-002
41	7.	7.	29.8	0.268	6.23e-002
42	7.5	7.5	29.8	0.249	5.79e-002
43	8.	8.	29.8	0.229	5.32e-002
44	8.5	8.5	29.8	0.216	5.02e-002
45	9.	9.	29.8	0.204	4.74e-002
46	9.5	9.5	29.7	0.194	4.51e-002
47	10.	10.	29.7	0.188	4.37e-002
48	11.	11.	29.7	0.179	4.16e-002
49	12.	12.	29.7	0.165	3.84e-002
50	13.	13.	29.7	0.157	3.65e-002

SLUG OUT OW-1 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

OW-1



Ho is 0.573 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT OW-1

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	OW-1
Aquifer Thickness:	13.2 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	20.9 feet
Water Table to Screen Bottom:	8.25 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 82 time and drawdown measurements
Maximum head is 0.573 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	21.4	0.573	1.
2	5.e-002	5.e-002	21.3	0.491	0.857
3	0.1	0.1	21.3	0.426	0.743
4	0.15	0.15	21.2	0.377	0.658
5	0.2	0.2	21.2	0.337	0.588
6	0.25	0.25	21.2	0.302	0.527
7	0.3	0.3	21.1	0.271	0.473
8	0.35	0.35	21.1	0.244	0.426
9	0.4	0.4	21.1	0.22	0.384
10	0.45	0.45	21.1	0.2	0.349
11	0.5	0.5	21.	0.174	0.304
12	0.55	0.55	21.	0.165	0.288
13	0.6	0.6	21.	0.152	0.265
14	0.65	0.65	21.	0.14	0.244
15	0.7	0.7	21.	0.128	0.223
16	0.75	0.75	21.	0.119	0.208
17	0.8	0.8	21.	0.111	0.194
18	0.85	0.85	21.	0.103	0.18
19	0.9	0.9	20.9	9.7e-002	0.169
20	0.95	0.95	20.9	9.2e-002	0.161
21	1.	1.	20.9	8.7e-002	0.152
22	1.05	1.05	20.9	8.2e-002	0.143
23	1.1	1.1	20.9	7.8e-002	0.136
24	1.15	1.15	20.9	7.3e-002	0.127
25	1.2	1.2	20.9	7.e-002	0.122
26	1.25	1.25	20.9	6.6e-002	0.115
27	1.3	1.3	20.9	6.3e-002	0.11
28	1.35	1.35	20.9	6.1e-002	0.106
29	1.4	1.4	20.9	5.8e-002	0.101
30	1.45	1.45	20.9	5.6e-002	9.77e-002
31	1.5	1.5	20.9	5.3e-002	9.25e-002
32	1.55	1.55	20.9	5.2e-002	9.08e-002
33	1.6	1.6	20.9	5.e-002	8.73e-002
34	1.65	1.65	20.9	4.8e-002	8.38e-002
35	1.7	1.7	20.9	4.6e-002	8.03e-002

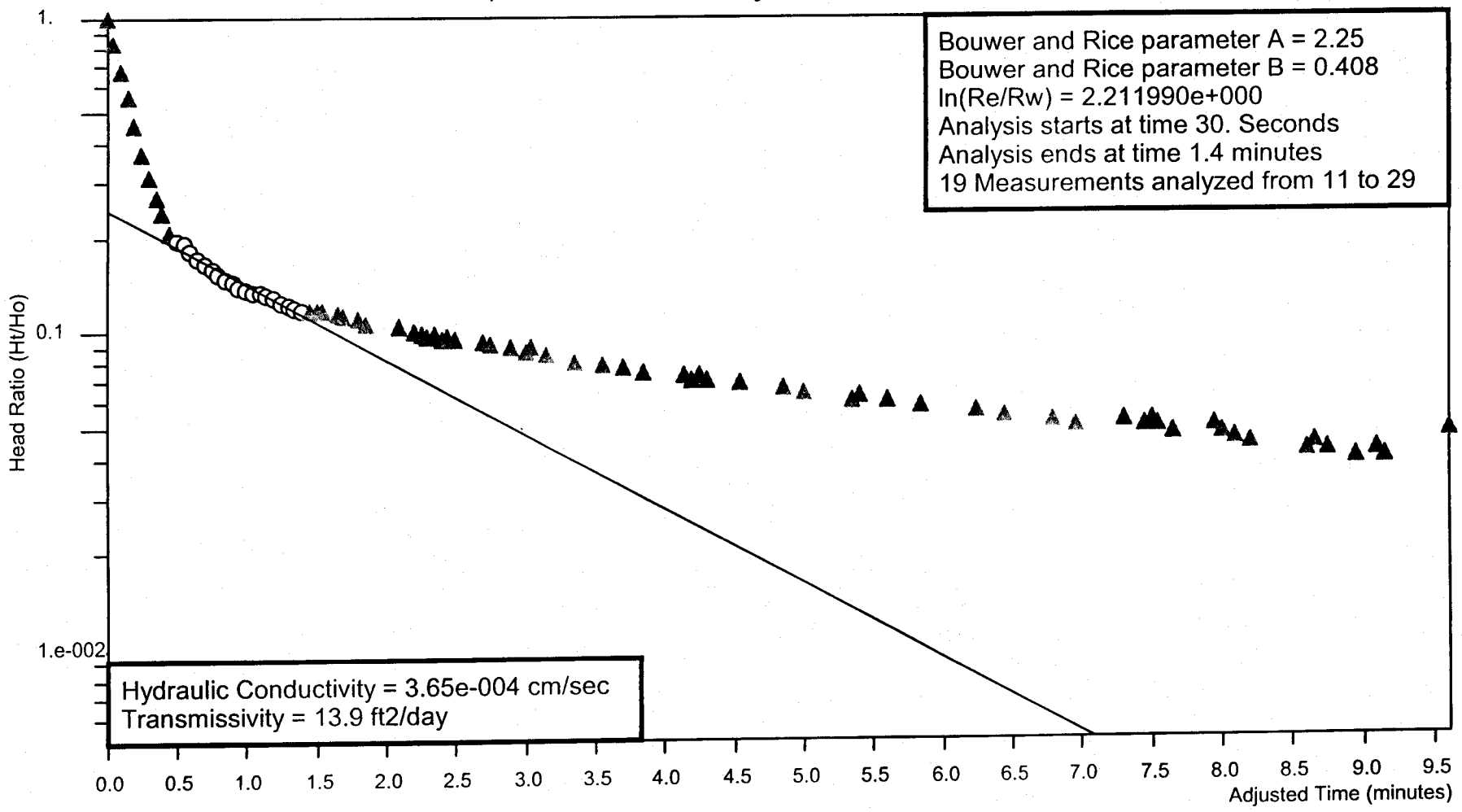
36	1.75	1.75	20.9	4.4e-002	7.68e-002
37	1.8	1.8	20.9	4.3e-002	7.5e-002
38	1.85	1.85	20.9	4.2e-002	7.33e-002
39	1.9	1.9	20.9	4.e-002	6.98e-002
40	1.95	1.95	20.9	3.9e-002	6.81e-002
41	2.	2.	20.9	3.8e-002	6.63e-002
42	2.05	2.05	20.9	3.6e-002	6.28e-002
43	2.1	2.1	20.9	3.3e-002	5.76e-002
44	2.15	2.15	20.9	3.6e-002	6.28e-002
45	2.2	2.2	20.9	3.5e-002	6.11e-002
46	2.25	2.25	20.9	3.4e-002	5.93e-002
47	2.3	2.3	20.9	3.3e-002	5.76e-002
48	2.35	2.35	20.9	3.1e-002	5.41e-002
49	2.45	2.45	20.9	3.e-002	5.24e-002
50	2.5	2.5	20.9	2.9e-002	5.06e-002
51	2.55	2.55	20.9	2.8e-002	4.89e-002
52	2.6	2.6	20.9	2.7e-002	4.71e-002
53	2.65	2.65	20.9	2.6e-002	4.54e-002
54	2.7	2.7	20.9	2.5e-002	4.36e-002
55	2.8	2.8	20.9	2.4e-002	4.19e-002
56	2.85	2.85	20.9	2.3e-002	4.01e-002
57	3.	3.	20.9	2.2e-002	3.84e-002
58	3.05	3.05	20.9	2.1e-002	3.66e-002
59	3.15	3.15	20.9	2.e-002	3.49e-002
60	3.25	3.25	20.9	1.9e-002	3.32e-002
61	3.35	3.35	20.9	1.8e-002	3.14e-002
62	3.45	3.45	20.9	1.7e-002	2.97e-002
63	3.6	3.6	20.9	1.6e-002	2.79e-002
64	3.65	3.65	20.9	1.5e-002	2.62e-002
65	3.8	3.8	20.9	1.4e-002	2.44e-002
66	3.95	3.95	20.9	1.3e-002	2.27e-002
67	4.15	4.15	20.9	1.2e-002	2.09e-002
68	4.4	4.4	20.9	1.1e-002	1.92e-002
69	4.5	4.5	20.9	1.e-002	1.75e-002
70	4.8	4.8	20.9	9.e-003	1.57e-002
71	4.95	4.95	20.9	8.e-003	1.4e-002
72	5.3	5.3	20.9	7.e-003	1.22e-002
73	5.8	5.8	20.9	6.e-003	1.05e-002
74	6.05	6.05	20.9	5.e-003	8.73e-003
75	6.5	6.5	20.9	4.e-003	6.98e-003
76	6.55	6.55	20.9	3.e-003	5.24e-003
77	6.75	6.75	20.9	4.e-003	6.98e-003
78	6.8	6.8	20.9	2.e-003	3.49e-003
79	6.85	6.85	20.9	5.e-003	8.73e-003
80	6.9	6.9	20.9	4.e-003	6.98e-003
81	6.95	6.95	20.9	3.e-003	5.24e-003
82	7.55	7.55	20.9	2.e-003	3.49e-003

SLUG OUT OW-2 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

OW-2



Ho is 0.484 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT OW-2

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	OW-2
Aquifer Thickness:	13.4 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	20.5 feet
Water Table to Screen Bottom:	8.44 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 85 time and drawdown measurements
Maximum head is 0.484 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	21.	0.484	1.
2	5.e-002	5.e-002	20.9	0.402	0.831
3	0.1	0.1	20.9	0.33	0.682
4	0.15	0.15	20.8	0.27	0.558
5	0.2	0.2	20.8	0.219	0.452
6	0.25	0.25	20.7	0.18	0.372
7	0.3	0.3	20.7	0.151	0.312
8	0.35	0.35	20.7	0.129	0.267
9	0.4	0.4	20.7	0.115	0.238
10	0.45	0.45	20.6	0.1	0.207
11	0.5	0.5	20.6	9.4e-002	0.194
12	0.55	0.55	20.6	9.3e-002	0.192
13	0.6	0.6	20.6	8.7e-002	0.18
14	0.65	0.65	20.6	8.3e-002	0.171
15	0.7	0.7	20.6	7.9e-002	0.163
16	0.75	0.75	20.6	7.7e-002	0.159
17	0.8	0.8	20.6	7.4e-002	0.153
18	0.85	0.85	20.6	7.1e-002	0.147
19	0.9	0.9	20.6	6.9e-002	0.143
20	0.95	0.95	20.6	6.7e-002	0.138
21	1.	1.	20.6	6.6e-002	0.136
22	1.05	1.05	20.6	6.5e-002	0.134
23	1.1	1.1	20.6	6.4e-002	0.132
24	1.15	1.15	20.6	6.3e-002	0.13
25	1.2	1.2	20.6	6.2e-002	0.128
26	1.25	1.25	20.6	6.e-002	0.124
27	1.3	1.3	20.6	5.9e-002	0.122
28	1.35	1.35	20.6	5.8e-002	0.12
29	1.4	1.4	20.6	5.7e-002	0.118
30	1.45	1.45	20.6	5.6e-002	0.116
31	1.5	1.5	20.6	5.7e-002	0.118
32	1.55	1.55	20.6	5.6e-002	0.116
33	1.65	1.65	20.6	5.5e-002	0.114
34	1.7	1.7	20.6	5.4e-002	0.112
35	1.8	1.8	20.6	5.3e-002	0.11

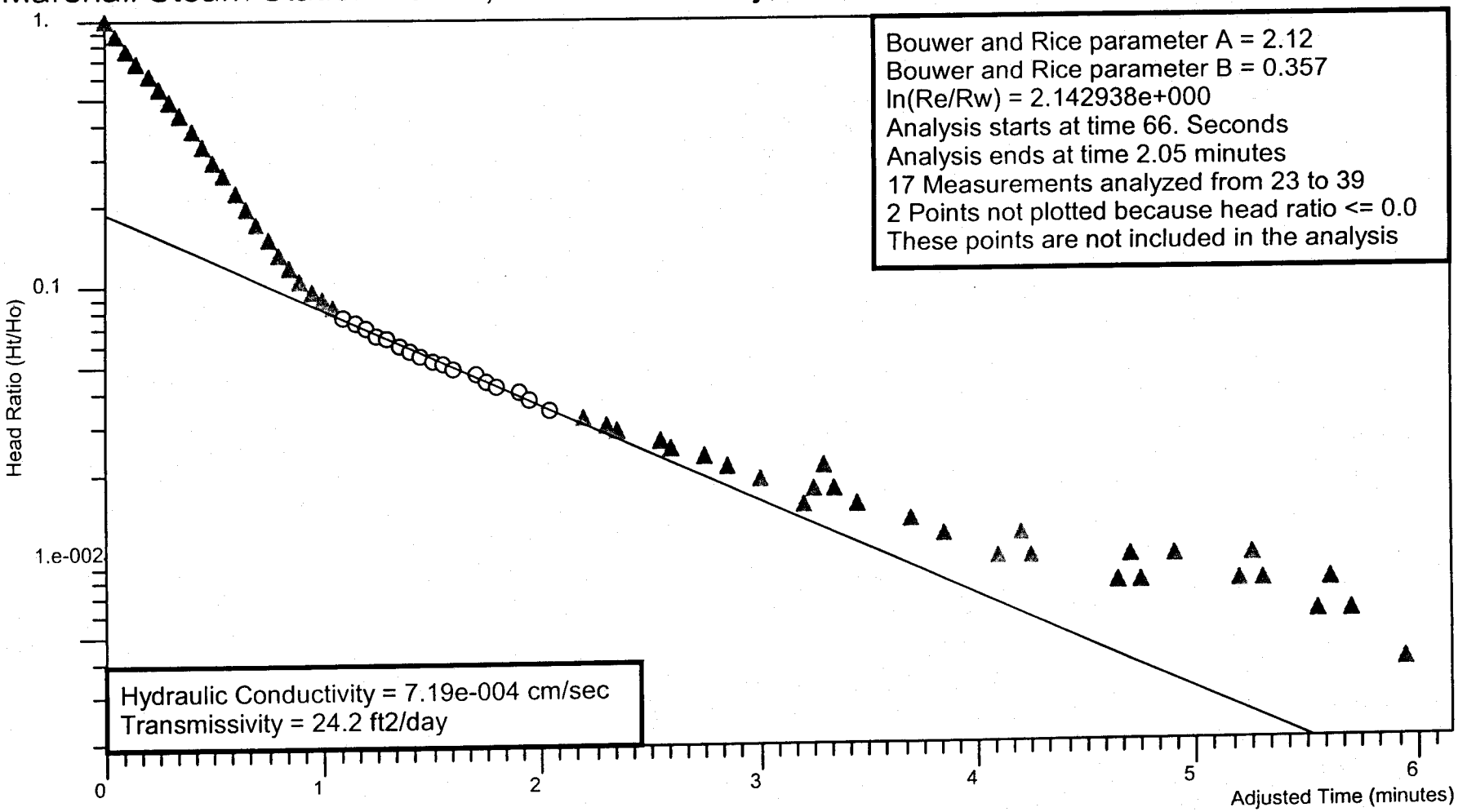
36	1.85	1.85	20.6	5.1e-002	0.105
37	2.1	2.1	20.6	5.e-002	0.103
38	2.2	2.2	20.6	4.9e-002	0.101
39	2.25	2.25	20.6	4.8e-002	9.92e-002
40	2.3	2.3	20.6	4.7e-002	9.71e-002
41	2.35	2.35	20.6	4.8e-002	9.92e-002
42	2.4	2.4	20.6	4.6e-002	9.5e-002
43	2.45	2.45	20.6	4.7e-002	9.71e-002
44	2.5	2.5	20.6	4.6e-002	9.5e-002
45	2.7	2.7	20.6	4.5e-002	9.3e-002
46	2.75	2.75	20.6	4.4e-002	9.09e-002
47	2.9	2.9	20.6	4.3e-002	8.88e-002
48	3.	3.	20.6	4.2e-002	8.68e-002
49	3.05	3.05	20.6	4.3e-002	8.88e-002
50	3.15	3.15	20.6	4.1e-002	8.47e-002
51	3.35	3.35	20.6	3.9e-002	8.06e-002
52	3.55	3.55	20.6	3.8e-002	7.85e-002
53	3.7	3.7	20.6	3.7e-002	7.64e-002
54	3.85	3.85	20.6	3.6e-002	7.44e-002
55	4.15	4.15	20.6	3.5e-002	7.23e-002
56	4.2	4.2	20.6	3.4e-002	7.02e-002
57	4.25	4.25	20.6	3.5e-002	7.23e-002
58	4.3	4.3	20.6	3.4e-002	7.02e-002
59	4.55	4.55	20.6	3.3e-002	6.82e-002
60	4.85	4.85	20.6	3.2e-002	6.61e-002
61	5.	5.	20.6	3.1e-002	6.4e-002
62	5.35	5.35	20.6	2.9e-002	5.99e-002
63	5.4	5.4	20.6	3.e-002	6.2e-002
64	5.6	5.6	20.6	2.9e-002	5.99e-002
65	5.85	5.85	20.6	2.8e-002	5.79e-002
66	6.25	6.25	20.6	2.7e-002	5.58e-002
67	6.45	6.45	20.6	2.6e-002	5.37e-002
68	6.8	6.8	20.6	2.5e-002	5.17e-002
69	6.95	6.95	20.6	2.4e-002	4.96e-002
70	7.3	7.3	20.6	2.5e-002	5.17e-002
71	7.45	7.45	20.6	2.4e-002	4.96e-002
72	7.5	7.5	20.6	2.5e-002	5.17e-002
73	7.55	7.55	20.6	2.4e-002	4.96e-002
74	7.65	7.65	20.6	2.3e-002	4.75e-002
75	7.95	7.95	20.6	2.4e-002	4.96e-002
76	8.	8.	20.6	2.3e-002	4.75e-002
77	8.1	8.1	20.6	2.2e-002	4.55e-002
78	8.2	8.2	20.6	2.1e-002	4.34e-002
79	8.6	8.6	20.6	2.e-002	4.13e-002
80	8.65	8.65	20.6	2.1e-002	4.34e-002
81	8.75	8.75	20.6	2.e-002	4.13e-002
82	8.95	8.95	20.6	1.9e-002	3.93e-002
83	9.1	9.1	20.6	2.e-002	4.13e-002
84	9.15	9.15	20.6	1.9e-002	3.93e-002
85	9.6	9.6	20.6	2.3e-002	4.75e-002

SLUG OUT OW-3 February 20, 2003

Bouwer and Rice Graph

Marshall Steam Station Terrell, Catawba County, North Carolina

OW-3



Ho is 0.526 feet at 0. Seconds

Client:: Duke Energy

Analysis by Julie Petersen of S&ME, Inc.

SLUG OUT OW-3

Site Name:	Marshall Steam Station
Location:	Terrell, Catawba County, North Carolina
Test Date:	February 20, 2003
Client:	Duke Energy

Well Label:	OW-3
Aquifer Thickness:	11.9 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	4. Inches
Static Water Level:	23.1 feet
Water Table to Screen Bottom:	6.85 feet
Anisotropy Ratio:	1.
Time Adjustment:	0. Seconds

Test starts with trial 0
There are 70 time and drawdown measurements
Maximum head is 0.526 feet
Minimum head is -6.e-003 feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.	0.	23.6	0.526	1.
2	5.e-002	5.e-002	23.6	0.465	0.884
3	0.1	0.1	23.5	0.411	0.781
4	0.15	0.15	23.5	0.365	0.694
5	0.2	0.2	23.4	0.325	0.618
6	0.25	0.25	23.4	0.29	0.551
7	0.3	0.3	23.4	0.258	0.49
8	0.35	0.35	23.3	0.23	0.437
9	0.4	0.4	23.3	0.201	0.382
10	0.45	0.45	23.3	0.179	0.34
11	0.5	0.5	23.3	0.157	0.298
12	0.55	0.55	23.2	0.138	0.262
13	0.6	0.6	23.2	0.12	0.228
14	0.65	0.65	23.2	0.105	0.2
15	0.7	0.7	23.2	9.1e-002	0.173
16	0.75	0.75	23.2	7.9e-002	0.15
17	0.8	0.8	23.2	7.e-002	0.133
18	0.85	0.85	23.2	6.2e-002	0.118
19	0.9	0.9	23.2	5.6e-002	0.106
20	0.95	0.95	23.2	5.1e-002	9.7e-002
21	1.	1.	23.2	4.7e-002	8.94e-002
22	1.05	1.05	23.2	4.4e-002	8.37e-002
23	1.1	1.1	23.2	4.1e-002	7.79e-002
24	1.15	1.15	23.1	3.9e-002	7.41e-002
25	1.2	1.2	23.1	3.7e-002	7.03e-002
26	1.25	1.25	23.1	3.5e-002	6.65e-002
27	1.3	1.3	23.1	3.4e-002	6.46e-002
28	1.35	1.35	23.1	3.2e-002	6.08e-002
29	1.4	1.4	23.1	3.e-002	5.7e-002
30	1.45	1.45	23.1	2.9e-002	5.51e-002
31	1.5	1.5	23.1	2.8e-002	5.32e-002
32	1.55	1.55	23.1	2.7e-002	5.13e-002
33	1.6	1.6	23.1	2.6e-002	4.94e-002
34	1.7	1.7	23.1	2.5e-002	4.75e-002
35	1.75	1.75	23.1	2.3e-002	4.37e-002

36	1.8	1.8	23.1	2.2e-002	4.18e-002
37	1.9	1.9	23.1	2.1e-002	3.99e-002
38	1.95	1.95	23.1	2.e-002	3.8e-002
39	2.05	2.05	23.1	1.8e-002	3.42e-002
40	2.2	2.2	23.1	1.7e-002	3.23e-002
41	2.3	2.3	23.1	1.6e-002	3.04e-002
42	2.35	2.35	23.1	1.5e-002	2.85e-002
43	2.55	2.55	23.1	1.4e-002	2.66e-002
44	2.6	2.6	23.1	1.3e-002	2.47e-002
45	2.75	2.75	23.1	1.2e-002	2.28e-002
46	2.85	2.85	23.1	1.1e-002	2.09e-002
47	3.	3.	23.1	1.e-002	1.9e-002
48	3.2	3.2	23.1	8.e-003	1.52e-002
49	3.25	3.25	23.1	9.e-003	1.71e-002
50	3.3	3.3	23.1	1.1e-002	2.09e-002
51	3.35	3.35	23.1	9.e-003	1.71e-002
52	3.45	3.45	23.1	8.e-003	1.52e-002
53	3.7	3.7	23.1	7.e-003	1.33e-002
54	3.85	3.85	23.1	6.e-003	1.14e-002
55	4.1	4.1	23.1	5.e-003	9.51e-003
56	4.2	4.2	23.1	6.e-003	1.14e-002
57	4.25	4.25	23.1	5.e-003	9.51e-003
58	4.65	4.65	23.1	4.e-003	7.6e-003
59	4.7	4.7	23.1	5.e-003	9.51e-003
60	4.75	4.75	23.1	4.e-003	7.6e-003
61	4.9	4.9	23.1	5.e-003	9.51e-003
62	5.2	5.2	23.1	4.e-003	7.6e-003
63	5.25	5.25	23.1	5.e-003	9.51e-003
64	5.3	5.3	23.1	4.e-003	7.6e-003
65	5.55	5.55	23.1	3.e-003	5.7e-003
66	5.6	5.6	23.1	4.e-003	7.6e-003
67	5.65	5.65	23.1	-6.e-003	-1.14e-002
68	5.7	5.7	23.1	3.e-003	5.7e-003
69	5.95	5.95	23.1	2.e-003	3.8e-003
70	6.15	6.15	23.1	1.e-003	1.9e-003

SOIL LABORATORY DATA SHEETS

LABORATORY PROCEDURES

Moisture Content: The moisture content is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the solid particles. This test was conducted in accordance with ASTM Designation D 2216.

Grain Size Test With Hydrometer: Grain size tests were performed to determine the particle size and distribution of the samples tested. The grain size distribution of soils coarser than a No. 200 sieve was determined by passing the samples through a set of nested sieves. The soil particles passing the No. 200 sieve were suspended in solution and the grain size distribution determined from the rate of settlement.

Soil Plasticity Tests (Atterberg Limits Test): Representative samples were 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. The Plastic Limit is the moisture content at which the soil begins to lose its plasticity. The Atterberg Limits are determined in accordance with ASTM D 4318.

Specific Gravity: The specivity gravity of the permeability test samples was determined. The specific gravity is the ratio of the weight, in air, of a given volume of soil particles to the weight in air, of an equal volume of water. This test conducted in accordance with ASTM Designation D-854-58.

Unit Weight: In the laboratory, a section of each selected undisturbed sample, still in its steel tube, was measured and weighed to determine gross weight and volume. The sample was then extruded from its steel tube and the net weight and volume of the sample determined for the calculation of the soil wet unit weight in pounds per cubic foot. The dry unit weight was then calculated from the net unit weight and the natural moisture content.

Standard Proctor Compaction Test: Representative samples of the on-site and borrow soils were obtained from auger cuttings to determine their suitability as potential fill material. Standard Proctor Compaction Tests (ASTM D 698) were performed on these soils to determine their compaction characteristics including maximum dry density and optimum moisture content.

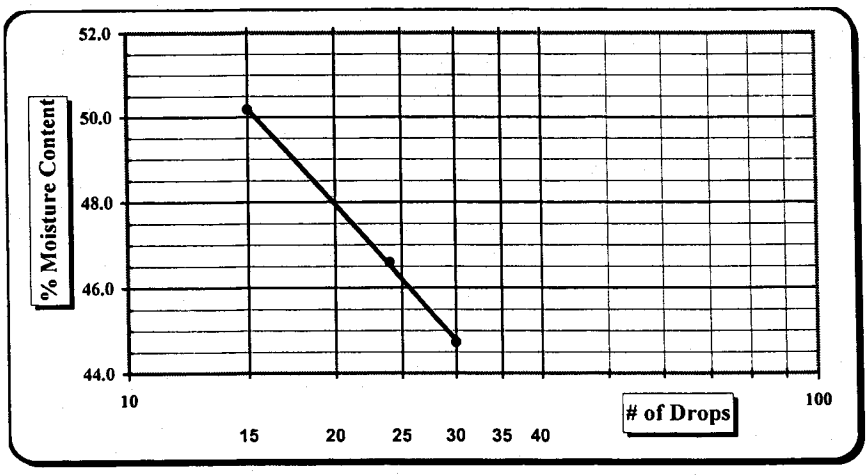
Permeability Test: The coefficient of permeability, k, of selected samples was estimated in the laboratory by testing the samples in a constant head permeameter. The sample and apparatus dimensions were carefully measured and the sample saturated prior to initiating the test. A head was then applied to the sample to provide flow, and the change in head was measured over a corresponding time interval. The coefficient of permeability was then calculated from the measured dimensions, head change and elapsed test time. This test was conducted in accordance with ASTM Designation D-5084.

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 27, 2003
Client Name:			
Boring #:	B-1	Sample #: S-1	Sample Depth: 3.5-5'
Sample Description:	REDDISH BROWN MICA. C-F SANDY SILTY CLAY		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	JORDI	VV	U				PP	CC	
A	Tare Weight	15.95	16.03	15.47				16.17	16.79	
B	Wet Soil Weight + A	23.23	23.77	23.82				23.35	24.42	
C	Dry Soil Weight + A	20.98	21.31	21.03				21.91	22.86	
D	Water Weight (B-C)	2.25	2.46	2.79				1.44	1.56	
E	Dry Soil Weight (C-A)	5.03	5.28	5.56				5.74	6.07	
F	% Moisture Content (D/E)*100	44.7%	46.6%	50.2%				25.1%	25.7%	
N	# OF DROPS	30	24	15						
Ave.	Average	47.2%						25.4%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	46
Plastic Limit	25
Plastic Index	22
Group Symbol	CL

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-1
Elev. or Depth: 3.5-5' **Sample Length (in./cm.):**
Location: B-1
Description: REDDISH BROWN MICACEOUS C-F SANDY SILTY CLAY
Liquid Limit: 46 **Plastic Limit:** 25
USCS Classification: CL **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	226.29
Tare =	0.00
Dry sample weight =	226.29

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	0.72	99.7
# 10	5.34	97.6
# 20	1.52	94.6
# 40	4.76	88.3
# 60	9.78	78.5
# 100	15.48	67.4
# 200	22.23	54.2

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 97.6
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 29.69
Dry weight & tare = 29.52
Tare = 17.02
Hygroscopic moisture= 1.4 %
Calculated biased weight= 50.54
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

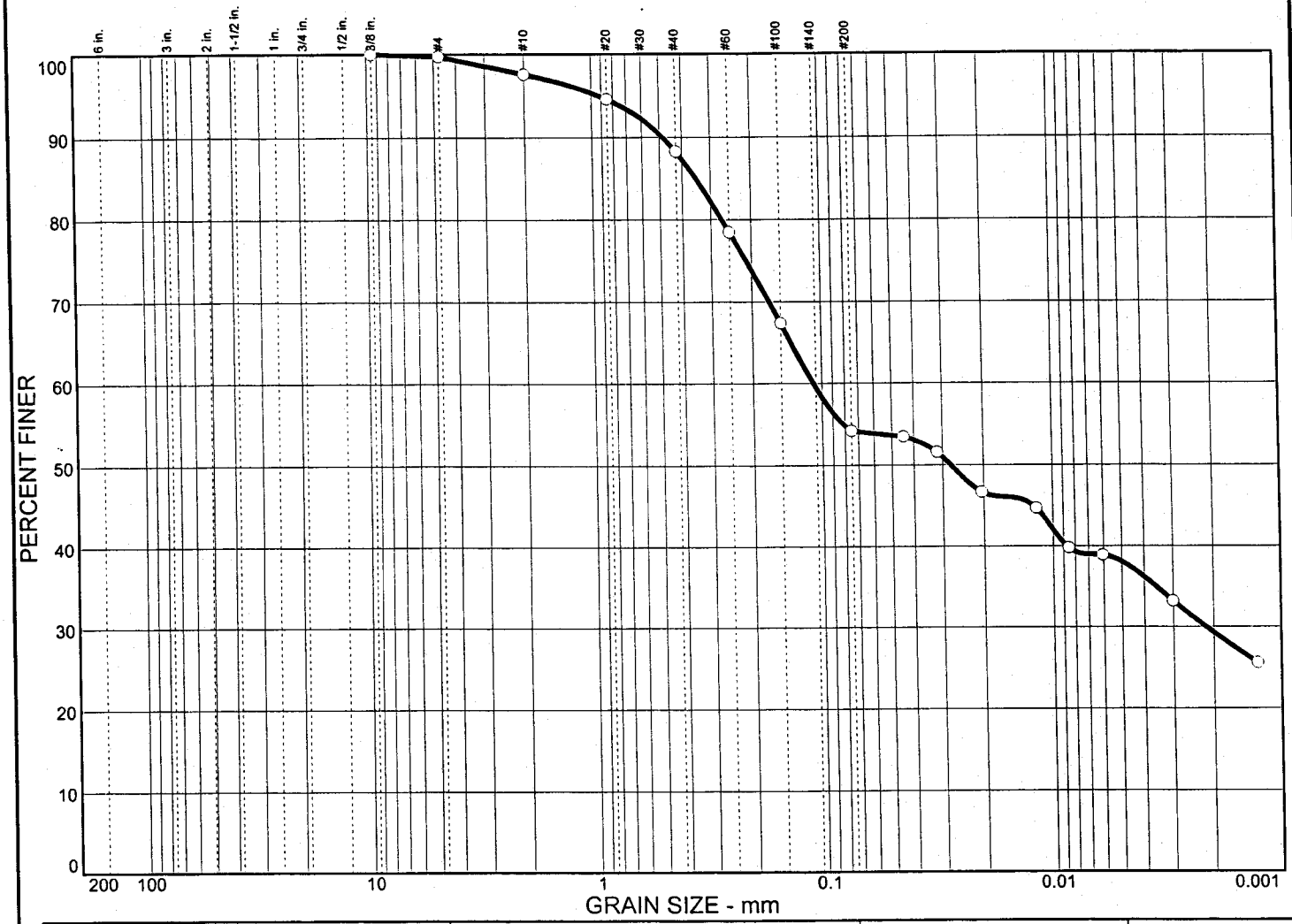
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	32.5	27.4	0.0135	33.5	10.8	0.0445	53.5
2.00	19.5	31.5	26.4	0.0135	32.5	11.0	0.0317	51.6
5.00	19.5	29.0	23.9	0.0135	30.0	11.4	0.0204	46.7
15.00	19.5	28.0	22.9	0.0135	29.0	11.5	0.0119	44.7
30.00	19.5	25.5	20.4	0.0135	26.5	11.9	0.0085	39.8
60.00	19.5	25.0	19.9	0.0135	26.0	12.0	0.0061	38.9
250.00	20.0	22.0	17.0	0.0134	23.0	12.5	0.0030	33.2
1440.00	20.5	18.0	13.1	0.0134	19.0	13.2	0.0013	25.6

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = % GRAVEL = 0.3 % SAND = 45.5
% SILT = 16.1 % CLAY = 38.1

D_{85}= 0.35 D_{60}= 0.11 D_{50}= 0.03
D_{30}= 0.00

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.3	45.5	16.1	38.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	46	25	0.348	0.109	0.0275	0.0022				

MATERIAL DESCRIPTION	USCS	AASHTO
○ REDDISH BROWN MICACEOUS C-F SANDY SILTY CLAY	CL	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-1

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

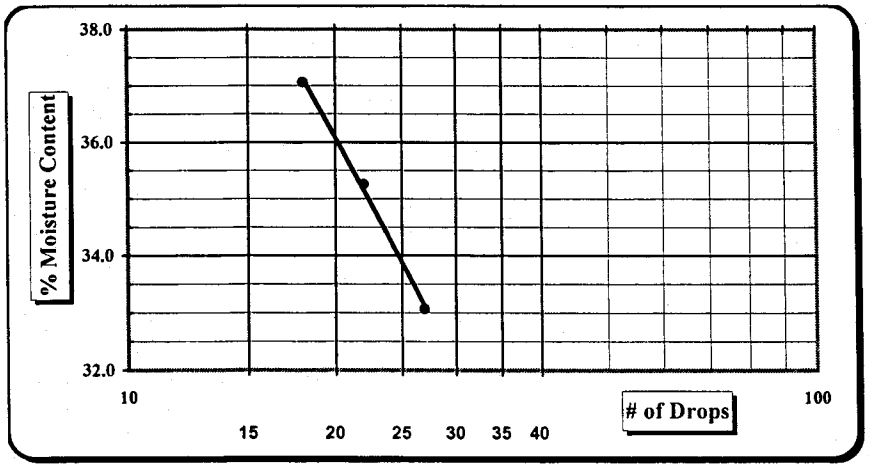
SAMPLE S-1,B-1

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 28, 2003
Client Name:			
Boring #:	B-1	Sample #: BAG	Sample Depth: 10'
Sample Description:	REDDISH BROWN MICACEOUS SANDY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	DC	WN	73				TAT	180	
A	Tare Weight	15.58	16.55	15.35				15.30	15.42	
B	Wet Soil Weight + A	25.56	25.22	25.89				23.92	25.24	
C	Dry Soil Weight + A	23.08	22.96	23.04				22.19	23.32	
D	Water Weight (B-C)	2.48	2.26	2.85				1.73	1.92	
E	Dry Soil Weight (C-A)	7.50	6.41	7.69				6.89	7.90	
F	% Moisture Content (D/E)*100	33.1%	35.3%	37.1%				25.1%	24.3%	
N	# OF DROPS	27	22	18						
Ave.	Average	35.1%						24.7%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes:

Estimate the % Retained on the #40 Sieve 19.3

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	34
Plastic Limit	25
Plastic Index	9
Group Symbol	ML

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 1, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	February 28, 2003
Client Name:	Duke Energy		
Boring #:	B-1	Sample #: Bag Sample	Sample Depth: 10 ft
Sample Description:	Reddish Brown Micaceous Sandy Silt		

VOL. FLASK NO.	48	VOL. FLASK NO.	27	VOL. FLASK NO.	58
WT. OF SOIL & VOL. FLASK	96.54	WT. OF SOIL & VOL. FLASK	100.44	WT. OF SOIL & VOL. FLASK	98.97
WT. OF VOL. FLASK	65.97	WT. OF VOL. FLASK	69.83	WT. OF VOL. FLASK	68.59
A. WT. OF SOIL	30.57	A. WT. OF SOIL	30.61	A. WT. OF SOIL	30.38
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	165.67	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.54	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.29
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	184.69	C. WT. OF VOL. FLASK, SOIL & WATER	188.38	C. WT. OF VOL. FLASK, SOIL & WATER	187.22
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.65	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.60	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.65

SPECIFIC GRAVITY (Corrected) $G_s = D \times K =$

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	48
$G_s = D \times K$	2.65
FLASK NO.	27
$G_s = D \times K$	2.60
FLASK NO.	58
$G_s = D \times K$	2.65
G_s (ave) =	2.63

Technician Name: Karen Warner

S&ME Moisture - Density Relationship

Test Date(s): February 10, 2003
Report Date: February 11, 2003

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:
Boring #: B-1 Sample #: BAG Sample Date: February 4, 2003
Location: Offset: Depth: 0-10'
Sample Description: REDDISH BROWN MICACEOUS C-F SANDY SANDY SILT

Liquid Limit: 34 Specific Gravity: 2.630
Plastic Limit: 25 Plastic Index: 9

Natural Moisture Content (Total Sample):
Moisture Content of the Oversize Fraction:

NOTES:

Sieve Size	% Passing
3/4"	
1/2"	
3/8"	
#4	
#10	
#40	
#60	
#200	

MDD: 108.4 **Opt. MC %: 17.2**

Water Content

Water Content requires GP 2 Balance (0.1 gram Readability).

ASTM D2216 ☒ AASHTO T265 ☐ ASTM D4959 ☐ ASTM D4643 ☐

Sample #:							
Water Added:		75	150	210	270	360	
Tare #:		MDJ	678	997	BET	A-1	
A. Tare Weight	A.	0	0	0	0	0	
B. Wet Wt + Tare Wt	B.	500	500	500	500	500	
C. Dry Wt. + Tare Wt.	C.	458.1	446.6	431.3	422.4	411.8	
D. Water Weight	B-C	41.9	53.4	68.7	77.6	88.2	0
E. Dry Weight	C-A	458.1	446.6	431.3	422.4	411.8	0
F. Moisture Content	100*D/E	**9.1%**	**12.0%**	**15.9%**	**18.4%**	**21.4%**	**#DIV/0!**

Compaction Data

The Compaction Test requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability).

G. Wt of Soil + Mold	G.	5902.000	6039.000	6172.000	6209.000	6165.000	
H. Wt. of Mold	H.	4279.000	4279.000	4279.000	4279.000	4279.000	
I. Wt. of Soil (g. or lbs.)	G-H	1623.000	1760.000	1893.000	1930.000	1886.000	0.000
J. Wt of Soil (Lbs.)	I/453.6 or I	3.578	3.880	4.173	4.255	4.158	0.000
K. Mold Volume Factor	K.	29.97	29.97	29.97	29.97	29.97	
L. Wet Density	J*K	107.2	116.3	125.1	127.5	124.6	0.0
M. Dry Density	L/(1+F)	**98.2**	**103.9**	**107.9**	**107.7**	**102.6**	**#DIV/0!**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (ASTM 1978) ☐ AASHTO Method D ☐

Moisture-Density Relation of: Fine Fraction ☒ Corrected for Coarse Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

Soil Plasticity: ASTM D 4318 ☐ AASHTO T 89 ☐ AASHTO T 90 ☐
Sieve Analysis / Particle Size Analysis: ASTM C136 ☐ AASHTO T 27 ☐ ASTM D 422 ☐ AASHTO T 88 ☐
Specific Gravity of Soil: ASTM D 854 ☐ AASHTO T 100 ☐
Bulk Gravity of Oversize Fraction: ASTM C 127 ☐ AASHTO T 85 ☐
Soil Classification: ASTM D 2487 ☐ ASTM D 2488 ☐ AASHTO M 145 ☐

Technician Name / Certification #: Matthew Johnson
Technical Responsibility: Julie Peterson

Moisture - Density Report

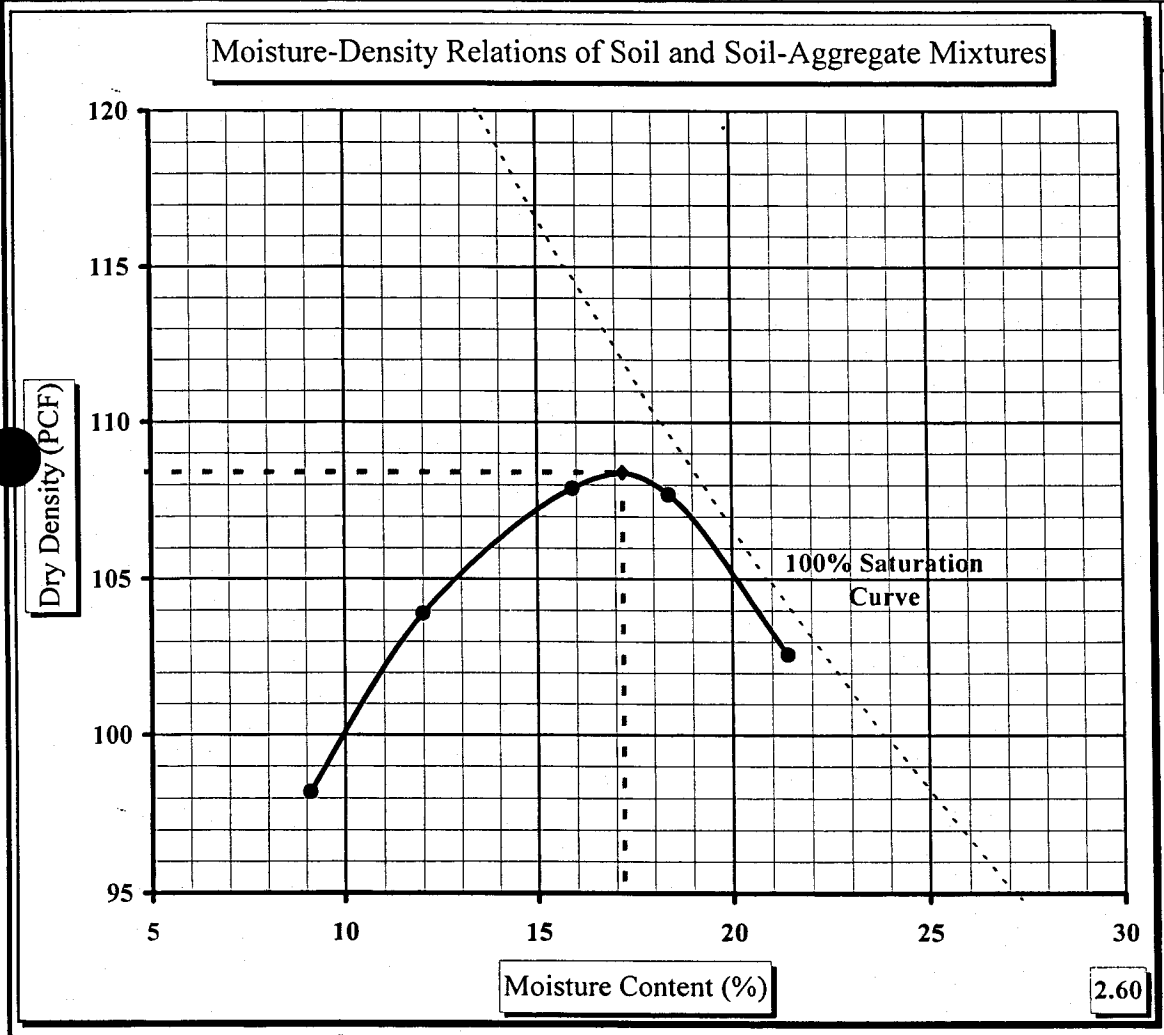
S&ME

S&ME Project #: **1264-02-578** Report Date: February 11, 2003
Project Name: **Marshall Steam Station** Test Date(s): February 10, 2003
Client Name:
Client Address:

Boring #: B-1 Sample #: BAG Sample Date: 2/4/2003
Location: Offset: Depth: 0-10'
Sample Description: REDDISH BROWN MICACEOUS C-F SANDY SANDY SILT

Maximum Dry Density **108.4 PCF.** **Optimum Moisture Content** **17.2 %**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (1978) ☐ AASHTO Method D ☐



Soil Properties	
Natural Moisture Content	
Liquid Limit:	34
Plastic Limit:	25
Plastic Index:	9
Specific Gravity:	2.630

% Passing
3/4"
1/2"
3/8"
#4
#10
#40
#60
#200

Oversize Fraction
Bulk Sp. Gravity
% Moisture
Oversize Fraction

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

References: ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Technical Responsibility: Julie Peterson 0

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/25/2003

Sample Name: B-1 BULK

Sample Description: REDDISH BROWN MICA. SANDY SILT

Type of Sample: REMOLDED

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.295	Tare No.	S-9	γ_{wet} (pcf)	123.8		Panel No	1
L (cm)	7.699	WWS+ Tare (gm)	466.7	γ_{dry} (pcf)	103		Cell P (psi)	83.5
A (cm^2)	41.80	WDS+Tare (gm)	405.5	w (%)	20.2		Soil P (psi)	81.0
V (cm^3)	321.79	WT of Water (gm)	61.2	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	626.9	WT of TARE (gm)	82.72	γ_{wet} (pcf)	121.6		Gs	2.63
		WT Dry Soil (gm)	322.78	γ_{dry} (pcf)	102.2		n	0.40
		w (%)	19.0	w (%)	19.0			

$K = (Q \times L) / (t \times H \times A)$

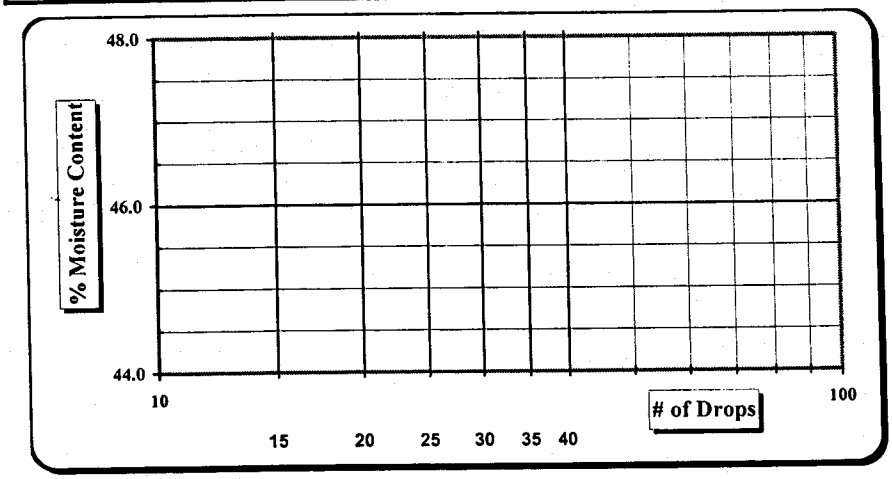
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		11	2		12.1	0.1	24.7				
	20	12	17	4500	12.1	22.2	2.5	22.2	70.4	1.0000	1.29E-05
2		12	18		12.1	0.2	24.1				
	20	13	35	4620	12.2	22.1	2.1	22.0	70.4	1.0000	1.24E-05
3		13	47		12.2	0.0	24.5				
	20	15	10	4980	12.2	23.0	1.3	23.1	70.4	1.0000	1.21E-05
4		15	25		12.2	0.1	24.5				
	20	16	54	5340	12.2	24.5	0.0	24.5	70.4	1.0000	1.20E-05
5		9	57		12.3	0.1	24.4				
	21	11	11	4440	12.3	20.4	3.8	20.5	70.4	0.9760	1.18E-05
7										AVG. K	1.21E-05
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-2	Sample #: S-10	Sample Depth: 48.5-50'
Sample Description:	GRAYISH TAN WHITE MICA. SILTY M-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic NP

Liquid Limit

Plastic Limit

Plastic Index

Group Symbol

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-10
Elev. or Depth: 48.5-50' **Sample Length (in./cm.):**
Location: B-2
Description: GREYISH TAN WHITE MICACEOUS SILTY M-F SAND
Liquid Limit: NP **Plastic Limit:** NP
USCS Classification: SM **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	198.76
Tare =	0.00
Dry sample weight =	198.76

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.03	100.0
# 20	0.50	99.0
# 40	2.75	94.5
# 60	10.93	78.1
# 100	23.73	52.5
# 200	26.96	46.1

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 31.43
Dry weight & tare = 31.33
Tare = 16.89
Hygroscopic moisture= 0.7 %
Calculated biased weight= 49.66
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

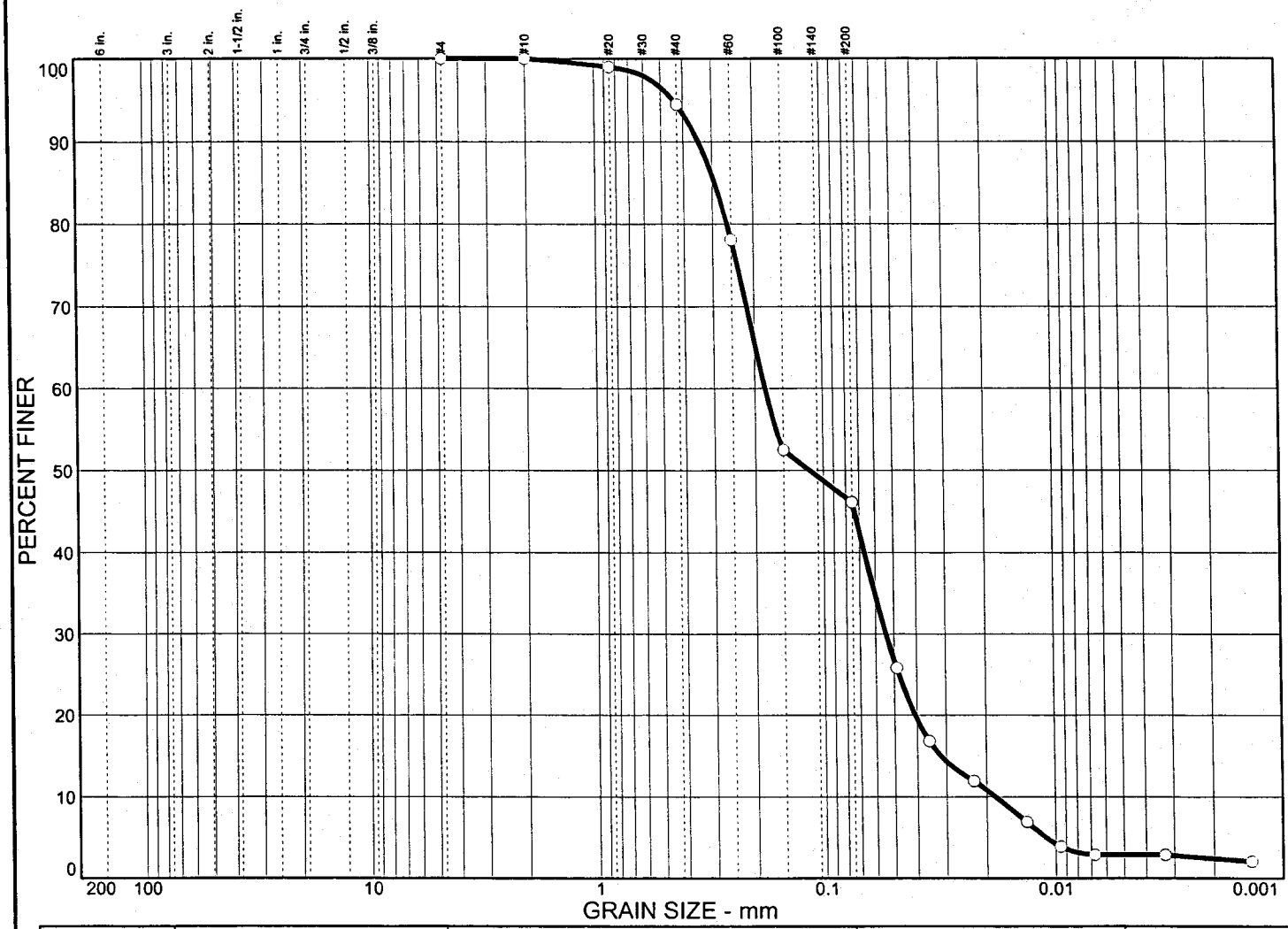
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	20.0	18.0	13.0	0.0134	19.0	13.2	0.0488	25.8
2.00	20.0	13.5	8.5	0.0134	14.5	13.9	0.0355	16.8
5.00	20.0	11.0	6.0	0.0134	12.0	14.3	0.0228	11.9
15.00	20.0	8.5	3.5	0.0134	9.5	14.7	0.0133	6.9
30.00	20.0	7.0	2.0	0.0134	8.0	15.0	0.0095	3.9
60.00	20.0	6.5	1.5	0.0134	7.5	15.1	0.0067	2.9
250.00	20.0	6.5	1.5	0.0134	7.5	15.1	0.0033	2.9
1440.00	20.5	6.0	1.1	0.0134	7.0	15.1	0.0014	2.1

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 53.9
% SILT = 43.2 **% CLAY =** 2.9

D_{85}= 0.29 D_{60}= 0.18 D_{50}= 0.11
D_{30}= 0.05 D_{15}= 0.03 D_{10}= 0.02
C_c= 0.8886 C_u= 9.8485

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	53.9	43.2	2.9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.293	0.180	0.114	0.0541	0.0317	0.0183	0.89	9.85

MATERIAL DESCRIPTION	USCS	AASHTO
○ GREYISH TAN WHITE MICACEOUS SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-2

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

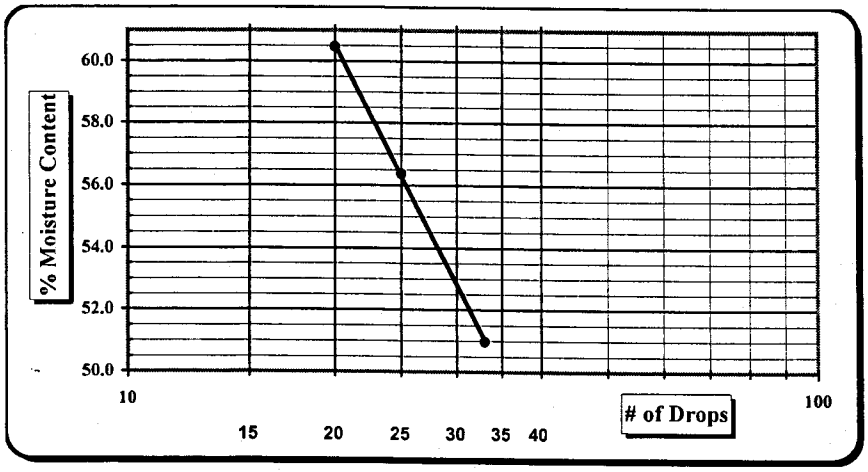
SAMPLE S-10,B-2

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	February 28, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-2	Sample #: BAG	Sample Depth: 10'
Sample Description:	TANNISH RED CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	VU	E	XX				VCR	MOT	
A	Tare Weight	15.64	15.35	15.29				15.08	14.56	
B	Wet Soil Weight + A	27.22	27.00	24.10				22.15	21.83	
C	Dry Soil Weight + A	23.31	22.80	20.78				20.08	19.70	
D	Water Weight (B-C)	3.91	4.20	3.32				2.07	2.13	
E	Dry Soil Weight (C-A)	7.67	7.45	5.49				5.00	5.14	
F	% Moisture Content (D/E)*100	51.0%	56.4%	60.5%				41.4%	41.4%	
N	# OF DROPS	33	25	20						
Ave.	Average	55.9%						41.4%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve 1.8

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	56
Plastic Limit	41
Plastic Index	15
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 1, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	February 28, 2003
Client Name:	Duke Energy		
Boring #:	B-2	Sample #: Bag Sample	Sample Depth: 10 ft
Sample Description:	Tannish Red Clayey Silt		

VOL. FLASK NO.	46	VOL. FLASK NO.	49	VOL. FLASK NO.	55
WT. OF SOIL & VOL. FLASK	96.78	WT. OF SOIL & VOL. FLASK	96.53	WT. OF SOIL & VOL. FLASK	99.38
WT. OF VOL. FLASK	66.33	WT. OF VOL. FLASK	66.2	WT. OF VOL. FLASK	68.91
A. WT. OF SOIL	30.45	A. WT. OF SOIL	30.33	A. WT. OF SOIL	30.47
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	165.97	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	165.92	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.73
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	185	C. WT. OF VOL. FLASK, SOIL & WATER	184.78	C. WT. OF VOL. FLASK, SOIL & WATER	187.93
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.67	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.64	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.70

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	46
G_s = D x K	2.67
FLASK NO.	49
G_s = D x K	2.64
FLASK NO.	55
G_s = D x K	2.70
G_s (ave) =	2.67

Technician Name: Karen Warner

S&ME Moisture - Density Relationship

Test Date(s): February 10, 2003
Report Date: February 11, 2003

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:
Boring #: B-2 Sample #: BAG Sample Date: February 4, 2003
Location: Offset: Depth: 0-10'
Sample Description: TANNISH RED MICACEOUS CLAYEY SILT

Liquid Limit: 56 Specific Gravity: 2.670
Plastic Limit: 41 Plastic Index: 15

Natural Moisture Content (Total Sample):
Moisture Content of the Oversize Fraction:

NOTES:

Sieve Size	% Passing
3/4"	
1/2"	
3/8"	
#4	
#10	
#40	
#60	
#200	

MDD: 89.7 **Opt. MC %: 25.1**

Water Content

Water Content requires GP 2 Balance (0.1 gram Readability).

ASTM D2216 ☒ AASHTO T265 ☐ ASTM D4959 ☐ ASTM D4643 ☐

	Sample #:						
	Water Added:	As Is	60	120	180		
	Tare #:	MDJ	678	539	5918		
Tare Weight	A.	0	0	0	0		
B. Wet Wt + Tare Wt	B.	500	500	500	500		
C. Dry Wt. + Tare Wt.	C.	418	399.8	390	375.5		
D. Water Weight	B-C	82	100.2	110	124.5	0	0
E. Dry Weight	C-A	418	399.8	390	375.5	0	0
F. Moisture Content	100*D/E	**19.6%**	**25.1%**	**28.2%**	**33.2%**	**#DIV/0!**	**#DIV/0!**

Compaction Data

The Compaction Test requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability).

G. Wt of Soil + Mold	G.	5883.000	5976.000	5982.000	5918.000		
H. Wt. of Mold	H.	4279.000	4279.000	4279.000	4279.000		
I. Wt. of Soil (g. or lbs.)	G-H	1604.000	1697.000	1703.000	1639.000	0.000	0.000
J. Wt of Soil (Lbs.)	I/453.6 or I	3.536	3.741	3.754	3.613	0.000	0.000
K. Mold Volume Factor	K.	29.97	29.97	29.97	29.97		
L. Wet Density	J*K	106.0	112.1	112.5	108.3	0.0	0.0
M. Dry Density	L/(1+F)	**88.6**	**89.7**	**87.8**	**81.3**	**#DIV/0!**	**#DIV/0!**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (ASTM 1978) ☐ AASHTO Method D ☐

Moisture-Density Relation of: Fine Fraction ☒ Corrected for Coarse Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

Soil Plasticity: ASTM D 4318 ☐ AASHTO T 89 ☐ AASHTO T 90 ☐
Sieve Analysis / Particle Size Analysis: ASTM C136 ☐ AASHTO T 27 ☐ ASTM D 422 ☐ AASHTO T 88 ☐
Specific Gravity of Soil: ASTM D 854 ☐ AASHTO T 100 ☐
Bulk Gravity of Oversize Fraction: ASTM C 127 ☐ AASHTO T 85 ☐
Soil Classification: ASTM D 2487 ☐ ASTM D 2488 ☐ AASHTO M 145 ☐

Technician Name / Certification #: Matthew Johnson
Technical Responsibility: Julie Peterson

Moisture - Density Report

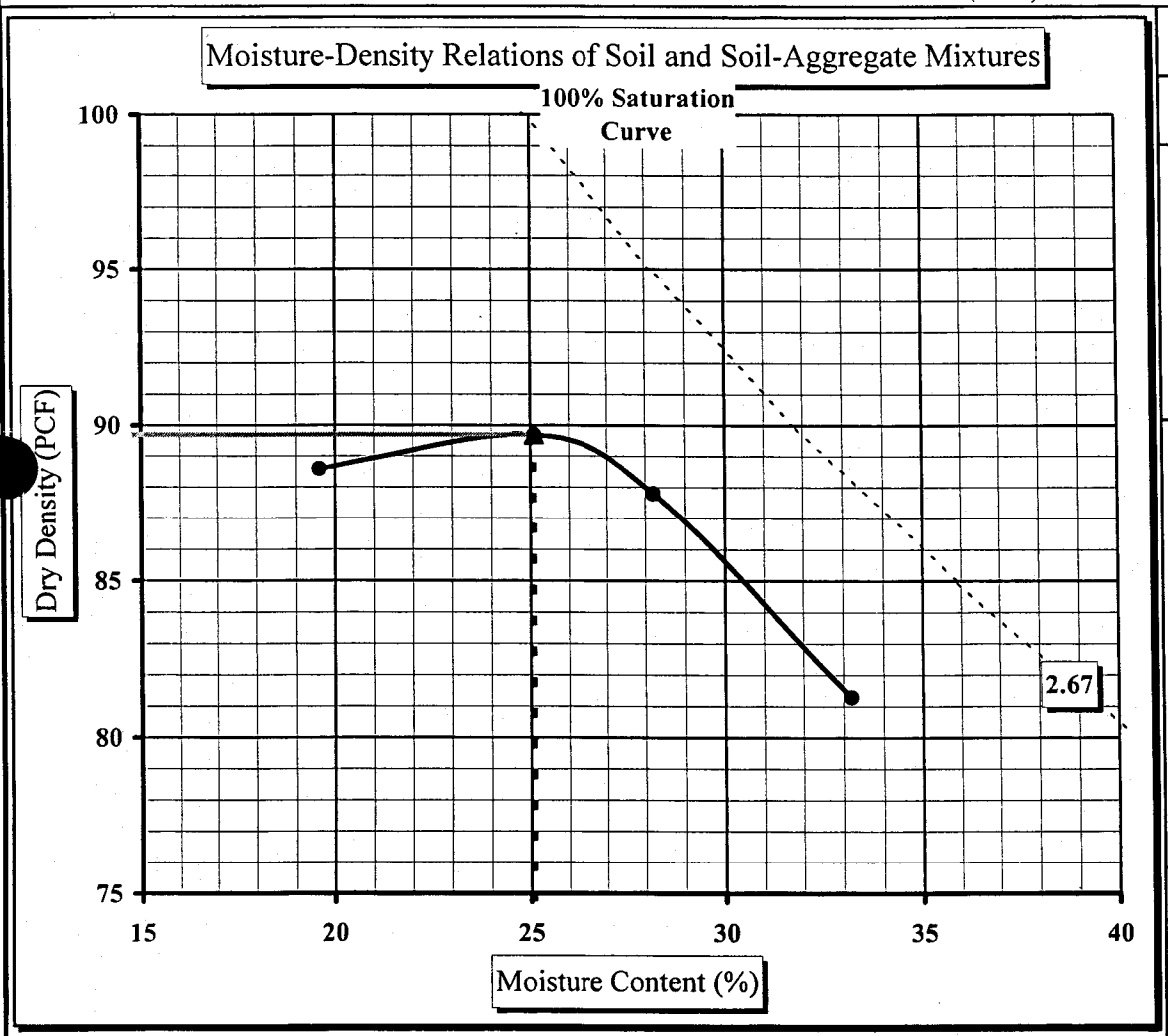
S&ME

S&ME Project #: **1264-02-578** Report Date: February 11, 2003
Project Name: **Marshall Steam Station** Test Date(s): February 10, 2003
Client Name:
Client Address:

Boring #: B-2 Sample #: BAG Sample Date: 2/4/2003
Location: Offset: Depth: 0-10'
Sample Description: TANNISH RED MICACEOUS CLAYEY SILT

Maximum Dry Density **89.7** **PCF.** **Optimum Moisture Content** **25.1** **%**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (1978) ☐ AASHTO Method D ☐



Soil Properties	
Natural Moisture Content	
Liquid Limit:	56
Plastic Limit:	41
Plastic Index:	15
Specific Gravity:	2.670

% Passing
3/4"
1/2"
3/8"
#4
#10
#40
#60
#200

Oversize Fraction
Bulk Sp. Gravity
% Moisture
Oversize Fraction

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

References: ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Technical Responsibility: Julie Peterson 0

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/27/2003

Sample Name: B-2 BULK

Sample Description: TANNISH RED MICA. CLAYEY SILT

Type of Sample: REMOLDED

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.297	Tare No.	S-9	γ_{wet} (pcf)	109.1		Panel No	3
L (cm)	7.62	WWS+ Tare (gm)	402.96	γ_{dry} (pcf)	85.2		Cell P (psi)	83.5
A (cm^2)	41.82	WDS+Tare (gm)	331.82	w (%)	28.1		Soil P (psi)	81.0
V (cm^3)	318.66	WT of Water (gm)	71.14	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	560.3	WT of TARE (gm)	82.7	γ_{wet} (pcf)	109.8		Gs	2.67
		WT Dry Soil (gm)	249.12	γ_{dry} (pcf)	85.4		n	0.44
		w (%)	28.6	w (%)	28.6			

K = (Q x L) / (t x H x A)

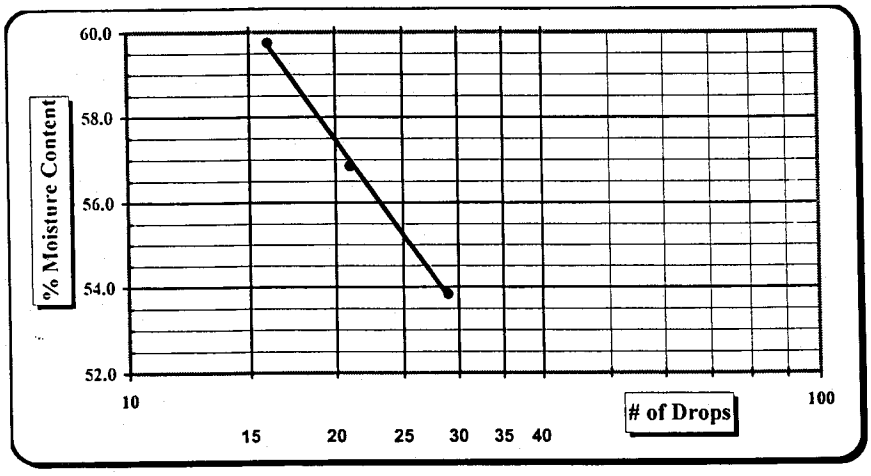
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		13	31		15.5	0.3	24.5				
	21	17	25	14040	15.5	21.3	2.0	21.8	70.4	0.9760	3.91E-06
2		8	50		15.6	0.3	23.7				
	21	13	15	15900	15.6	20.6	2.5	20.8	70.4	0.9760	3.30E-06
3		13	16		15.6	0.0	24.0				
	21	16	59	13380	15.6	20.0	4.0	20.0	70.4	0.9760	3.78E-06
4		11	23		15.6	0.4	24.5				
	21	15	25	14520	15.7	21.7	1.8	22.0	70.4	0.9760	3.83E-06
5		11	3		15.7	0.2	24.2				
	21	15	27	15840	15.7	23.4	0.8	23.3	70.4	0.9760	3.72E-06
7										AVG. K	3.66E-06
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	February 28, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-3	Sample #: S-4	Sample Depth: 18.5-20'
Sample Description:	REDDISH TAN M-F SANDY CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	QQ	SMS	FF				ST	PO	
A	Tare Weight	16.87	15.15	16.86				15.52	15.13	
B	Wet Soil Weight + A	25.90	25.00	25.95				22.31	21.62	
C	Dry Soil Weight + A	22.74	21.43	22.55				20.22	19.63	
D	Water Weight (B-C)	3.16	3.57	3.40				2.09	1.99	
E	Dry Soil Weight (C-A)	5.87	6.28	5.69				4.70	4.50	
F	% Moisture Content (D/E)*100	53.8%	56.8%	59.8%				44.5%	44.2%	
N	# OF DROPS	29	21	16						
Ave.	Average	56.8%						44.3%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	55
Plastic Limit	49
Plastic Index	11
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 1, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	February 28, 2003
Client Name:	Duke Energy		
Boring #:	B-3	Sample #: S-4	Sample Depth: 18.5 - 20 ft
Sample Description:	Reddish Tan Medium to Fine Sandy Clayey Silt		

VOL. FLASK NO.	26	VOL. FLASK NO.	56	VOL. FLASK NO.	
WT. OF SOIL & VOL. FLASK	101.08	WT. OF SOIL & VOL. FLASK	99.32	WT. OF SOIL & VOL. FLASK	
WT. OF VOL. FLASK	70.51	WT. OF VOL. FLASK	68.68	WT. OF VOL. FLASK	
A. WT. OF SOIL	30.57	A. WT. OF SOIL	30.64	A. WT. OF SOIL	
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	170.24	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.46	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	
C. WT. OF VOL. FLASK, SOIL & WATER	189.45	C. WT. OF VOL. FLASK, SOIL & WATER	187.49	C. WT. OF VOL. FLASK, SOIL & WATER	
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.69	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.64	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	26
G_s = D x K	2.69
FLASK NO.	56
G_s = D x K	2.64
FLASK NO.	
G_s = D x K	
G_s (ave) =	2.66

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-4
Elev. or Depth: 18.5-20' **Sample Length (in./cm.):**
Location: B-3
Description: REDDISH TAN M-F SANDY CLAYEY SILT
Liquid Limit: 55 **Plastic Limit:** 44
USCS Classification: MH **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	152.56
Tare =	0.00
Dry sample weight =	152.56

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 20	0.41	99.2
# 40	1.62	96.8
# 60	3.58	92.8
# 100	7.07	85.9
# 200	14.17	71.7

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 26.40
Dry weight & tare = 26.03
Tare = 15.52
Hygroscopic moisture= 3.5 %
Calculated biased weight= 48.30
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.67
Specific gravity correction factor= 0.995
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

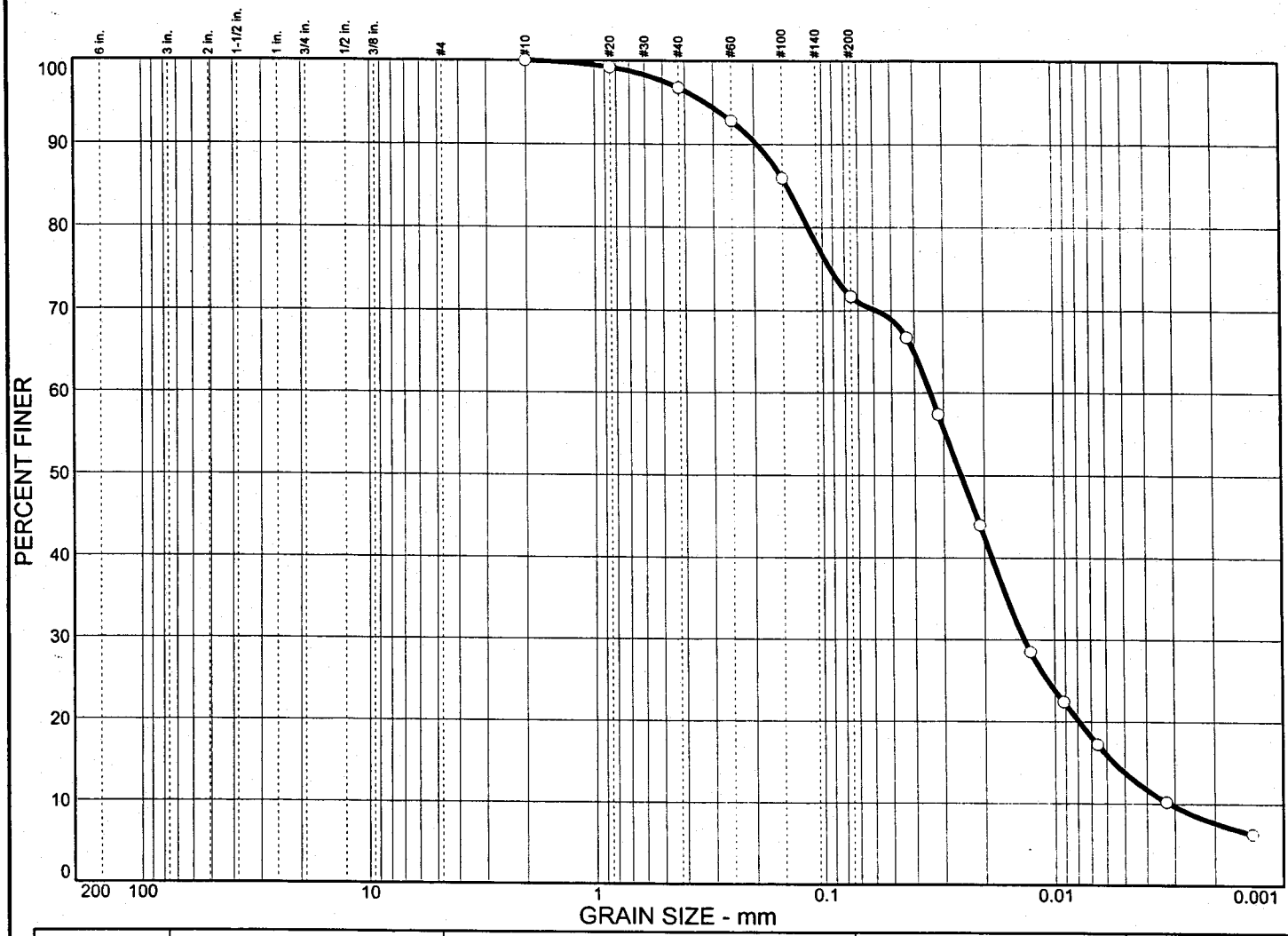
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	37.5	32.4	0.0136	38.5	10.0	0.0431	66.7
2.00	19.5	33.0	27.9	0.0136	34.0	10.7	0.0316	57.4
5.00	19.5	26.5	21.4	0.0136	27.5	11.8	0.0210	44.0
15.00	19.5	19.0	13.9	0.0136	20.0	13.0	0.0127	28.5
30.00	19.5	16.0	10.9	0.0136	17.0	13.5	0.0092	22.4
60.00	19.5	13.5	8.4	0.0136	14.5	13.9	0.0066	17.2
250.00	20.0	10.0	5.0	0.0136	11.0	14.5	0.0033	10.2
1440.00	20.5	8.0	3.1	0.0135	9.0	14.8	0.0014	6.3

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 28.3
% SILT = 57.9 **% CLAY =** 13.8

D_{85}= 0.14 D_{60}= 0.03 D_{50}= 0.03
D_{30}= 0.01 D_{15}= 0.01 D_{10}= 0.00
C_c= 1.6844 C_u= 10.7806

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	28.3	57.9	13.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	55	44	0.143	0.0341	0.0252	0.0135	0.0056	0.0032	1.68	10.78

MATERIAL DESCRIPTION	USCS	AASHTO
○ REDDISH TAN M-F SANDY CLAYEY SILT	MH	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-3

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

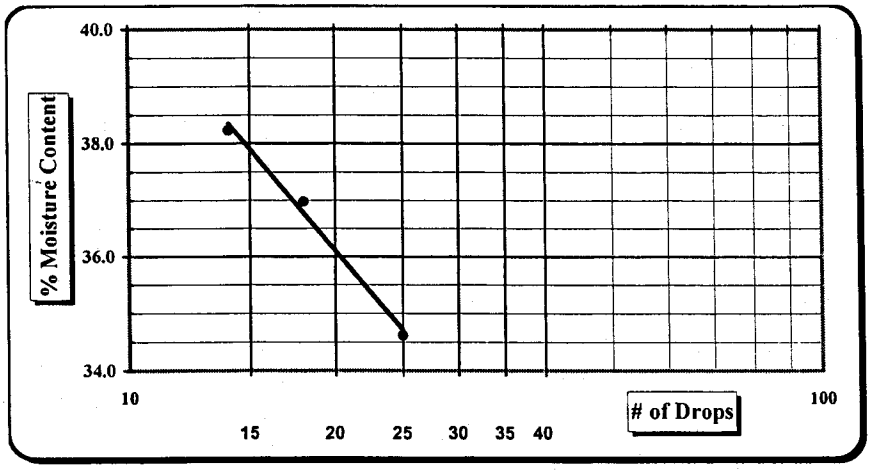
SAMPLE S-4,B-3

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-3	Sample #: S14-S15	Sample Depth: 68.5-75'
Sample Description:	TANNISH BROWN MICA. SL. CLAYEY SILTY M-F SAND W/ROCK FRAGMENTS		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	DC	TAT	OU				180	VCR	
A	Tare Weight	15.59	15.30	16.33				15.43	15.19	
B	Wet Soil Weight + A	27.80	26.08	26.78				21.91	22.22	
C	Dry Soil Weight + A	24.66	23.17	23.89				20.31	20.44	
D	Water Weight (B-C)	3.14	2.91	2.89				1.60	1.78	
E	Dry Soil Weight (C-A)	9.07	7.87	7.56				4.88	5.25	
F	% Moisture Content (D/E)*100	34.6%	37.0%	38.2%				32.8%	33.9%	
N	# OF DROPS	25	18	14						
Ave.	Average	36.6%						33.3%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	35
Plastic Limit	33
Plastic Index	2
Group Symbol	ML

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072 Report Date: March 3, 2003
Project Name: Marshall Steam Station - Beneficial Fill Test Dates(s): March 1, 2003
Client Name: Duke Energy
Boring #: B-3 Sample #: S-14 - 15 Sample Depth: 68.5 - 75 ft
Sample Description: Tannish Brown Micaceous Slightly Clayey Silty Medium to Fine Sand with Rock Fragments

VOL. FLASK NO.	33	VOL. FLASK NO.	69	VOL. FLASK NO.	67
WT. OF SOIL & VOL. FLASK	100.8	WT. OF SOIL & VOL. FLASK	100.61	WT. OF SOIL & VOL. FLASK	100.54
WT. OF VOL. FLASK	70.05	WT. OF VOL. FLASK	70.36	WT. OF VOL. FLASK	69.84
A. WT. OF SOIL	30.75	A. WT. OF SOIL	30.25	A. WT. OF SOIL	30.7
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.77	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	170.01	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.56
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	189.24	C. WT. OF VOL. FLASK, SOIL & WATER	189.66	C. WT. OF VOL. FLASK, SOIL & WATER	189.15
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.73	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.85	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.76

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	33
G_s = D x K	2.72
FLASK NO.	69
G_s = D x K	2.85
FLASK NO.	67
G_s = D x K	2.76
G_s (ave) =	2.78

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S14-15
Elev. or Depth: 68.5-75'
Sample Length (in./cm.):
Location: B-3
Description: TANNISH BROWN MICACEOUS SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS
Liquid Limit: 35
Plastic Limit: 33
USCS Classification: SM
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	303.91
Tare =	0.00
Dry sample weight =	303.91

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	1.10	99.6
# 10	13.20	95.7
# 20	3.18	89.6
# 40	6.27	83.7
# 60	11.16	74.3
# 100	19.41	58.5
# 200	30.64	37.1

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 95.7
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 27.89
Dry weight & tare = 27.72
Tare = 15.94
Hygroscopic moisture= 1.4 %
Calculated biased weight= 51.50
Automatic temperature correction
Composite correction at 20 deg C = -6

Meniscus correction only= 1
Specific gravity of solids= 2.74
Specific gravity correction factor= 0.980
Hydrometer type: 152H

Effective depth L= 16.294964 - 0.164 x Rm

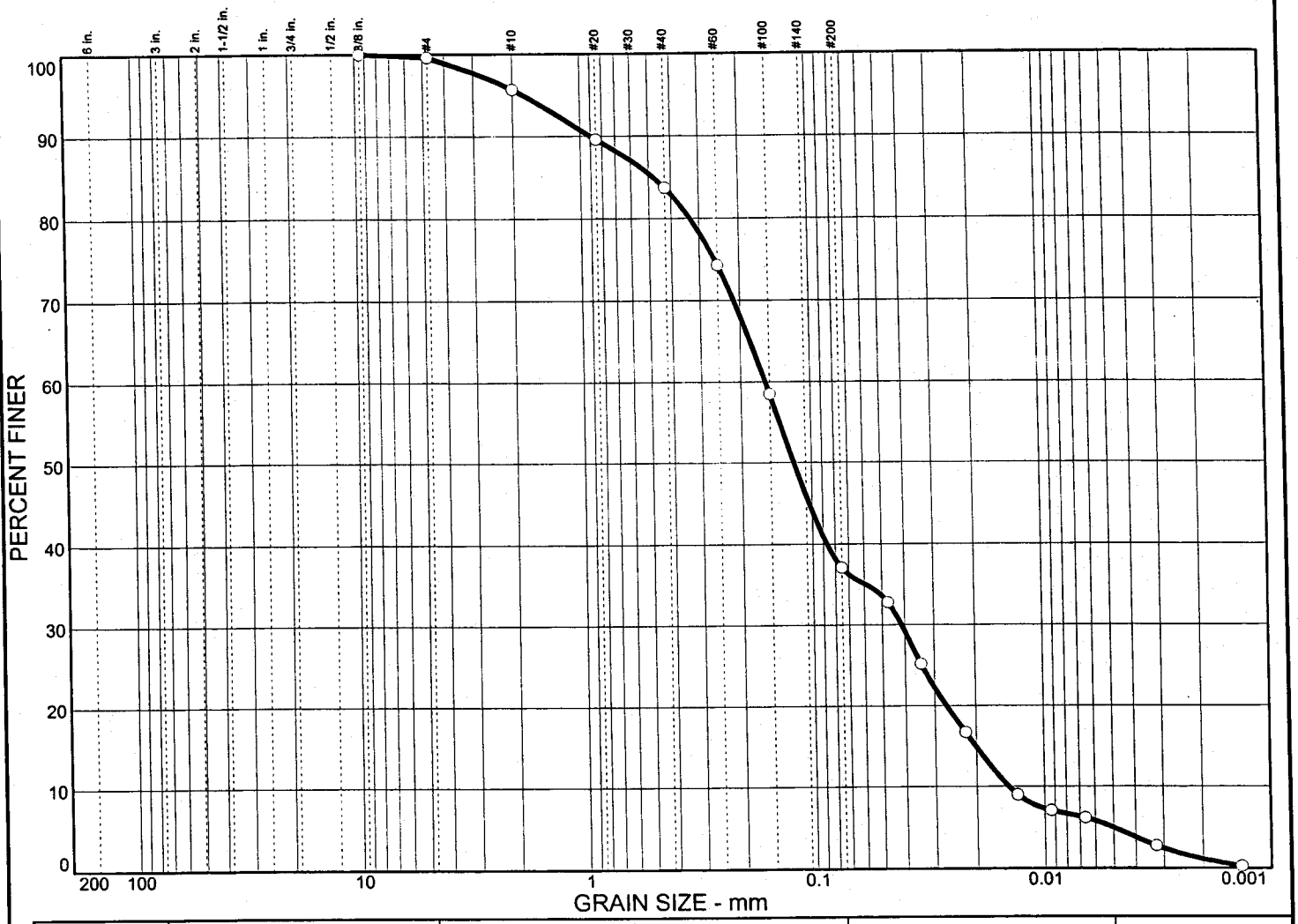
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	23.5	17.3	0.0135	24.5	12.3	0.0471	32.8
2.00	19.0	19.5	13.3	0.0135	20.5	12.9	0.0342	25.2
5.00	19.0	15.0	8.8	0.0135	16.0	13.7	0.0222	16.7
15.00	19.0	11.0	4.8	0.0135	12.0	14.3	0.0132	9.0
30.00	19.0	10.0	3.8	0.0135	11.0	14.5	0.0094	7.1
60.00	19.0	9.5	3.3	0.0135	10.5	14.6	0.0066	6.2
250.00	20.0	7.5	1.5	0.0133	8.5	14.9	0.0032	2.8
1440.00	21.0	6.0	0.2	0.0131	7.0	15.1	0.0013	0.3

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = % GRAVEL = 0.4 % SAND = 62.5
% SILT = 32.1 % CLAY = 5.0

D_{85}= 0.48 D_{60}= 0.16 D_{50}= 0.12
D_{30}= 0.04 D_{15}= 0.02 D_{10}= 0.01
C_C= 0.7539 C_u= 10.8341

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.4	62.5	32.1	5.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	35	33	0.477	0.156	0.119	0.0413	0.0202	0.0144	0.75	10.83

MATERIAL DESCRIPTION	USCS	AASHTO
○ TANNISH BROWN MICACEOUS SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-3

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

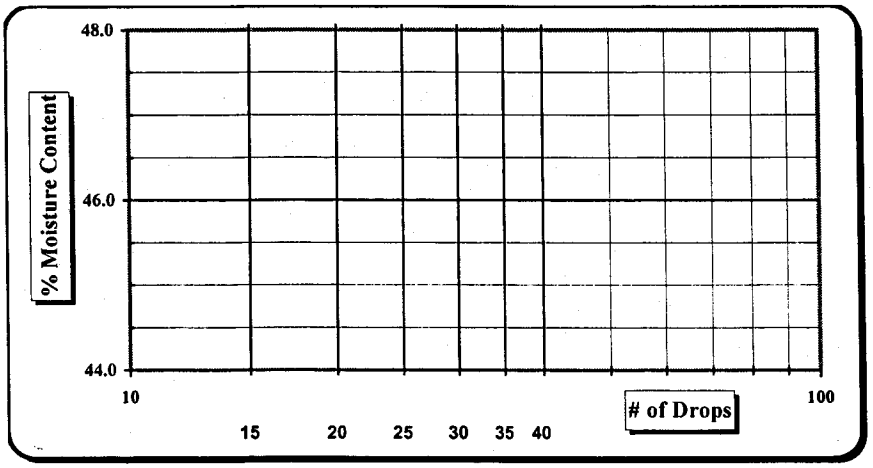
SAMPLE S14-15,B-3

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 27, 2003
Client Name:			
Boring #:	B-3	Sample #: U.D.	Sample Depth: 50-52'
Sample Description:	TANNISH BROWN MICA. SL. CLAYEY SILTY M-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	
Plastic Limit	
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072
Project Name: Marshall Steam Station - Beneficial Fill
Client Name: Duke Energy
Boring #: B-3 Sample #: UD
Sample Description: Tannish Brown Micaceous Slightly Clayey Silty Medium to Fine Sand

Report Date: March 1, 2003
Test Dates(s): February 27, 2003
Sample Depth: 50 - 52 ft

VOL. FLASK NO.	70	VOL. FLASK NO.	35	VOL. FLASK NO.	37
WT. OF SOIL & VOL. FLASK	98.24	WT. OF SOIL & VOL. FLASK	101.5	WT. OF SOIL & VOL. FLASK	99.97
WT. OF VOL. FLASK	67.88	WT. OF VOL. FLASK	71.06	WT. OF VOL. FLASK	69.65
A. WT. OF SOIL	30.36	A. WT. OF SOIL	30.44	A. WT. OF SOIL	30.32
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	167.63	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	170.77	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.4
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	187.17	C. WT. OF VOL. FLASK, SOIL & WATER	190.16	C. WT. OF VOL. FLASK, SOIL & WATER	188.73
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.81	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.75	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.76

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	70
G_s = D x K	2.80
FLASK NO.	35
G_s = D x K	2.75
FLASK NO.	37
G_s = D x K	2.76
G_s (ave) =	2.77

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: U.D
Elev. or Depth: 50-52' Sample Length (in./cm.):
Location: B-3
Description: TANNISH BROWN MICACEOUS SL.CLAYEY SILTY M-F SAND
Liquid Limit: NP Plastic Limit: NP
USCS Classification: SM AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	168.20
Tare =	0.00
Dry sample weight =	168.20

Sample split on number 10 sieve
Split sample data:
Sample and tare = 100.00 Tare = .00 Sample weight = 100.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 20	3.18	96.8
# 40	11.46	88.5
# 60	29.61	70.4
# 100	49.98	50.0
# 200	73.50	26.5

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 100.00
Hygroscopic moisture correction:
Moist weight & tare = 29.22
Dry weight & tare = 28.95
Tare = 16.88
Hygroscopic moisture= 2.2 %
Calculated biased weight= 97.81
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.77
Specific gravity correction factor= 0.974
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

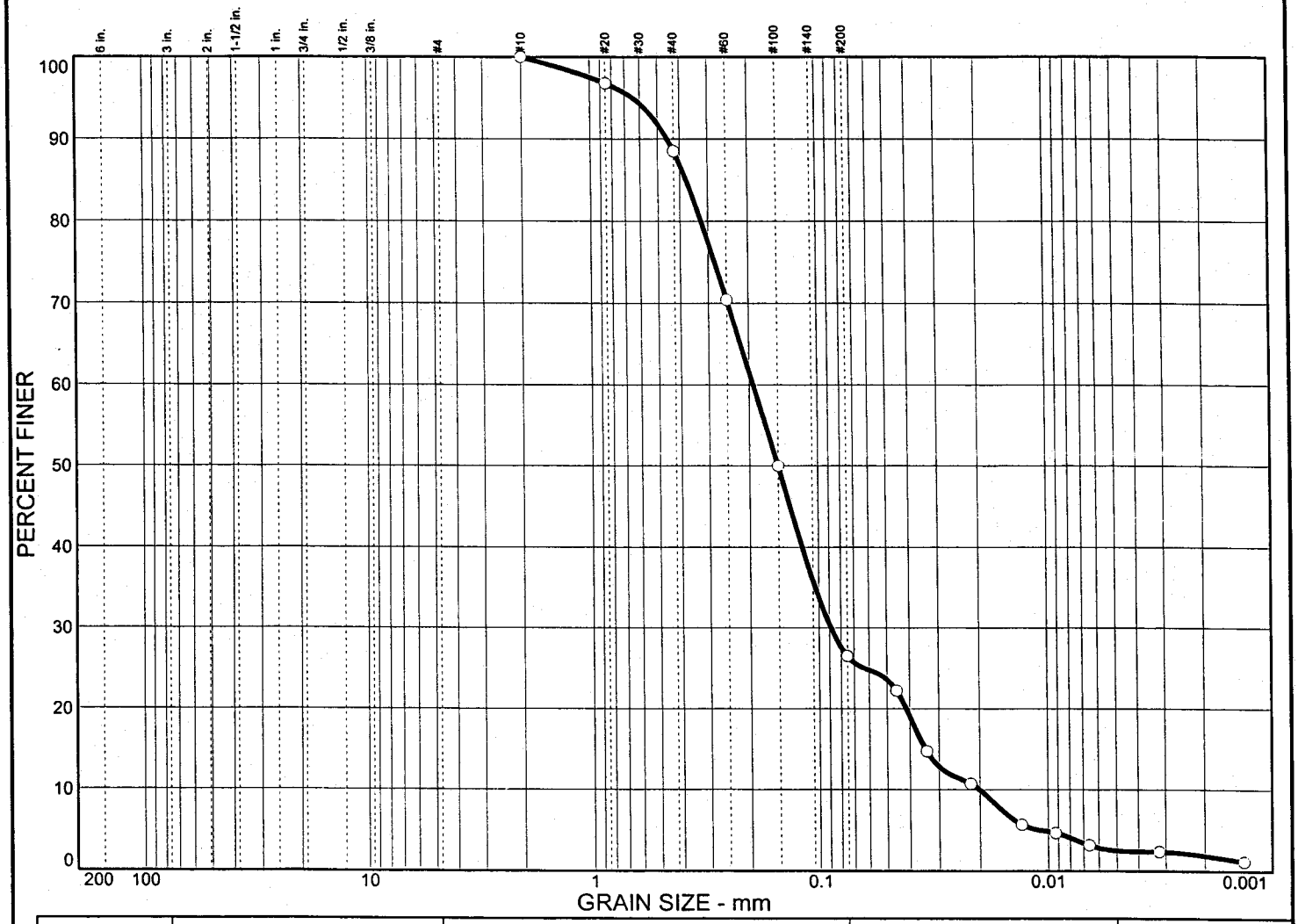
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	27.5	22.3	0.0133	28.5	11.6	0.0455	22.2
2.00	19.0	20.0	14.8	0.0133	21.0	12.9	0.0338	14.7
5.00	19.0	16.0	10.8	0.0133	17.0	13.5	0.0219	10.7
15.00	19.0	11.0	5.8	0.0133	12.0	14.3	0.0130	5.7
30.00	19.0	10.0	4.8	0.0133	11.0	14.5	0.0093	4.7
60.00	19.0	8.5	3.3	0.0133	9.5	14.7	0.0066	3.2
250.00	20.0	7.5	2.5	0.0132	8.5	14.9	0.0032	2.4
1440.00	21.0	6.0	1.2	0.0130	7.0	15.1	0.0013	1.2

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 73.5
% SILT = 24.0 **% CLAY =** 2.5

D_{85}= 0.37 D_{60}= 0.19 D_{50}= 0.15
D_{30}= 0.09 D_{15}= 0.03 D_{10}= 0.02
C_c= 2.0262 C_u= 9.519

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	73.5	24.0	2.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.375	0.192	0.150	0.0885	0.0343	0.0201	2.03	9.52

MATERIAL DESCRIPTION	USCS	AASHTO
○ TANNISH BROWN MICACEOUS SL.CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-3

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE B-3 U.D.

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/25/2003

Sample Name: B-3 U.D. (50-52')

Sample Description: TANNISH BROWN SL. CLAYEY SILTY M-F SAND (MICA)

Type of Sample: UNDISTURBED (10 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.3	Tare No.	T-1	γ_{wet} (pcf)	0.0		Panel No	12
L (cm)	9.368	WWS+ Tare (gm)	413.4	γ_{dry} (pcf)			Cell P (psi)	91.0
A (cm^2)	41.85	WDS+Tare (gm)	343.8	w (%)			Soil P (psi)	81.0
V (cm^3)	392.09	WT of Water (gm)	69.6	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	793.9	WT of TARE (gm)	83.16	γ_{wet} (pcf)	126.4		Gs	2.77
		WT Dry Soil (gm)	260.64	γ_{dry} (pcf)	99.8		n	0.56
		w (%)	26.7	w (%)	26.7			

$K = (Q \times L) / (t \times H \times A)$

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		11	2		10.3	0.3	24.2				
	21	11	12	600	10.3	24.2	0.2	24.0	70.4	0.9760	1.24E-04
2		11	17		10.3	0.0	24.5				
	21	11	27	600	10.4	24.1	0.2	24.2	70.4	0.9760	1.25E-04
3		13	58		10.4	0.0	24.3				
	21	14	8	600	10.4	24.2	0.1	24.2	70.4	0.9760	1.25E-04
4		14	10		10.4	0.3	24.3				
	21	14	20	600	10.4	23.5	0.8	23.4	70.4	0.9760	1.21E-04
5		14	21		10.4	0.1	24.9				
	21	14	31	600	10.4	23.4	0.4	23.9	70.4	0.9760	1.24E-04
7										AVG. K	1.24E-04
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/26/2003

Sample Name: B-3 U.D. (50-52')

Sample Description: TANNISH BROWN SL. CLAYEY SILTY M-F SAND (MICA)

Type of Sample: UNDISTURBED (20 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.3	Tare No.	T-1	γ_{wet} (pcf)	0.0		Panel No	12
L (cm)	9.368	WWS+ Tare (gm)	413.4	γ_{dry} (pcf)			Cell P (psi)	102.0
A (cm^2)	41.85	WDS+Tare (gm)	343.8	w (%)			Soil P (psi)	82.0
V (cm^3)	392.09	WT of Water (gm)	69.6	Actual Molding Condition			Back P (psi)	81.0
WWS (gm)	793.9	WT of TARE (gm)	83.16	γ_{wet} (pcf)	126.4		Gs	2.77
		WT Dry Soil (gm)	260.64	γ_{dry} (pcf)	99.8		n	0.56
		w (%)	26.7	w (%)	26.7			

$K = (Q \times L) / (t \times H \times A)$

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		0	0		10.6	0.1	24.1				
	21	0	13	780	10.6	23.6	0.2	23.7	70.4	0.9760	9.43E-05
2		9	17		10.6	0.1	24.1				
	21	9	30	780	10.6	23.8	0.3	23.8	70.4	0.9760	9.45E-05
3		9	32		10.6	0.2	24.9				
	21	9	44	720	10.7	22.5	2.2	22.5	70.4	0.9760	9.70E-05
4		9	45		10.7	0.0	24.5				
	21	9	58	780	10.7	24.1	0.0	24.3	70.4	0.9760	9.67E-05
5		10	30		10.8	0.2	24.3				
	21	10	43	780	10.8	24.0	0.2	24.0	70.4	0.9760	9.53E-05
7										AVG. K	9.59E-05
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 Project Name: MARSHALL STEAM STATION 3/12/2003

Sample Name: B-3 U.D. (50-52')

Sample Description: TANNISH BROWN SL. CLAYEY SILTY M-F SAND (MICA)

Type of Sample: UNDISTURBED (30 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.3	Tare No.	T-1	γ_{wet} (pcf)	0.0		Panel No	12
L (cm)	9.368	WWS+ Tare (gm)	413.4	γ_{dry} (pcf)			Cell P (psi)	113.0
A (cm^2)	41.85	WDS+Tare (gm)	343.8	w (%)			Soil P (psi)	83.0
V (cm^3)	392.09	WT of Water (gm)	69.6	Actual Molding Condition			Back P (psi)	82.0
WWS (gm)	793.9	WT of TARE (gm)	83.16	γ_{wet} (pcf)	126.4		Gs	2.77
		WT Dry Soil (gm)	260.64	γ_{dry} (pcf)	99.8		n	0.56
		w (%)	26.7	w (%)	26.7			

$K = (Q \times L) / (t \times H \times A)$

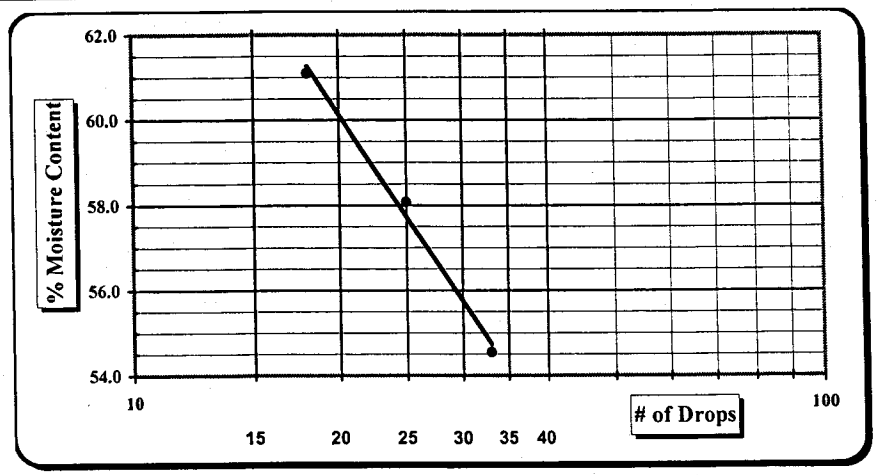
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		14	15		10.3	0.0	24.2				
	21	14	29	840	10.3	23.9	0.2	24.0	70.4	0.9760	8.85E-05
2		14	34		10.3	0.1	24.5				
	21	14	48	840	10.3	24.5	0.1	24.4	70.4	0.9760	9.02E-05
3		15	4		10.3	0.0	24.6				
	21	15	18	840	10.3	24.0	0.3	24.2	70.4	0.9760	8.92E-05
4		15	39		10.4	0.2	24.3				
	21	15	53	840	10.4	24.0	0.4	23.9	70.4	0.9760	8.81E-05
5		15	54		10.4	0.2	24.5				
	21	16	8	840	10.4	24.0	0.4	24.0	70.4	0.9760	8.85E-05
7										AVG. K	8.90E-05
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	February 28, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-3	Sample #: BAG	Sample Depth: 10'
Sample Description:	TANNISH RED SANDY CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	NN	LL	TES				DAFFY	FE	
A	Tare Weight	15.30	16.95	14.52				14.63	15.19	
B	Wet Soil Weight + A	22.95	25.17	23.59				21.61	21.89	
C	Dry Soil Weight + A	20.25	22.15	20.15				19.76	20.14	
D	Water Weight (B-C)	2.70	3.02	3.44				1.85	1.75	
E	Dry Soil Weight (C-A)	4.95	5.20	5.63				5.13	4.95	
F	% Moisture Content (D/E)*100	54.5%	58.1%	61.1%				36.1%	35.4%	
N	# OF DROPS	33	25	18						
Ave.	Average	57.9%						35.7%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve 2.2

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	58
Plastic Limit	36
Plastic Index	22
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 1, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	February 28, 2003
Client Name:	Duke Energy		
Boring #:	B-3	Sample #: Bag Sample	Sample Depth: 10 ft
Sample Description:	Tannish Red Sandy Clayey Silt		

VOL. FLASK NO.	36	VOL. FLASK NO.	53	VOL. FLASK NO.	71
WT. OF SOIL & VOL. FLASK	100.92	WT. OF SOIL & VOL. FLASK	96.75	WT. OF SOIL & VOL. FLASK	100.32
WT. OF VOL. FLASK	70.61	WT. OF VOL. FLASK	66.37	WT. OF VOL. FLASK	69.83
A. WT. OF SOIL	30.31	A. WT. OF SOIL	30.38	A. WT. OF SOIL	30.49
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	170.24	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	166.08	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.45
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	189.23	C. WT. OF VOL. FLASK, SOIL & WATER	185.08	C. WT. OF VOL. FLASK, SOIL & WATER	188.67
D. SPECIFIC GRAVITY $\frac{A}{A+(B-C)}$	2.68	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.67	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.71

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	36
G_s = D x K	2.68
FLASK NO.	53
G_s = D x K	2.67
FLASK NO.	71
G_s = D x K	2.70
G_s (ave) =	2.68

Technician Name: Karen Warner

S&ME Moisture - Density Relationship

Test Date(s): February 11, 2003
Report Date: February 12, 2003

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:
Boring #: B-3 Sample #: BAG Sample Date: February 4, 2003
Location: Offset: Depth: 0-10'
Sample Description: TANNISH RED SANDY CLAYEY SILT

Liquid Limit: 58 Specific Gravity: 2.680
Plastic Limit: 36 Plastic Index: 22

Natural Moisture Content (Total Sample):
Moisture Content of the Oversize Fraction:

NOTES:

Sieve Size	% Passing
3/4"	
1/2"	
3/8"	
#4	
#10	
#40	
#60	
#200	

MDD: 92.4 **Opt. MC %: 27.3**

Water Content

Water Content requires GP 2 Balance (0.1 gram Readability).

ASTM D2216 ☒ AASHTO T265 ☐ ASTM D4959 ☐ ASTM D4643 ☐

	Sample #:						
	Water Added:	0	65	135	210		
	Tare #:	997	536	AICS	RAHIM		
A. Tare Weight	A.	0	0	0	0		
B. Wet Wt + Tare Wt	B.	500	500	500	500		
C. Dry Wt. + Tare Wt.	C.	407.2	390.1	384.9	372.1		
D. Water Weight	B-C	92.8	109.9	115.1	127.9	0	0
E. Dry Weight	C-A	407.2	390.1	384.9	372.1	0	0
F. Moisture Content	100*D/E	**22.8%**	**28.2%**	**29.9%**	**34.4%**	**#DIV/0!**	**#DIV/0!**

Compaction Data

The Compaction Test requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability).

G. Wt of Soil + Mold	G.	5986.000	6069.000	6065.000	6009.000		
H. Wt. of Mold	H.	4279.000	4279.000	4279.000	4279.000		
I. Wt. of Soil (g. or lbs.)	G-H	1707.000	1790.000	1786.000	1730.000	0.000	0.000
J. Wt of Soil (Lbs.)	I/453.6 or I	3.763	3.946	3.937	3.814	0.000	0.000
K. Mold Volume Factor	K.	29.97	29.97	29.97	29.97		
L. Wet Density	J*K	112.8	118.3	118.0	114.3	0.0	0.0
M. Dry Density	L/(1+F)	**91.9**	**92.3**	**90.8**	**85.1**	**#DIV/0!**	**#DIV/0!**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (ASTM 1978) ☐ AASHTO Method D ☐

Moisture-Density Relation of: Fine Fraction ☒ Corrected for Coarse Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

Soil Plasticity: ASTM D 4318 ☐ AASHTO T 89 ☐ AASHTO T 90 ☐
Sieve Analysis / Particle Size Analysis: ASTM C136 ☐ AASHTO T 27 ☐ ASTM D 422 ☐ AASHTO T 88 ☐
Specific Gravity of Soil: ASTM D 854 ☐ AASHTO T 100 ☐
Bulk Gravity of Oversize Fraction: ASTM C 127 ☐ AASHTO T 85 ☐
Soil Classification: ASTM D 2487 ☐ ASTM D 2488 ☐ AASHTO M 145 ☐

Technician Name / Certification #: Matthew Johnson
Technical Responsibility: Julie Peterson

Moisture - Density Report

S&ME

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:

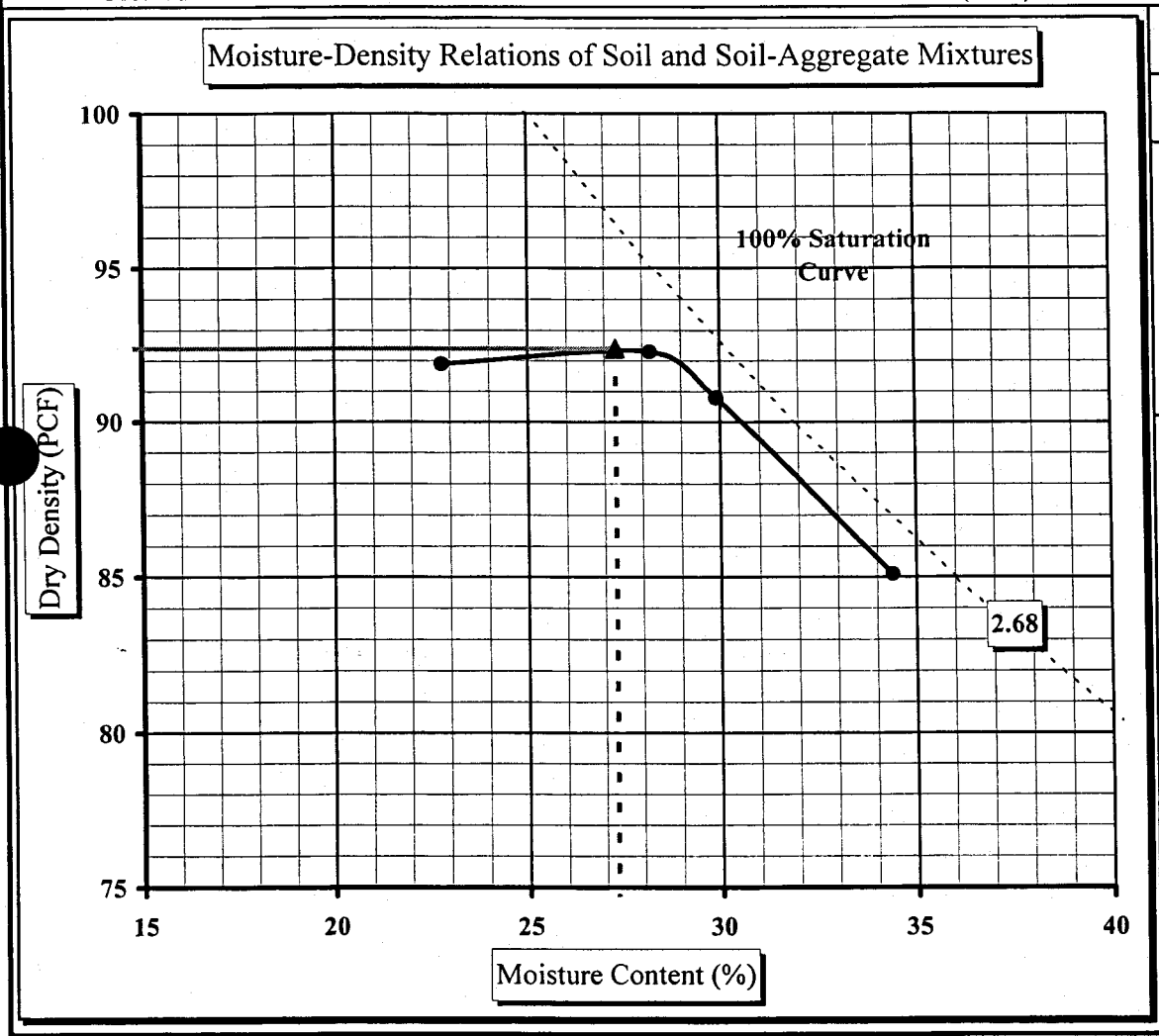
Report Date: February 12, 2003
Test Date(s): February 11, 2003

Boring #:	B-3	Sample #:	BAG	Sample Date:	2/4/2003
Location:		Offset:		Depth:	0-10'

Sample Description: TANNISH RED SANDY CLAYEY SILT

Maximum Dry Density 92.4 **PCF.** **Optimum Moisture Content** 27.3 %

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (1978) ☐ AASHTO Method D ☐



Soil Properties

Natural Moisture Content

Liquid Limit:	58
Plastic Limit:	36
Plastic Index:	22
Specific Gravity:	2.680

% Passing
3/4"
1/2"
3/8"
#4
#10
#40
#60
#200

Oversize Fraction
Bulk Sp. Gravity
% Moisture
Oversize Fraction

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

References: ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

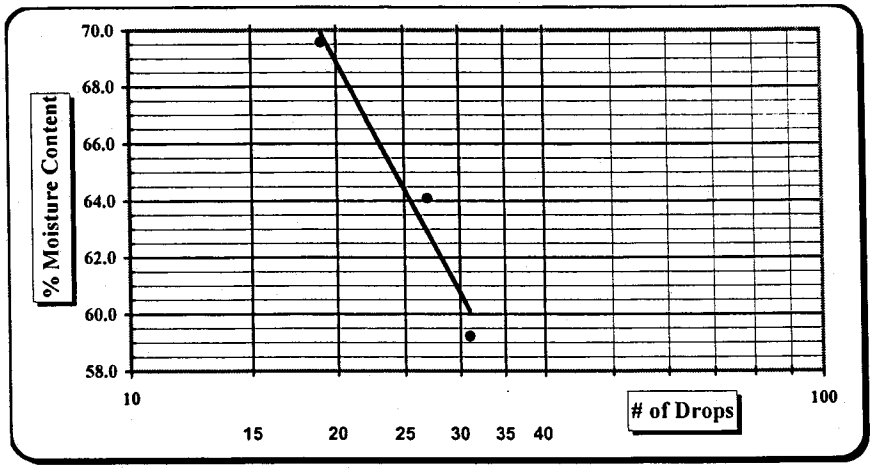
Technical Responsibility: Julie Peterson

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 28, 2003
Client Name:			
Boring #:	B-4	Sample #: S-1	Sample Depth: 3.5-5'
Sample Description:	YELLOWISH RED MICA. M-F SANDY CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	D	OO	TUX				CC	VV	
A	Tare Weight	15.36	16.33	15.69				16.80	16.04	
B	Wet Soil Weight + A	24.50	26.11	24.83				23.18	24.33	
C	Dry Soil Weight + A	21.10	22.29	21.08				21.10	21.65	
D	Water Weight (B-C)	3.40	3.82	3.75				2.08	2.68	
E	Dry Soil Weight (C-A)	5.74	5.96	5.39				4.30	5.61	
F	% Moisture Content (D/E)*100	59.2%	64.1%	69.6%				48.4%	47.8%	
N	# OF DROPS	31	27	19						
Ave.	Average	64.3%						48.1%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	64
Plastic Limit	48
Plastic Index	16
Group Symbol	MH

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-1
Elev. or Depth: 3.5-5'
Sample Length (in./cm.):
Location: B-4
Description: YELLOWISH RED MICACEOUS M-F SANDY CLAYEY SILT
Liquid Limit: 64
Plastic Limit: 48
USCS Classification: MH
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	179.51
Tare =	0.00
Dry sample weight =	179.51

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 20	0.21	99.6
# 40	1.17	97.7
# 60	3.76	92.5
# 100	9.58	80.8
# 200	15.45	69.1

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 28.73
Dry weight & tare = 28.47
Tare = 15.29
Hygroscopic moisture= 2.0 %
Calculated biased weight= 49.03
Automatic temperature correction
Composite correction at 20 deg C = -6

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

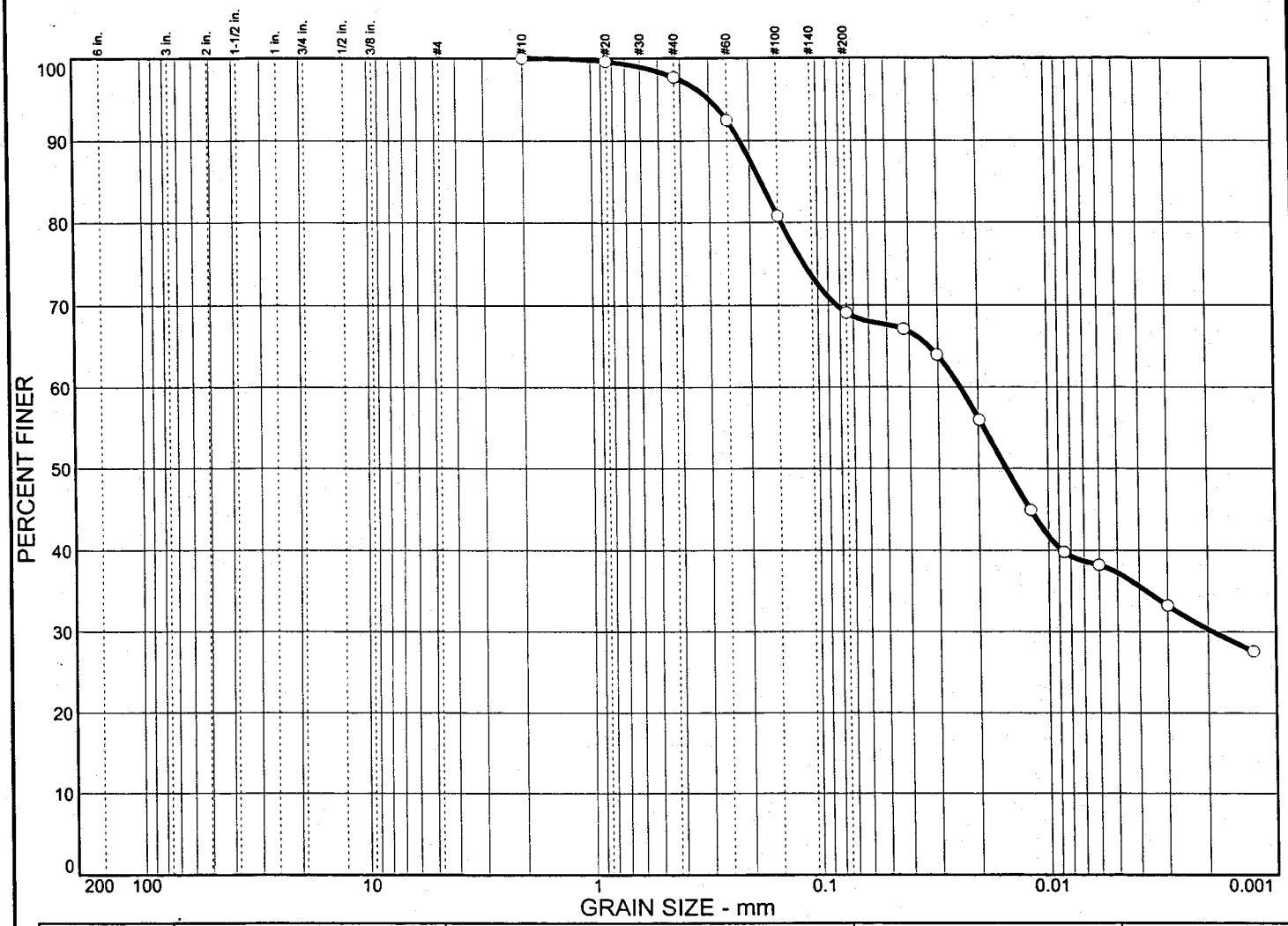
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	39.5	33.3	0.0136	40.5	9.7	0.0423	67.1
2.00	19.0	38.0	31.8	0.0136	39.0	9.9	0.0303	64.0
5.00	19.0	34.0	27.8	0.0136	35.0	10.6	0.0198	56.0
15.00	19.0	28.5	22.3	0.0136	29.5	11.5	0.0119	44.9
30.00	19.0	26.0	19.8	0.0136	27.0	11.9	0.0086	39.8
60.00	20.0	25.0	19.0	0.0134	26.0	12.0	0.0060	38.2
250.00	20.0	22.5	16.5	0.0134	23.5	12.4	0.0030	33.2
1440.00	21.0	19.5	13.7	0.0133	20.5	12.9	0.0013	27.6

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 30.9
% SILT = 31.9 **% CLAY =** 37.2

D_{85}= 0.18 D_{60}= 0.02 D_{50}= 0.02
D_{30}= 0.00

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	30.9	31.9	37.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	64	48	0.178	0.0239	0.0151	0.0019				

MATERIAL DESCRIPTION	USCS	AASHTO
○ YELLOWISH RED MICACEOUS M-F SANDY CLAYEY SILT	MH	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-4

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

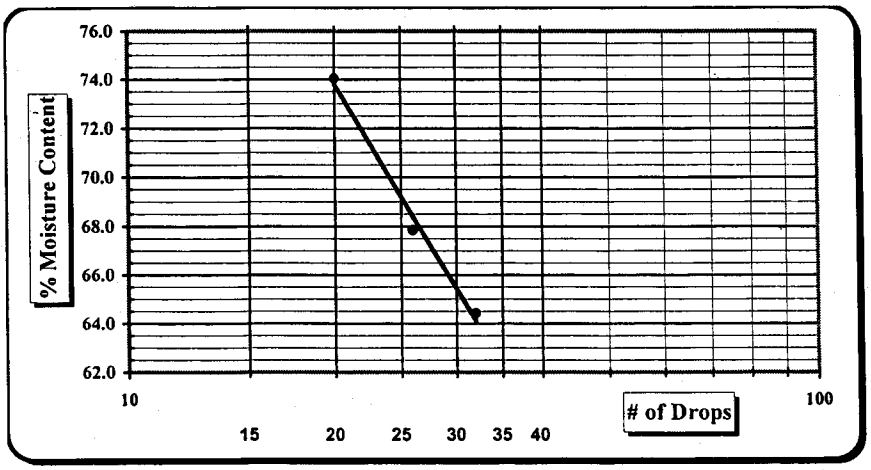
SAMPLE S-1,B-4

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-4	Sample #: BAG	Sample Depth: 10'
Sample Description:	YELLOWISH RED CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	ZY	XX	TS				PP	MM	
A	Tare Weight	15.52	16.09	15.31				16.19	16.58	
B	Wet Soil Weight + A	23.79	24.60	24.43				23.32	24.74	
C	Dry Soil Weight + A	20.55	21.16	20.55				20.99	22.05	
D	Water Weight (B-C)	3.24	3.44	3.88				2.33	2.69	
E	Dry Soil Weight (C-A)	5.03	5.07	5.24				4.80	5.47	
F	% Moisture Content (D/E)*100	64.4%	67.9%	74.0%				48.5%	49.2%	
N	# OF DROPS	32	26	20						
Ave.	Average	68.8%						48.9%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve 1.9

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	69
Plastic Limit	49
Plastic Index	20
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 3, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	March 1, 2003
Client Name:	Duke Energy		
Boring #:	B-4	Sample #: Bag Sample	Sample Depth: 10 ft
Sample Description:	Yellowish Red Clayey Silt		

VOL. FLASK NO.	72	VOL. FLASK NO.	30	VOL. FLASK NO.	68
WT. OF SOIL & VOL. FLASK	100.89	WT. OF SOIL & VOL. FLASK	100.58	WT. OF SOIL & VOL. FLASK	98.68
WT. OF VOL. FLASK	70.4	WT. OF VOL. FLASK	69.95	WT. OF VOL. FLASK	68.27
A. WT. OF SOIL	30.49	A. WT. OF SOIL	30.63	A. WT. OF SOIL	30.41
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	170.12	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.79	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	167.94
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	189.48	C. WT. OF VOL. FLASK, SOIL & WATER	189.23	C. WT. OF VOL. FLASK, SOIL & WATER	187.16
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.74	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.74	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.72

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	72
G_s = D x K	2.74
FLASK NO.	30
G_s = D x K	2.74
FLASK NO.	68
G_s = D x K	2.72
G_s (ave) =	2.73

Technician Name: Karen Warner

S&ME Moisture - Density Relationship

Test Date(s): February 10, 2003
Report Date: February 11, 2003

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:
Boring #: B-4 Sample #: BAG Sample Date: February 4, 2003
Location: Offset: Depth: 0-10'
Sample Description: YELLOWISH RED SANDY MICACEOUS M-F SANDY CLAYEY SILT

Liquid Limit: 69 Specific Gravity: 2.730
Plastic Limit: 49 Plastic Index: 20

Natural Moisture Content (Total Sample):
Moisture Content of the Oversize Fraction:

NOTES:

Sieve Size	% Passing
3/4"	
1/2"	
3/8"	
#4	
#10	
#40	
#60	
#200	

MDD: 88.0 **Opt. MC %: 29.4**

Water Content

Water Content requires GP 2 Balance (0.1 gram Readability).

ASTM D2216 ☒ AASHTO T265 ☐ ASTM D4959 ☐ ASTM D4643 ☐

	Sample #:						
	Water Added:	As Is	65	140	230		
	Tare #:	SEJ	JTJ	535	583		
A. Tare Weight	A.	0	0	0	0		
B. Wet Wt + Tare Wt	B.	500	500	500	500		
C. Dry Wt. + Tare Wt.	C.	392.8	383.7	370.2	358.3		
D. Water Weight	B-C	107.2	116.3	129.8	141.7	0	0
E. Dry Weight	C-A	392.8	383.7	370.2	358.3	0	0
F. Moisture Content	100*D/E	**27.3%**	**30.3%**	**35.1%**	**39.5%**	**#DIV/0!**	**#DIV/0!**

Compaction Data

The Compaction Test requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability).

G. Wt of Soil + Mold	G.	5962.000	6011.000	6005.000	5958.000		
H. Wt. of Mold	H.	4279.000	4279.000	4279.000	4279.000		
I. Wt. of Soil (g. or lbs.)	G-H	1683.000	1732.000	1726.000	1679.000	0.000	0.000
J. Wt of Soil (Lbs.)	I/453.6 or I	3.710	3.818	3.805	3.701	0.000	0.000
K. Mold Volume Factor	K.	29.97	29.97	29.97	29.97		
L. Wet Density	J*K	111.2	114.4	114.0	110.9	0.0	0.0
M. Dry Density	L/(1+F)	**87.4**	**87.8**	**84.4**	**79.5**	**#DIV/0!**	**#DIV/0!**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (ASTM 1978) ☐ AASHTO Method D ☐

Moisture-Density Relation of: Fine Fraction ☒ Corrected for Coarse Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

Soil Plasticity: ASTM D 4318 ☐ AASHTO T 89 ☐ AASHTO T 90 ☐
Sieve Analysis / Particle Size Analysis: ASTM C136 ☐ AASHTO T 27 ☐ ASTM D 422 ☐ AASHTO T 88 ☐
Specific Gravity of Soil: ASTM D 854 ☐ AASHTO T 100 ☐
Bulk Gravity of Oversize Fraction: ASTM C 127 ☐ AASHTO T 85 ☐
Soil Classification: ASTM D 2487 ☐ ASTM D 2488 ☐ AASHTO M 145 ☐

Technician Name / Certification #: Matthew Johnson
Technical Responsibility: Julie Peterson

Moisture - Density Report

S&ME

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:

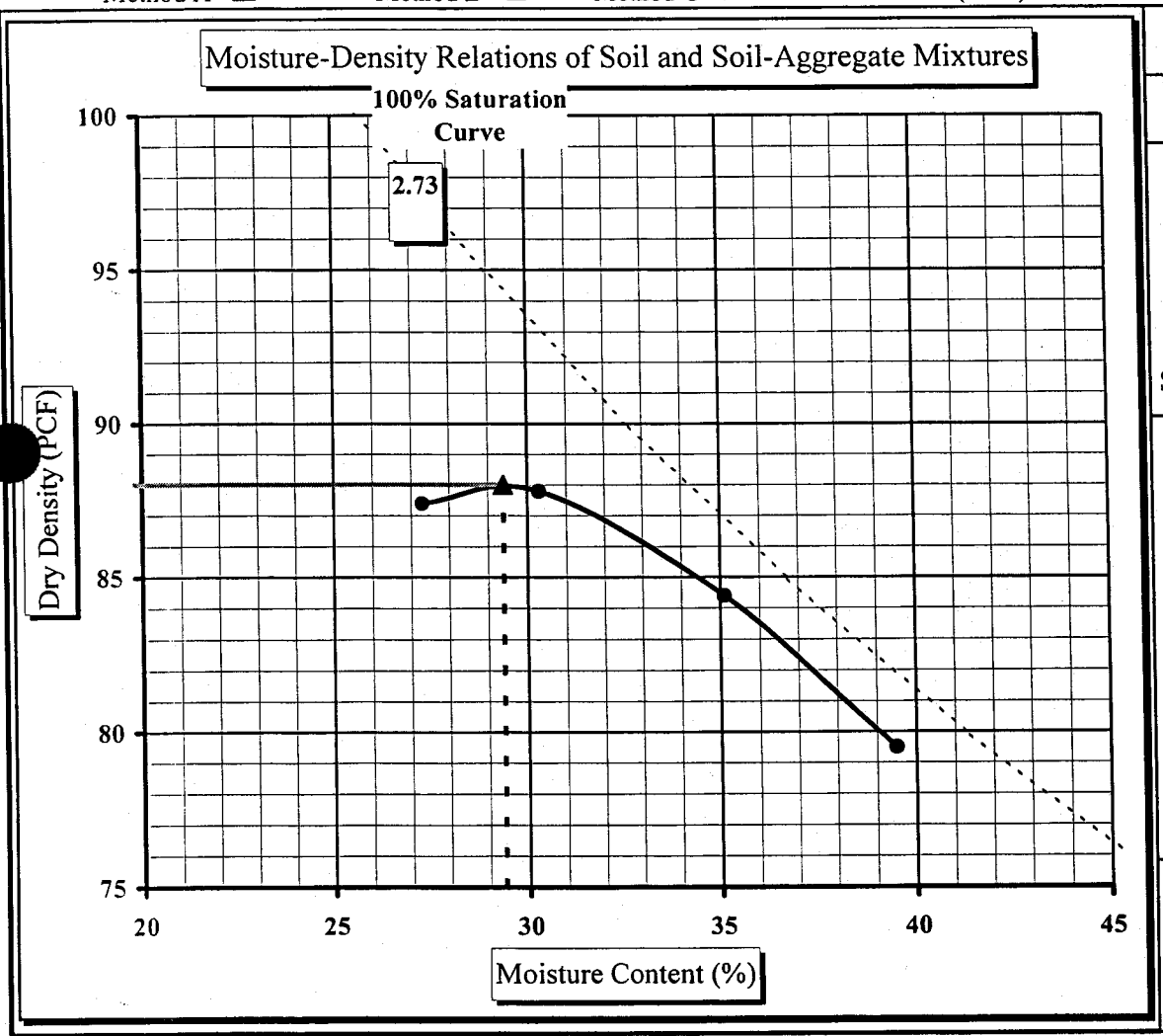
Report Date: February 11, 2003
Test Date(s): February 10, 2003

Boring #:	B-4	Sample #:	BAG	Sample Date:	2/4/2003
Location:		Offset:		Depth:	0-10'

Sample Description: YELLOWISH RED SANDY MICACEOUS M-F SANDY CLAYEY SILT

Maximum Dry Density 88.0 PCF. **Optimum Moisture Content** 29.4 %

ASTM D558 ☐	ASTM D 698 ☒	ASTM D1557 ☐	AASHTO T99 ☐	AASHTO T180 ☐
Method A ☒	Method B ☐	Method C ☐	Method D (1978) ☐	AASHTO Method D ☐



Soil Properties

Natural Moisture Content

Liquid Limit:	69
Plastic Limit:	49
Plastic Index:	20
Specific Gravity:	2.730

% Passing

3/4"
1/2"
3/8"
#4
#10
#40
#60
#200

Oversize Fraction

Bulk Sp. Gravity
% Moisture
Oversize Fraction

Moisture-Density Curve Displayed: Fine Fraction ☒ Corrected for Oversize Fraction (ASTM D 4718) ☐

Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

References: ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Technical Responsibility: Julie Peterson

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/28/2003

Sample Name: B-4 BAG

Sample Description: YELLOWISH RED CLAYEY SILT

Type of Sample: REMOLDED (2.5 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	6.858	Tare No.	T-6	γ_{wet} (pcf)	110.7		Panel No	5
L (cm)	7.699	WWS+ Tare (gm)	397.69	γ_{dry} (pcf)	83.6		Cell P (psi)	82.5
A (cm^2)	36.94	WDS+Tare (gm)	320.58	w (%)	32.4		Soil P (psi)	81.0
V (cm^3)	284.39	WT of Water (gm)	77.11	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	566.9	WT of TARE (gm)	81.58	γ_{wet} (pcf)	110.2		Gs	2.73
		WT Dry Soil (gm)	239	γ_{dry} (pcf)	83.3		n	0.41
		w (%)	32.3	w (%)	32.3			

$K = (Q \times L) / (t \times H \times A)$

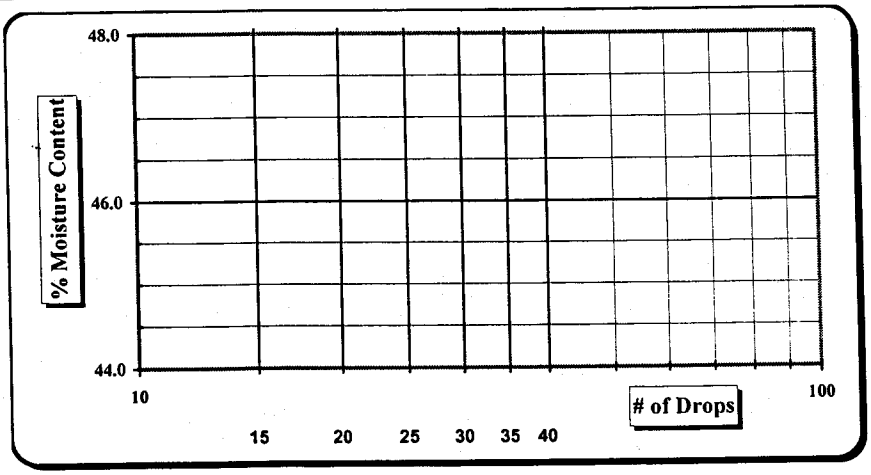
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		10	49		16	0.0	24.6				
	21	14	3	11640	16	22.6	1.2	23.0	70.4	0.9760	5.71E-06
2		14	4		16	0.2	24.0				
	21	17	45	13260	16.1	22.9	0.5	23.1	70.4	0.9760	5.04E-06
3		11	20		16.1	0.1	24.2				
	21	14	47	12420	16.1	24.0	0.0	24.1	70.4	0.9760	5.60E-06
4		16	0		16.1	0.5	23.2				
	21	17	25	5100	16.1	8.7	14.7	8.4	70.4	0.9760	4.73E-06
5		9	26		16.1	0.1	24.2				
	21	14	4	16680	16.2	24.1	0.1	24.1	70.4	0.9760	4.17E-06
7										AVG. K	4.88E-06
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 28, 2003
Client Name:			
Boring #:	B-5	Sample #: S-2	Sample Depth: 8.5-10'
Sample Description:	RED MICA. CLAYEY SILTY M-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	
Plastic Limit	
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-2
Elev. or Depth: 8.5-10'
Sample Length (in./cm.):
Location: B-5
Description: RED MICACEOUS CLAYEY SILTY M-F SAND
Liquid Limit: NP
Plastic Limit: NP
USCS Classification: SM
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	211.43
Tare =	0.00
Dry sample weight =	211.43

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 20	0.65	98.7
# 40	5.27	89.5
# 60	11.79	76.4
# 100	18.69	62.6
# 200	28.65	42.7

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 27.88
Dry weight & tare = 27.80
Tare = 15.20
Hygroscopic moisture= 0.6 %
Calculated biased weight= 49.68
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

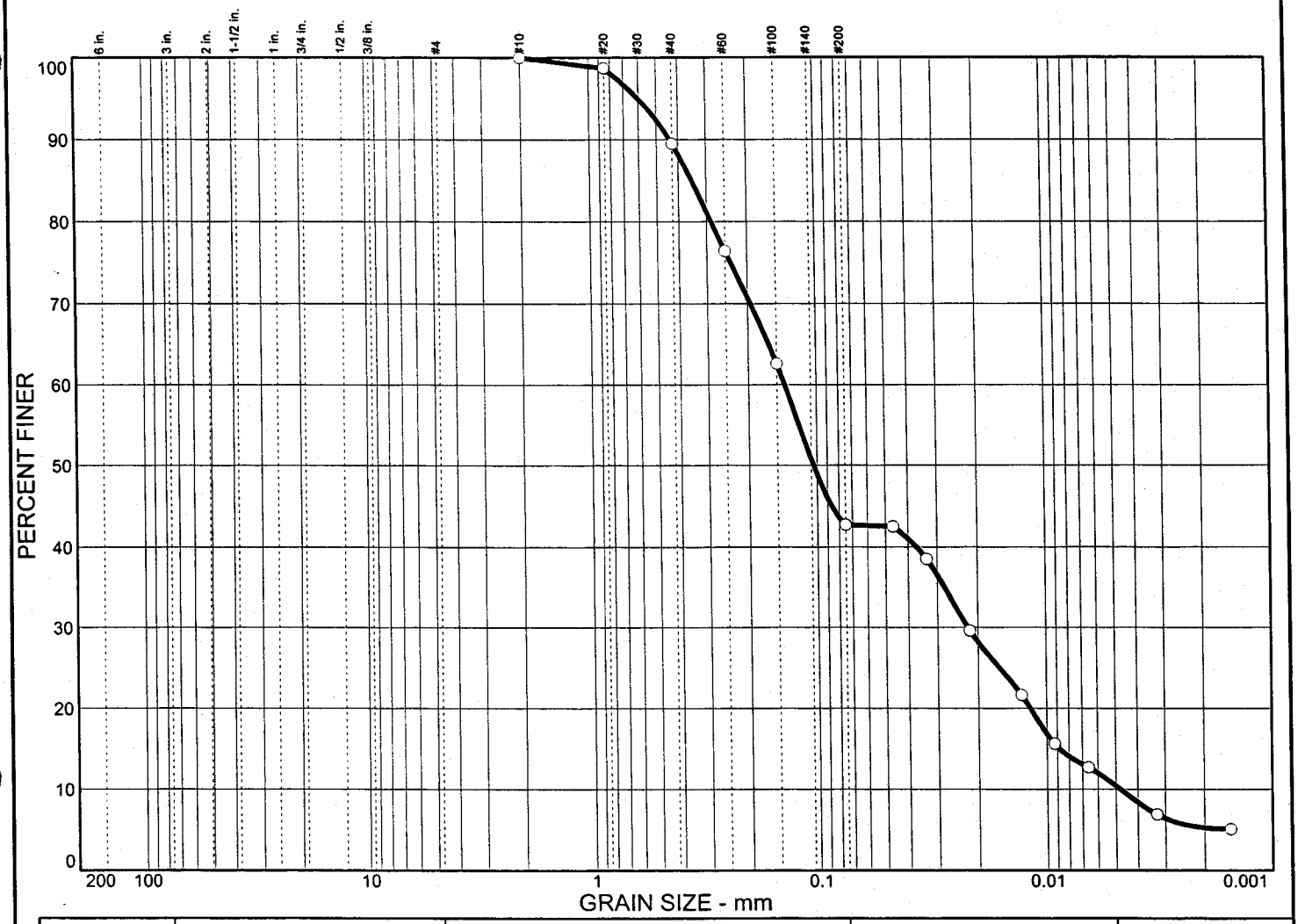
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	26.5	21.4	0.0135	27.5	11.8	0.0464	42.5
2.00	19.5	24.5	19.4	0.0135	25.5	12.1	0.0333	38.5
5.00	19.5	20.0	14.9	0.0135	21.0	12.9	0.0217	29.6
15.00	19.5	16.0	10.9	0.0135	17.0	13.5	0.0128	21.6
30.00	19.5	13.0	7.9	0.0135	14.0	14.0	0.0092	15.6
60.00	19.5	11.5	6.4	0.0135	12.5	14.2	0.0066	12.7
250.00	20.0	8.5	3.5	0.0134	9.5	14.7	0.0033	6.9
1140.00	20.5	7.5	2.6	0.0134	8.5	14.9	0.0015	5.1

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 57.3
% SILT = 32.3 **% CLAY =** 10.4

D_{85}= 0.35 D_{60}= 0.14 D_{50}= 0.10
D_{30}= 0.02 D_{15}= 0.01 D_{10}= 0.00
C_c= 0.7405 C_u= 29.0349

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	57.3	32.3	10.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.349	0.139	0.103	0.0221	0.0088	0.0048	0.74	29.03

MATERIAL DESCRIPTION	USCS	AASHTO
○ RED MICACEOUS CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-5

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

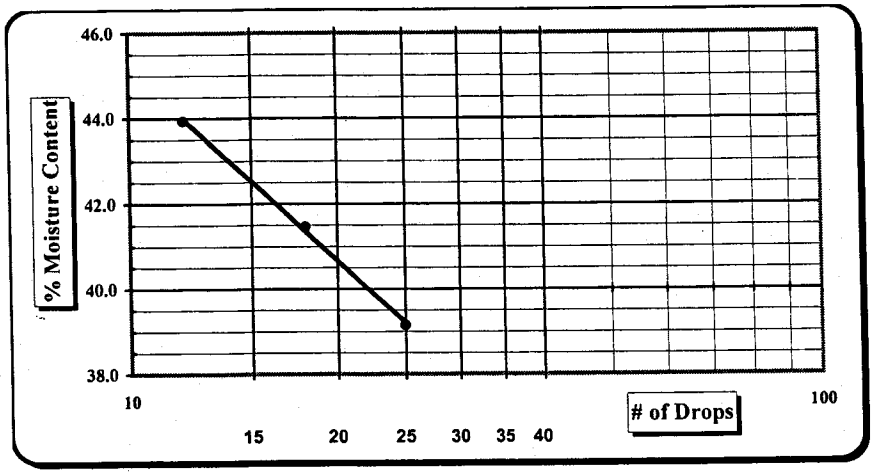
SAMPLE S-2,B-5

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-5	Sample #: S-7	Sample Depth: 33.5-35'
Sample Description:	TANNISH BROWN WHITE MICA. SL. CLAYEY SILTY M-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	E	DD	XX				VU	LL	
A	Tare Weight	15.36	15.05	15.31				15.65	16.95	
B	Wet Soil Weight + A	26.20	26.48	26.22				21.86	23.33	
C	Dry Soil Weight + A	23.15	23.13	22.89				20.10	21.51	
D	Water Weight (B-C)	3.05	3.35	3.33				1.76	1.82	
E	Dry Soil Weight (C-A)	7.79	8.08	7.58				4.45	4.56	
F	% Moisture Content (D/E)*100	39.2%	41.5%	43.9%				39.6%	39.9%	
N	# OF DROPS	25	18	12						
Ave.	Average	41.5%						39.7%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	39
Plastic Limit	40
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-7
Elev. or Depth: 33.5-35' **Sample Length (in./cm.):**
Location: B-5
Description: TANNISH BROWN WHITE MICACEOUS SL. CLAYEY SILTY M-F SAND
Liquid Limit: NP **Plastic Limit:** NP
USCS Classification: SM **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	207.45
Tare =	0.00
Dry sample weight =	207.45

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	1.18	99.4
# 10	1.47	99.3
# 20	2.48	94.4
# 40	7.01	85.4
# 60	14.53	70.4
# 100	23.23	53.2
# 200	33.40	33.0

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 99.3
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 30.13
Dry weight & tare = 29.74
Tare = 16.17
Hygroscopic moisture= 2.9 %
Calculated biased weight= 48.95
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	20.5	15.4	0.0135	21.5	12.8	0.0483	31.0
2.00	19.5	17.5	12.4	0.0135	18.5	13.3	0.0348	25.0
5.00	19.5	13.5	8.4	0.0135	14.5	13.9	0.0226	16.9
15.00	20.0	11.0	6.0	0.0134	12.0	14.3	0.0131	12.0
30.00	20.0	9.0	4.0	0.0134	10.0	14.7	0.0094	8.0
60.00	20.0	8.0	3.0	0.0134	9.0	14.8	0.0067	6.0
250.00	20.0	6.5	1.5	0.0134	7.5	15.1	0.0033	2.9
1440.00	20.5	6.0	1.1	0.0134	7.0	15.1	0.0014	2.2

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** 0.6 **% SAND =** 66.4
% SILT = 28.4 **% CLAY =** 4.6

D_{85}= 0.42 D_{60}= 0.18 D_{50}= 0.14
D_{30}= 0.04 D_{15}= 0.02 D_{10}= 0.01
C_c= 0.9834 C_u= 16.3333

Particle Size Distribution Report

	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.6	66.4	28.4	4.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.417	0.182	0.137	0.0447	0.0188	0.0112	0.98	16.33

MATERIAL DESCRIPTION	USCS	AASHTO
○ TANNISH BROWN WHITE MICACEOUS SL. CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-5

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

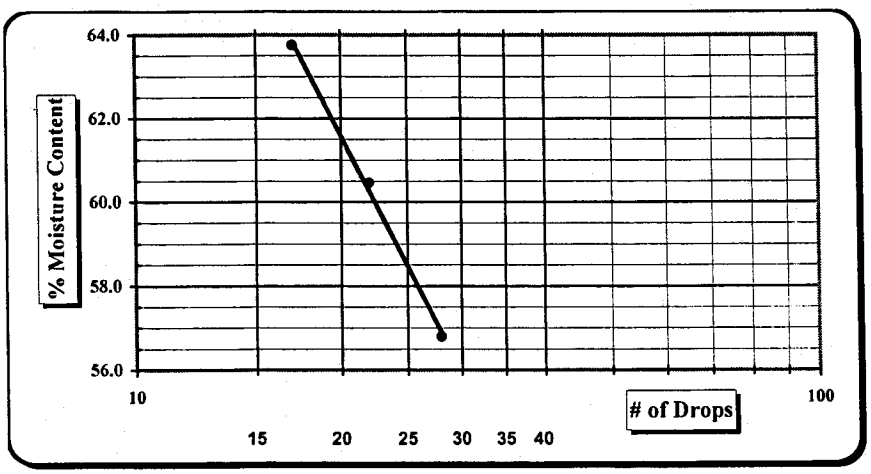
SAMPLE S-7,B-5

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	February 28, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-5	Sample #: BAG	Sample Depth: 10'
Sample Description:	RED MICACEOUS CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	TH	DD	SS				BB	69	
A	Tare Weight	15.32	15.04	16.14				15.33	15.33	
B	Wet Soil Weight + A	25.01	26.16	23.82				23.03	21.95	
C	Dry Soil Weight + A	21.50	21.97	20.83				20.77	20.01	
D	Water Weight (B-C)	3.51	4.19	2.99				2.26	1.94	
E	Dry Soil Weight (C-A)	6.18	6.93	4.69				5.44	4.68	
F	% Moisture Content (D/E)*100	56.8%	60.5%	63.8%				41.5%	41.5%	
N	# OF DROPS	28	22	17						
Ave.	Average	60.3%						41.5%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve 2.1

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	59
Plastic Limit	42
Plastic Index	17
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 1, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	February 28, 2003
Client Name:	Duke Energy		
Boring #:	B-5	Sample #: Bag Sample	Sample Depth: 10 ft
Sample Description:	Red Micaceous Clayey Silt		

VOL. FLASK NO.	40	VOL. FLASK NO.	50	VOL. FLASK NO.	75
WT. OF SOIL & VOL. FLASK	93.78	WT. OF SOIL & VOL. FLASK	97.03	WT. OF SOIL & VOL. FLASK	100.2
WT. OF VOL. FLASK	63.25	WT. OF VOL. FLASK	66.42	WT. OF VOL. FLASK	69.75
A. WT. OF SOIL	30.53	A. WT. OF SOIL	30.61	A. WT. OF SOIL	30.45
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	162.86	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	166.1	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.39
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	182.33	C. WT. OF VOL. FLASK, SOIL & WATER	185.52	C. WT. OF VOL. FLASK, SOIL & WATER	188.83
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.76	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.74	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.77

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	40
G_s = D x K	2.76
FLASK NO.	50
G_s = D x K	2.73
FLASK NO.	75
G_s = D x K	2.76
G_s (ave) =	2.75

Technician Name: Karen Warner

S&ME Moisture - Density Relationship

Test Date(s): February 10, 2003
Report Date: February 11, 2003

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:

Boring #: B-5 Sample #: BAG Sample Date: February 4, 2003
Location: Offset: Depth: 0-10'
Sample Description: RED MICACEOUS CLAYEY SILT

Liquid Limit: 59 Specific Gravity: 2.750
Plastic Limit: 42 Plastic Index: 17

Natural Moisture Content (Total Sample):
Moisture Content of the Oversize Fraction:

NOTES:

Sieve Size	% Passing
3/4"	
1/2"	
3/8"	
#4	
#10	
#40	
#60	
#200	

MDD: 90.9 **Opt. MC %: 27.4**

Water Content

Water Content requires GP 2 Balance (0.1 gram Readability).

ASTM D2216 ☒ AASHTO T265 ☐ ASTM D4959 ☐ ASTM D4643 ☐

	Sample #:						
	Water Added:	60	180	300			
	Tare #:	SEJ	DL	539			
A. Tare Weight	A.	0	0	0			
B. Wet Wt + Tare Wt	B.	500	500	500			
C. Dry Wt. + Tare Wt.	C.	423.2	395.9	382.1			
D. Water Weight	B-C	76.8	104.1	117.9	0	0	0
E. Dry Weight	C-A	423.2	395.9	382.1	0	0	0
F. Moisture Content	100*D/E	**18.1%**	**26.3%**	**30.9%**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

Compaction Data

The Compaction Test requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability).

G. Wt of Soil + Mold	G.	5774.000	6011.000	6040.000			
H. Wt. of Mold	H.	4279.000	4279.000	4279.000			
I. Wt. of Soil (g. or lbs.)	G-H	1495.000	1732.000	1761.000	0.000	0.000	0.000
J. Wt of Soil (Lbs.)	I/453.6 or I	3.296	3.818	3.882	0.000	0.000	0.000
K. Mold Volume Factor	K.	29.97	29.97	29.97			
L. Wet Density	J*K	98.8	114.4	116.4	0.0	0.0	0.0
M. Dry Density	L/(1+F)	**83.6**	**90.6**	**88.9**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (ASTM 1978) ☐ AASHTO Method D ☐

Moisture-Density Relation of: Fine Fraction ☒ Corrected for Coarse Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

Soil Plasticity: ASTM D 4318 ☐ AASHTO T 89 ☐ AASHTO T 90 ☐
Sieve Analysis / Particle Size Analysis: ASTM C136 ☐ AASHTO T 27 ☐ ASTM D 422 ☐ AASHTO T 88 ☐
Specific Gravity of Soil: ASTM D 854 ☐ AASHTO T 100 ☐
Bulk Gravity of Oversize Fraction: ASTM C 127 ☐ AASHTO T 85 ☐
Soil Classification: ASTM D 2487 ☐ ASTM D 2488 ☐ AASHTO M 145 ☐

Technician Name / Certification #: Matthew Johnson
Technical Responsibility: Julie Peterson

Moisture - Density Report

S&ME

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:

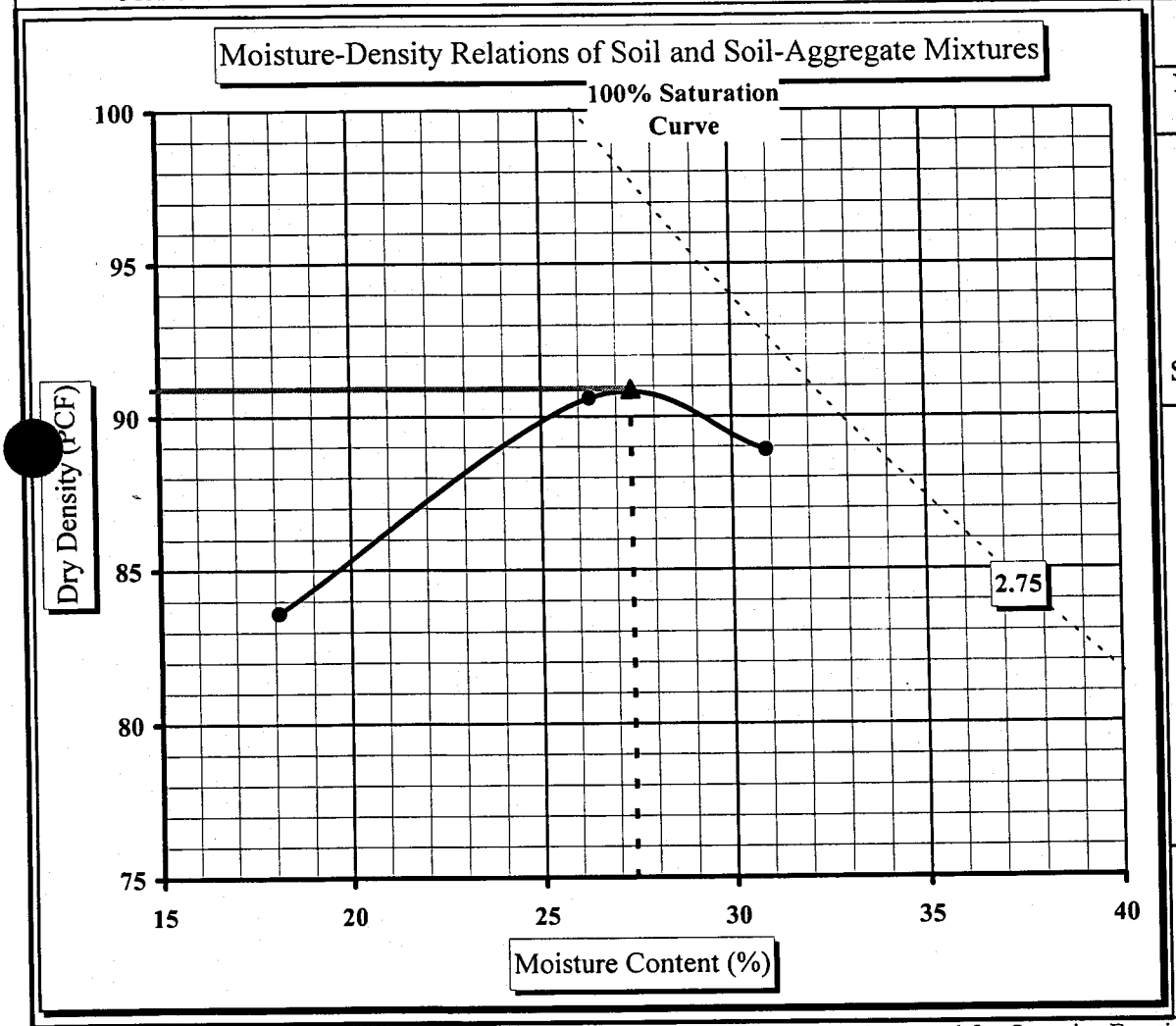
Report Date: February 11, 2003
Test Date(s): February 10, 2003

Boring #:	B-5	Sample #:	BAG	Sample Date:	2/4/2003
Location:		Offset:		Depth:	0-10'

Sample Description: RED MICACEOUS CLAYEY SILT

Maximum Dry Density 90.9 PCF. **Optimum Moisture Content** 27.4 %

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (1978) ☐ AASHTO Method D ☐



Soil Properties

Natural Moisture Content

Liquid Limit:	59
Plastic Limit:	42
Plastic Index:	17
Specific Gravity:	2.750

% Passing
3/4"
1/2"
3/8"
#4
#10
#40
#60
#200

Oversize Fraction
Bulk Sp. Gravity
% Moisture
Oversize Fraction

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

References: ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Technical Responsibility: Julie Peterson

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/27/2003

Sample Name: B-5 BULK

Sample Description: RED MICACEOUS CLAYEY SILT

Type of Sample: REMOLDED

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.29	Tare No.	T-6	γ_{wet} (pcf)	112.7		Panel No	2
L (cm)	7.699	WWS+ Tare (gm)	382.99	γ_{dry} (pcf)	86.4		Cell P (psi)	83.5
A (cm^2)	41.74	WDS+Tare (gm)	314.97	w (%)	30.4		Soil P (psi)	81.0
V (cm^3)	321.35	WT of Water (gm)	68.02	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	573.6	WT of TARE (gm)	81.58	γ_{wet} (pcf)	111.4		Gs	2.75
		WT Dry Soil (gm)	233.39	γ_{dry} (pcf)	86.3		n	0.47
		w (%)	29.1	w (%)	29.1			

K = (Q x L) / (t x H x A)

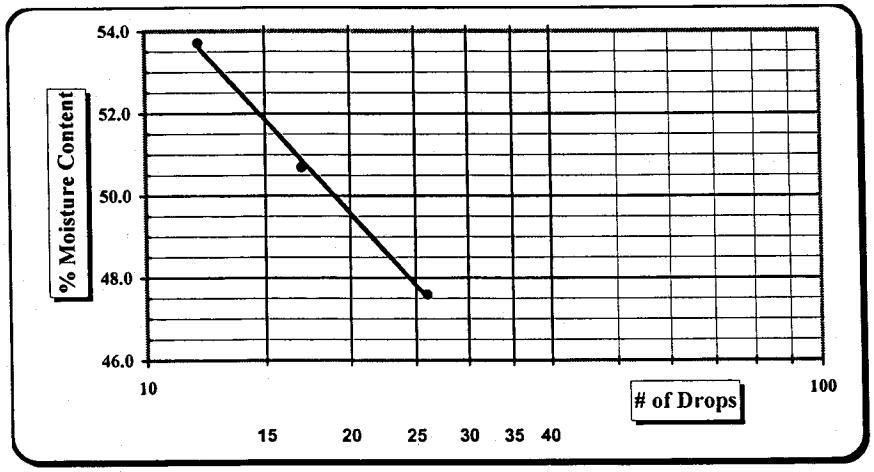
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		14	24		13.5	1.3	24.8				
	21	17	0	9360	13.5	22.4	1.3	22.3	70.4	0.9760	6.09E-06
2		8	51		13.5	0.3	24.3				
	21	11	21	9000	13.5	22.2	2.2	22.0	70.4	0.9760	6.25E-06
3		13	10		13.6	0.0	24.5				
	21	15	50	9600	13.6	23.0	1.7	22.9	70.4	0.9760	6.10E-06
4		11	22		13.6	0.2	24.9				
	21	13	53	9060	13.7	22.0	3.7	21.5	70.4	0.9760	6.07E-06
5		13	54		13.7	0.5	24.0				
	21	15	25	5460	13.7	13.8	11.2	13.1	70.4	0.9760	6.11E-06
7										AVG. K	6.13E-06
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 28, 2003
Client Name:			
Boring #:	B-6	Sample #: S-1	Sample Depth: 3.5-5'
Sample Description:	REDDISH BROWN MICA. CLAYEY SILTY M-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	ZY	U	XY				XX	PP	
A	Tare Weight	15.54	15.52	15.95				16.11	16.18	
B	Wet Soil Weight + A	26.58	26.37	25.68				23.09	23.28	
C	Dry Soil Weight + A	23.02	22.72	22.28				20.92	21.10	
D	Water Weight (B-C)	3.56	3.65	3.40				2.17	2.18	
E	Dry Soil Weight (C-A)	7.48	7.20	6.33				4.81	4.92	
F	% Moisture Content (D/E)*100	47.6%	50.7%	53.7%				45.1%	44.3%	
N	# OF DROPS	26	17	12						
Ave.	Average	50.7%						44.7%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	48
Plastic Limit	45
Plastic Index	3
Group Symbol	SM

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-1
Elev. or Depth: 3.5-5' **Sample Length (in./cm.):**
Location: B-6
Description: REDDISH BROWN MICACEOUS CLAYEY SILTY M-F SAND
Liquid Limit: 48 **Plastic Limit:** 45
USCS Classification: SM **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	192.71
Tare =	0.00
Dry sample weight =	192.71

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
10	0.00	100.0
# 20	0.89	98.2
# 40	4.44	91.1
# 60	10.87	78.3
# 100	19.20	61.6
# 200	27.53	44.9

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 28.58
Dry weight & tare = 28.41
Tare = 16.89
Hygroscopic moisture= 1.5 %
Calculated biased weight= 49.27
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

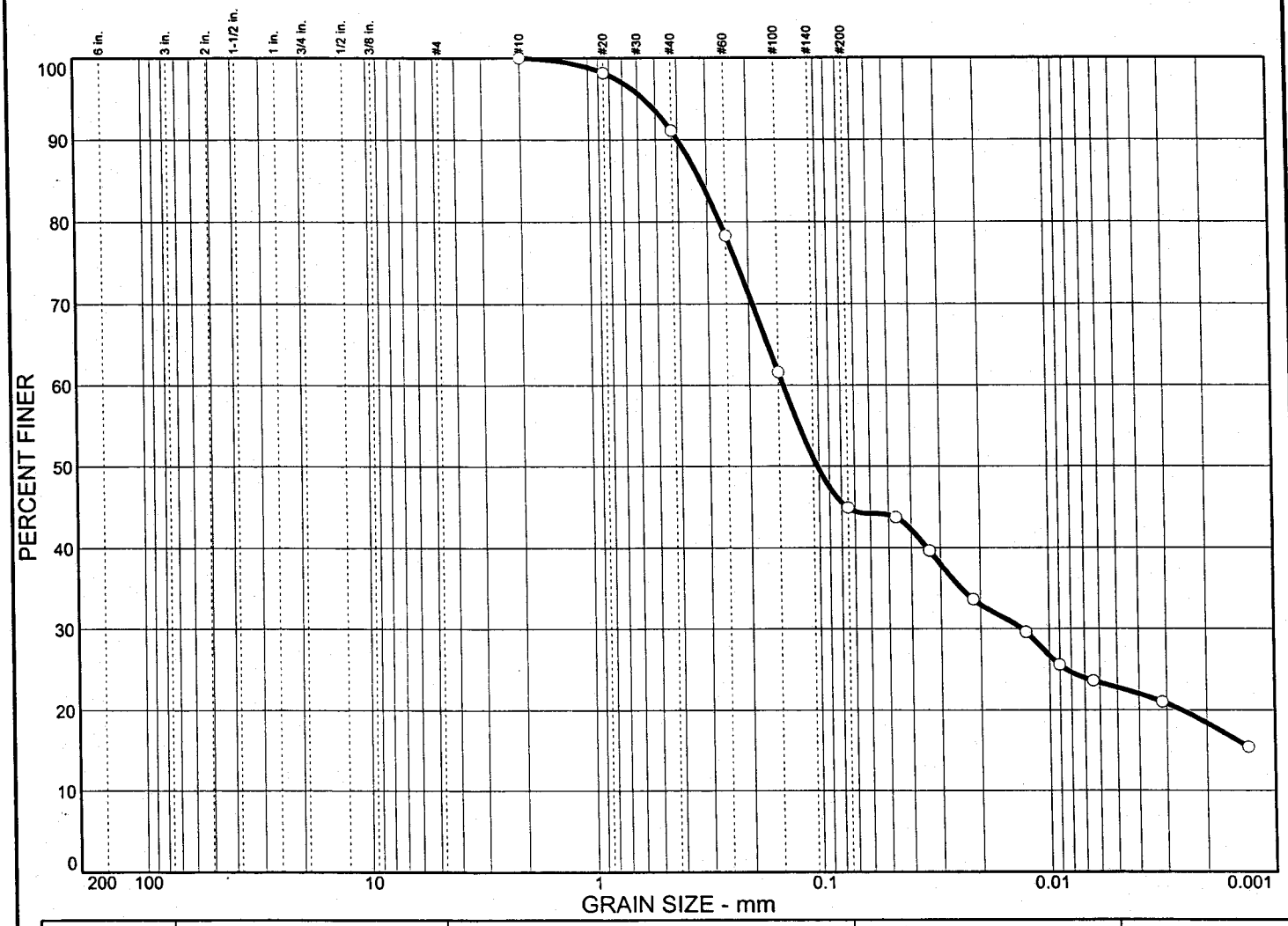
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	27.0	21.8	0.0136	28.0	11.7	0.0466	43.7
2.00	19.0	25.0	19.8	0.0136	26.0	12.0	0.0334	39.6
5.00	19.0	22.0	16.8	0.0136	23.0	12.5	0.0215	33.6
15.00	19.0	20.0	14.8	0.0136	21.0	12.9	0.0126	29.6
30.00	19.0	18.0	12.8	0.0136	19.0	13.2	0.0090	25.6
60.00	19.0	17.0	11.8	0.0136	18.0	13.3	0.0064	23.6
250.00	20.0	15.5	10.5	0.0134	16.5	13.6	0.0031	21.0
1440.00	21.0	12.5	7.7	0.0133	13.5	14.1	0.0013	15.4

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 55.1
% SILT = 22.1 **% CLAY =** 22.8

D_{85}= 0.32 D_{60}= 0.14 D_{50}= 0.10
D_{30}= 0.01

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	55.1	22.1	22.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	48	45	0.319	0.143	0.101	0.0131				

MATERIAL DESCRIPTION	USCS	AASHTO
○ REDDISH BROWN MICACEOUS CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-6

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

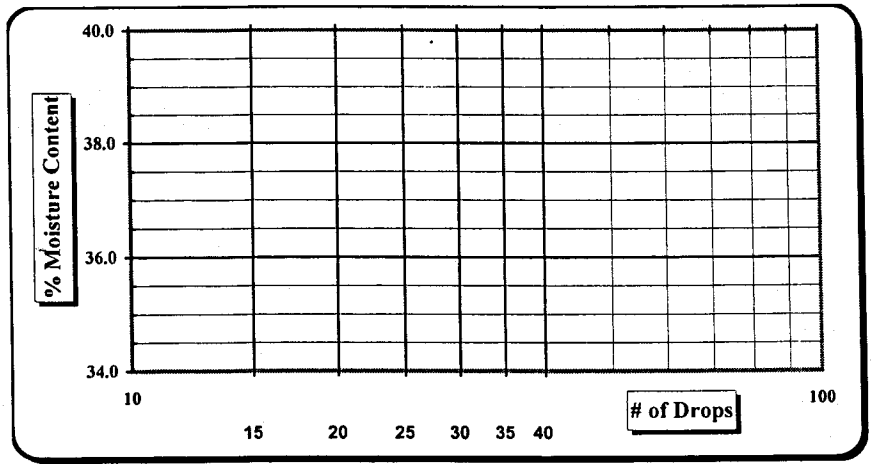
SAMPLE S-1,B-6

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-6	Sample #: S-12	Sample Depth: 58-5-60'
Sample Description:	WHITE PINK GRAY MICA. SL. CLAYEY SILTY M-F SAND W/ROCK FRAGMENTS		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	
Plastic Limit	
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-12
Elev. or Depth: 58.5-60'
Sample Length (in./cm.):
Location: B-6
Description: WHITE PINK GRAY MICACEOUS SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS
Liquid Limit: NP
Plastic Limit: NP
USCS Classification: SM
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	279.22
Tare =	0.00
Dry sample weight =	279.22

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	0.45	99.8
# 10	21.41	92.3
# 20	6.22	80.8
# 40	10.34	73.2
# 60	16.27	62.3
# 100	23.88	48.2
# 200	33.33	30.8

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 92.3
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 28.05
Dry weight & tare = 27.97
Tare = 15.94
Hygroscopic moisture= 0.7 %
Calculated biased weight= 53.81
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H

Effective depth L= 16.294964 - 0.164 x Rm

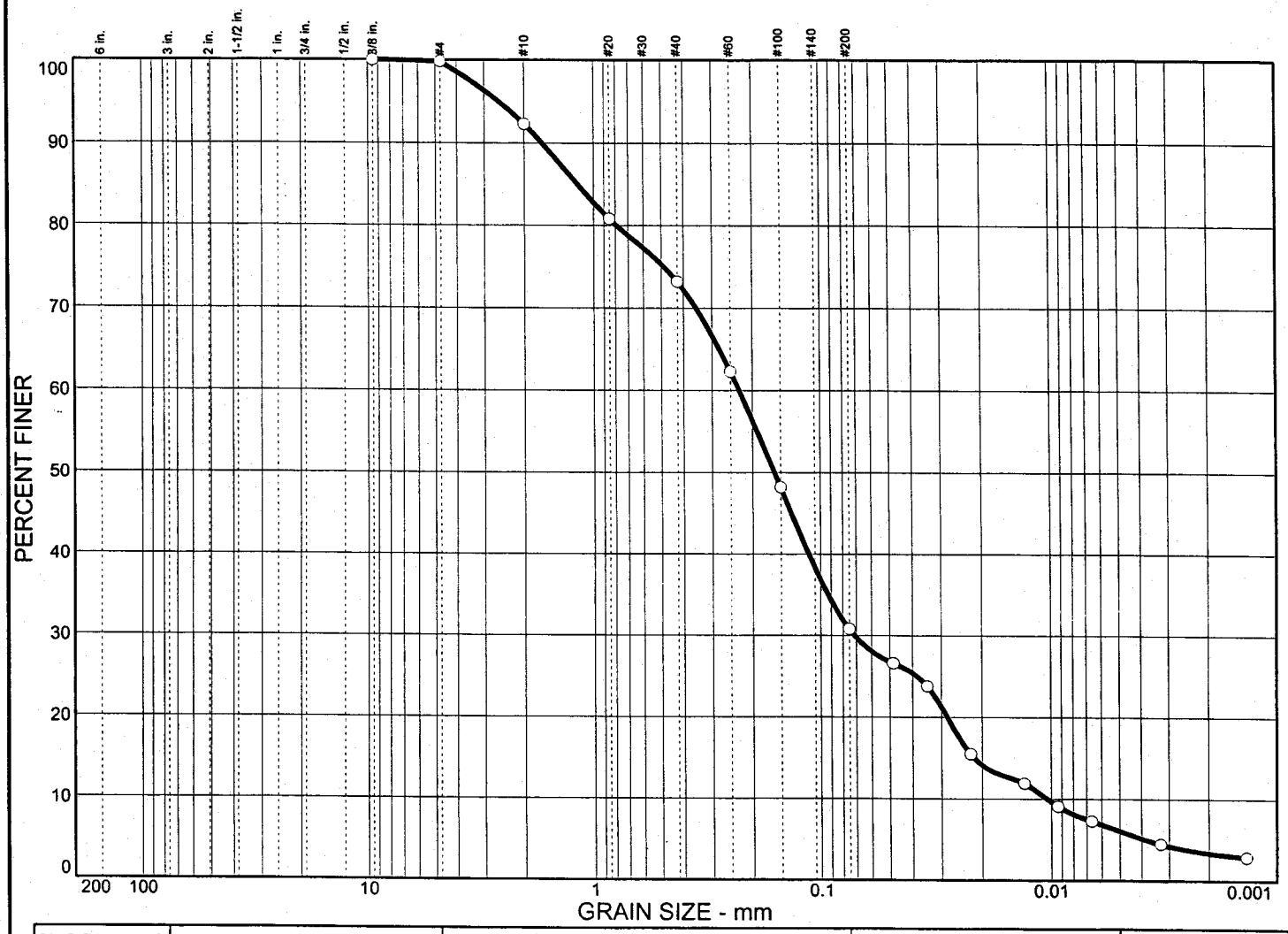
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	20.0	19.5	14.5	0.0134	20.5	12.9	0.0483	26.6
2.00	20.0	18.0	13.0	0.0134	19.0	13.2	0.0345	23.8
5.00	20.0	13.5	8.5	0.0134	14.5	13.9	0.0224	15.5
15.00	20.0	11.5	6.5	0.0134	12.5	14.2	0.0131	11.9
30.00	20.0	10.0	5.0	0.0134	11.0	14.5	0.0093	9.1
60.00	20.0	9.0	4.0	0.0134	10.0	14.7	0.0066	7.3
250.00	20.0	7.5	2.5	0.0134	8.5	14.9	0.0033	4.5
1440.00	20.5	6.5	1.6	0.0134	7.5	15.1	0.0014	2.9

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = % GRAVEL = 0.2 % SAND = 69.0
% SILT = 24.7 % CLAY = 6.1

D_{85}= 1.18 D_{60}= 0.23 D_{50}= 0.16
D_{30}= 0.07 D_{15}= 0.02 D_{10}= 0.01
C_C= 2.1255 C_u= 21.9702

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.2	69.0	24.7	6.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	1.18	0.229	0.160	0.0711	0.0216	0.0104	2.13	21.97

MATERIAL DESCRIPTION	USCS	AASHTO
○ WHITE PINK GRAY MICACEOUS SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-6

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

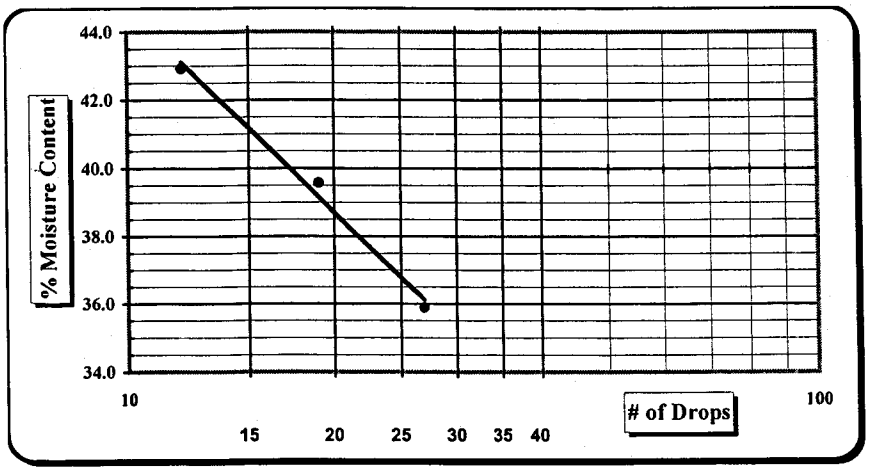
SAMPLE S-12,B-6

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 27, 2003
Client Name:			
Boring #:	B-6	Sample #: U.D.	Sample Depth: 43-45'
Sample Description:	PINKISH BROWN SL. CLAYEY SILTY M-F SAND W/ROCK FRAGMENTS		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	XX	KK	TS				Z	TUX	
A	Tare Weight	16.08	16.07	15.30				16.89	15.67	
B	Wet Soil Weight + A	26.91	25.91	24.49				22.34	21.84	
C	Dry Soil Weight + A	24.05	23.12	21.73				20.81	20.09	
D	Water Weight (B-C)	2.86	2.79	2.76				1.53	1.75	
E	Dry Soil Weight (C-A)	7.97	7.05	6.43				3.92	4.42	
F	% Moisture Content (D/E)*100	35.9%	39.6%	42.9%				39.0%	39.6%	
N	# OF DROPS	27	19	12						
Ave.	Average	%						39.3%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	37
Plastic Limit	39
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072
Project Name: Marshall Steam Station - Beneficial Fill
Client Name: Duke Energy
Boring #: B-6 Sample #: UD Sample Depth: 43 - 45 ft
Sample Description: Pinkish Brown Slightly Clayey Silty Medium to Fine Sand with Rock Fragments

Report Date: March 1, 2003
Test Dates(s): February 27, 2003

VOL. FLASK NO.	74	VOL. FLASK NO.	59	VOL. FLASK NO.	45
WT. OF SOIL & VOL. FLASK	98.53	WT. OF SOIL & VOL. FLASK	98.83	WT. OF SOIL & VOL. FLASK	97.12
WT. OF VOL. FLASK	67.87	WT. OF VOL. FLASK	68.47	WT. OF VOL. FLASK	66.67
A. WT. OF SOIL	30.66	A. WT. OF SOIL	30.36	A. WT. OF SOIL	30.45
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	167.54	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.12	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	166.39
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	186.73	C. WT. OF VOL. FLASK, SOIL & WATER	187.22	C. WT. OF VOL. FLASK, SOIL & WATER	185.38
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.67	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.70	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.66

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	74
G_s = D x K	2.67
FLASK NO.	59
G_s = D x K	2.70
FLASK NO.	45
G_s = D x K	2.66
G_s (ave) =	2.67

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: U.D.
Elev. or Depth: 43-45' Sample Length (in./cm.):
Location: B-6
Description: PINKISH BROWN SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS
Liquid Limit: NP Plastic Limit: NP
USCS Classification: SM AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	221.44
Tare =	0.00
Dry sample weight =	221.44

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	14.84	93.3
# 20	8.00	78.4
# 40	12.90	69.2
# 60	18.20	59.3
# 100	24.80	47.0
# 200	32.90	31.9

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 93.3
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 26.14
Dry weight & tare = 26.00
Tare = 15.94
Hygroscopic moisture= 1.4 %
Calculated biased weight= 52.86
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.68
Specific gravity correction factor= 0.993
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

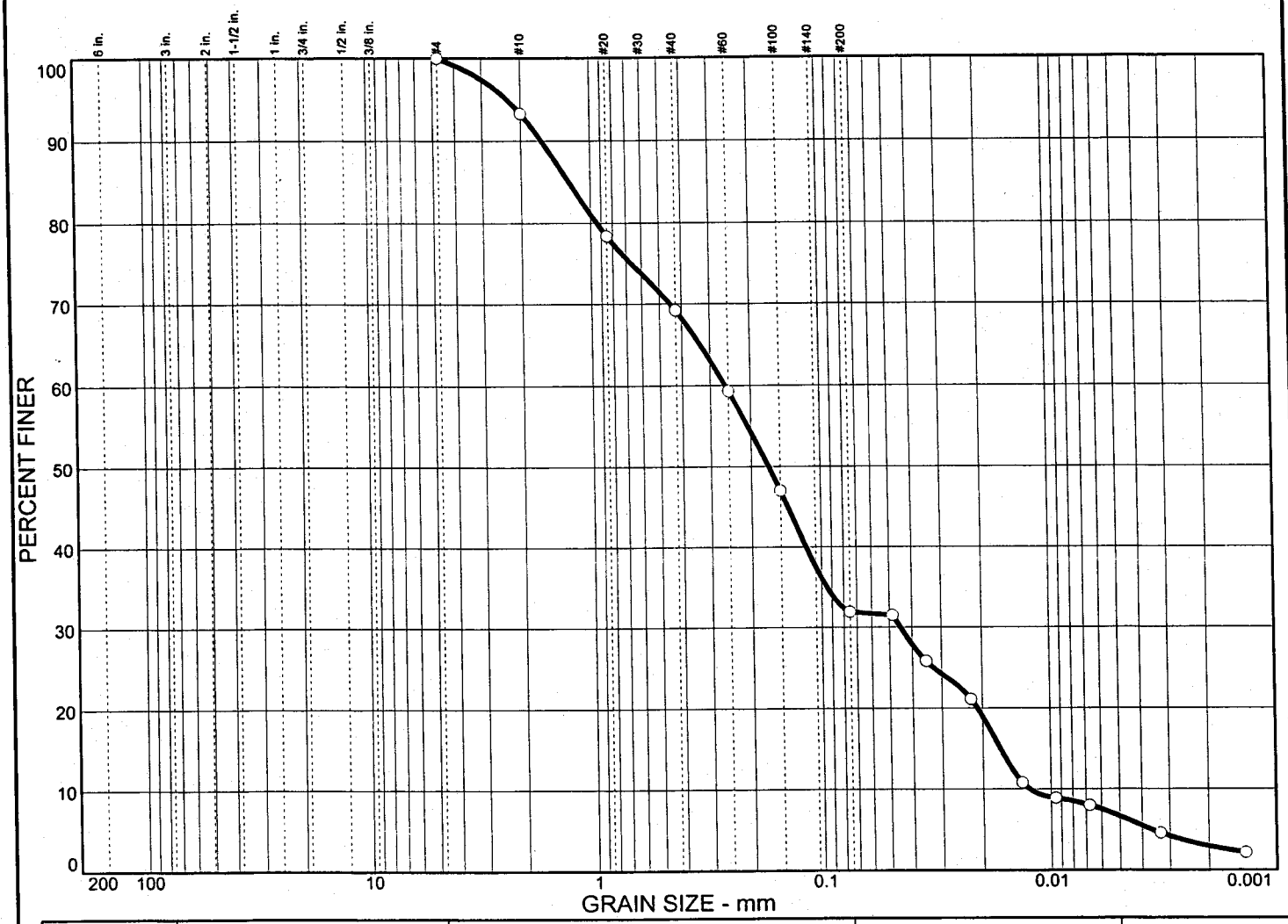
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	22.0	16.8	0.0137	23.0	12.5	0.0485	31.5
2.00	19.0	19.0	13.8	0.0137	20.0	13.0	0.0349	25.8
5.00	19.0	16.5	11.3	0.0137	17.5	13.4	0.0224	21.1
15.00	19.0	11.0	5.8	0.0137	12.0	14.3	0.0134	10.8
30.00	19.0	10.0	4.8	0.0137	11.0	14.5	0.0095	8.9
60.00	19.0	9.5	4.3	0.0137	10.5	14.6	0.0067	8.0
250.00	20.0	7.5	2.5	0.0135	8.5	14.9	0.0033	4.6
1440.00	21.0	6.0	1.2	0.0134	7.0	15.1	0.0014	2.2

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 68.1
% SILT = 25.2 **% CLAY =** 6.7

D_{85}= 1.24 D_{60}= 0.26 D_{50}= 0.17
D_{30}= 0.04 D_{15}= 0.02 D_{10}= 0.01
C_c= 0.6275 C_u= 20.7802

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	68.1	25.2	6.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	1.24	0.258	0.168	0.0449	0.0167	0.0124	0.63	20.78

MATERIAL DESCRIPTION	USCS	AASHTO
○ PINKISH BROWN SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-6

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE B-6,U.D.

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 Project Name: MARSHALL STEAM STATION Date: 2-26-03

Sample Name: B-6 U.D. (43-45')

Sample Description: PINKISH BROWN SL. CLAYEY SILTY M-F SAND WITH ROCKS

Type of Sample: UNDISTURBED (10 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.275	Tare No.	S-7	γ_{wet} (pcf)	0.0		Panel No	11
L (cm)	9.921	WWS+ Tare (gm)	366.7	γ_{dry} (pcf)			Cell P (psi)	91.0
A (cm^2)	41.57	WDS+Tare (gm)	286.19	w (%)			Soil P (psi)	81.0
V (cm^3)	412.39	WT of Water (gm)	80.51	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	779.2	WT of TARE (gm)	81.68	γ_{wet} (pcf)	118.0		Gs	2.68
		WT Dry Soil (gm)	204.51	γ_{dry} (pcf)	84.6		n	0.60
		w (%)	39.4	w (%)	39.4			

$K = (Q \times L) / (t \times H \times A)$

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		8	52		13.2	0.2	24.5				
	21	9	10	1080	13.2	24.0	0.4	24.0	70.4	0.9760	7.34E-05
2		9	11		13.2	0.0	24.2				
	21	9	29	1080	13.3	23.7	0.2	23.9	70.4	0.9760	7.31E-05
3		9	30		13.3	0.1	24.4				
	21	9	46	960	13.3	20.7	3.1	21.0	70.4	0.9760	7.22E-05
4		9	47		13.3	0.0	24.6				
	21	10	6	1140	13.4	24.0	0.2	24.2	70.4	0.9760	7.03E-05
5		10	7		13.4	0.2	24.5				
	21	10	26	1140	13.4	24.3	0.1	24.3	70.4	0.9760	7.04E-05
6											
7										AVG. K	7.15E-05
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 3/4/2003

Sample Name: B-6 U.D. (43-45')

Sample Description: PINKISH BROWN SL. CLAYEY SILTY M-F SAND WITH ROCKS

Type of Sample: UNDISTURBED (20 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.275	Tare No.	S-7	γ_{wet} (pcf)	0.0		Panel No	11
L (cm)	9.921	WWS+ Tare (gm)	366.7	γ_{dry} (pcf)			Cell P (psi)	102.0
A (cm^2)	41.57	WDS+Tare (gm)	286.19	w (%)			Soil P (psi)	82.0
V (cm^3)	412.39	WT of Water (gm)	80.51	Actual Molding Condition			Back P (psi)	81.0
WWS (gm)	779.2	WT of TARE (gm)	81.68	γ_{wet} (pcf)	118.0		Gs	2.68
		WT Dry Soil (gm)	204.51	γ_{dry} (pcf)	84.6		n	0.60
		w (%)	39.4	w (%)	39.4			

K = (Q x L) / (t x H x A)

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		9	37		13.3	0.1	24.2				
	21	10	6	1740	13.3	24.0	0.2	24.0	70.4	0.9760	4.56E-05
2		9	5		13.3	0.1	24.4				
	21	9	32	1620	13.3	23.1	0.8	23.3	70.4	0.9760	4.76E-05
3		10	7		10.4	0.1	24.0				
	21	10	31	1440	10.4	21.5	2.7	21.4	70.4	0.9760	4.91E-05
4		10	33		10.4	0.2	24.4				
	21	10	58	1500	10.4	22.0	2.5	21.9	70.4	0.9760	4.82E-05
5		10	59		10.4	0.4	24.5				
	21	11	24	1500	10.5	22.4	2.3	22.1	70.4	0.9760	4.88E-05
6											
7										AVG. K	4.84E-05
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 **Project Name: MARSHALL STEAM STATION** **3/13/2003**

Sample Name: B-6 U.D. (43-45')

Sample Description: PINKISH BROWN SL. CLAYEY SILTY M-F SAND WITH ROCKS

Type of Sample: UNDISTURBED (30 PSI)

Sample Data		**Molding Moisture Content**		**Target Molding Conditon**			**Additonal Data**	
D (cm)	7.275	Tare No.	S-7	γ_{wet} (pcf)	0.0		Panel No	11
L (cm)	9.921	WWS+ Tare (gm)	366.7	γ_{dry} (pcf)			Cell P (psi)	113.0
A (cm^2)	41.57	WDS+Tare (gm)	286.19	w (%)			Soil P (psi)	83.0
V (cm^3)	412.39	WT of Water (gm)	80.51	**Actual Molding Condition**			Back P (psi)	82.0
WWS (gm)	779.2	WT of TARE (gm)	81.68	γ_{wet} (pcf)	118.0		Gs	2.68
		WT Dry Soil (gm)	204.51	γ_{dry} (pcf)	84.6		n	0.60
		w (%)	39.4	w (%)	39.4			

$K = (Q \times L) / (t \times H \times A)$

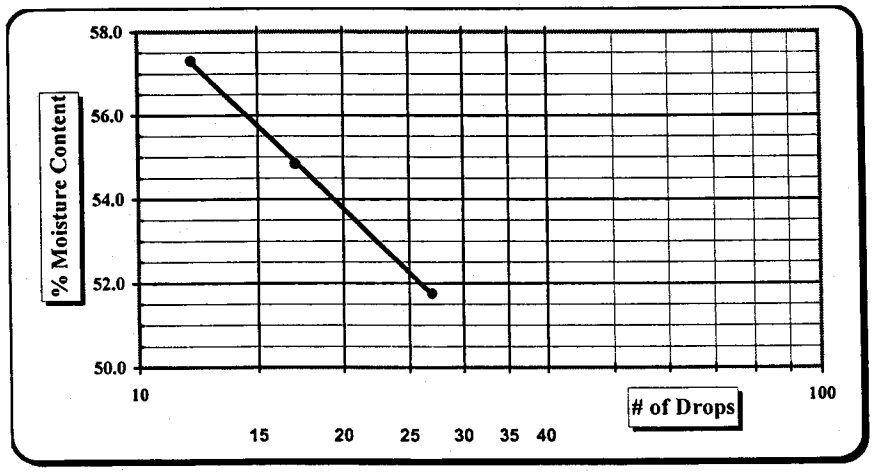
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		14	12		12.3	0.4	24.0				
	21	14	34	1320	12.3	22.9	1.6	22.5	70.4	0.9760	5.63E-05
2		14	35		12.3	0.2	24.5				
	21	14	59	1440	12.3	23.4	1.1	23.3	70.4	0.9760	5.36E-05
3		15	0		12.3	0.5	24.6				
	21	15	25	1500	12.3	24.1	0.6	23.8	70.4	0.9760	5.25E-05
4		15	26		12.3	0.2	24.5				
	21	15	49	1380	12.3	22.7	1.8	22.6	70.4	0.9760	5.42E-05
5		15	50		12.3	0.2	24.5				
	21	16	14	1440	12.3	23.5	1.0	23.4	70.4	0.9760	5.38E-05
6		16	15		12.3	0.2	24.5				
	21	16	38	1380	12.3	22.6	1.7	22.6	70.4	0.9760	5.42E-05
7										AVG. K	5.35E-05
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-6	Sample #: BAG	Sample Depth: 10'
Sample Description:	REDDISH BROWN MICACEOUS CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	STAR	KK	II				XW	SMS	
A	Tare Weight	15.51	16.06	16.90				15.24	15.12	
B	Wet Soil Weight + A	25.92	26.45	26.59				22.29	23.15	
C	Dry Soil Weight + A	22.37	22.77	23.06				20.26	20.78	
D	Water Weight (B-C)	3.55	3.68	3.53				2.03	2.37	
E	Dry Soil Weight (C-A)	6.86	6.71	6.16				5.02	5.66	
F	% Moisture Content (D/E)*100	51.7%	54.8%	57.3%				40.4%	41.9%	
N	# OF DROPS	27	17	12						
Ave.	Average	54.6%						41.2%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve 1.5

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	52
Plastic Limit	41
Plastic Index	11
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 3, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	March 1, 2003
Client Name:	Duke Energy		
Boring #:	B-6	Sample #: Bag Sample	Sample Depth: 10 ft
Sample Description:	Reddish Brown Micaceous Clayey Silt		

VOL. FLASK NO.	65	VOL. FLASK NO.	31	VOL. FLASK NO.	41
WT. OF SOIL & VOL. FLASK	99.13	WT. OF SOIL & VOL. FLASK	101.12	WT. OF SOIL & VOL. FLASK	94.29
WT. OF VOL. FLASK	68.67	WT. OF VOL. FLASK	70.77	WT. OF VOL. FLASK	63.62
A. WT. OF SOIL	30.46	A. WT. OF SOIL	30.35	A. WT. OF SOIL	30.67
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.34	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	170.51	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	163.29
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	187.3	C. WT. OF VOL. FLASK, SOIL & WATER	189.47	C. WT. OF VOL. FLASK, SOIL & WATER	182.46
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.65	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.66	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.67

SPECIFIC GRAVITY (Corrected) $G_s = D \times K =$

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	65
$G_s = D \times K$	2.65
FLASK NO.	31
$G_s = D \times K$	2.66
FLASK NO.	41
$G_s = D \times K$	2.67
G_s (ave) =	2.66

Technician Name: Karen Warner

S&ME Moisture - Density Relationship

Test Date(s): February 11, 2003
Report Date: February 12, 2003

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:
Boring #: B-6 Sample #: BAG Sample Date: February 4, 2003
Location: Offset: Depth: 0-10'
Sample Description: REDDISH BROWN MICACEOUS CLAYEY SILT

Liquid Limit: 52 Specific Gravity: 2.660
Plastic Limit: 41 Plastic Index: 11

Natural Moisture Content (Total Sample):
Moisture Content of the Oversize Fraction:

NOTES:

Sieve Size	% Passing
3/4"	
1/2"	
3/8"	
#4	
#10	
#40	
#60	
#200	

MDD: 93.0 **Opt. MC %: 25.0**

Water Content

Water Content requires GP 2 Balance (0.1 gram Readability).

ASTM D2216 ☒ AASHTO T265 ☐ ASTM D4959 ☐ ASTM D4643 ☐

	Sample #:						
	Water Added:						
	Tare #:	63	89	77	997		
Tare Weight	A.	0	0	0	0		
B. Wet Wt + Tare Wt	B.	500	500	500	500		
C. Dry Wt. + Tare Wt.	C.	425.2	396	388.6	377.7		
D. Water Weight	B-C	74.8	104	111.4	122.3	0	0
E. Dry Weight	C-A	425.2	396	388.6	377.7	0	0
F. Moisture Content	100*D/E	**17.6%**	**26.3%**	**28.7%**	**32.4%**	**#DIV/0!**	**#DIV/0!**

Compaction Data

The Compaction Test requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability).

G. Wt of Soil + Mold	G.	5895.000	6056.000	6045.000	5982.000		
H. Wt. of Mold	H.	4279.000	4279.000	4279.000	4279.000		
I. Wt. of Soil (g. or lbs.)	G-H	1616.000	1777.000	1766.000	1703.000	0.000	0.000
J. Wt of Soil (Lbs.)	I/453.6 or I	3.563	3.918	3.893	3.754	0.000	0.000
K. Mold Volume Factor	K.	29.97	29.97	29.97	29.97		
L. Wet Density	J*K	106.8	117.4	116.7	112.5	0.0	0.0
M. Dry Density	L/(1+F)	**90.8**	**93.0**	**90.7**	**85.0**	**#DIV/0!**	**#DIV/0!**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (ASTM 1978) ☐ AASHTO Method D ☐

Moisture-Density Relation of: Fine Fraction ☒ Corrected for Coarse Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

Soil Plasticity: ASTM D 4318 ☐ AASHTO T 89 ☐ AASHTO T 90 ☐
Sieve Analysis / Particle Size Analysis: ASTM C136 ☐ AASHTO T 27 ☐ ASTM D 422 ☐ AASHTO T 88 ☐
Specific Gravity of Soil: ASTM D 854 ☐ AASHTO T 100 ☐
Bulk Gravity of Oversize Fraction: ASTM C 127 ☐ AASHTO T 85 ☐
Soil Classification: ASTM D 2487 ☐ ASTM D 2488 ☐ AASHTO M 145 ☐

Technician Name / Certification #: Matthew Johnson
Technical Responsibility: Julie Peterson

Moisture - Density Report

S&ME

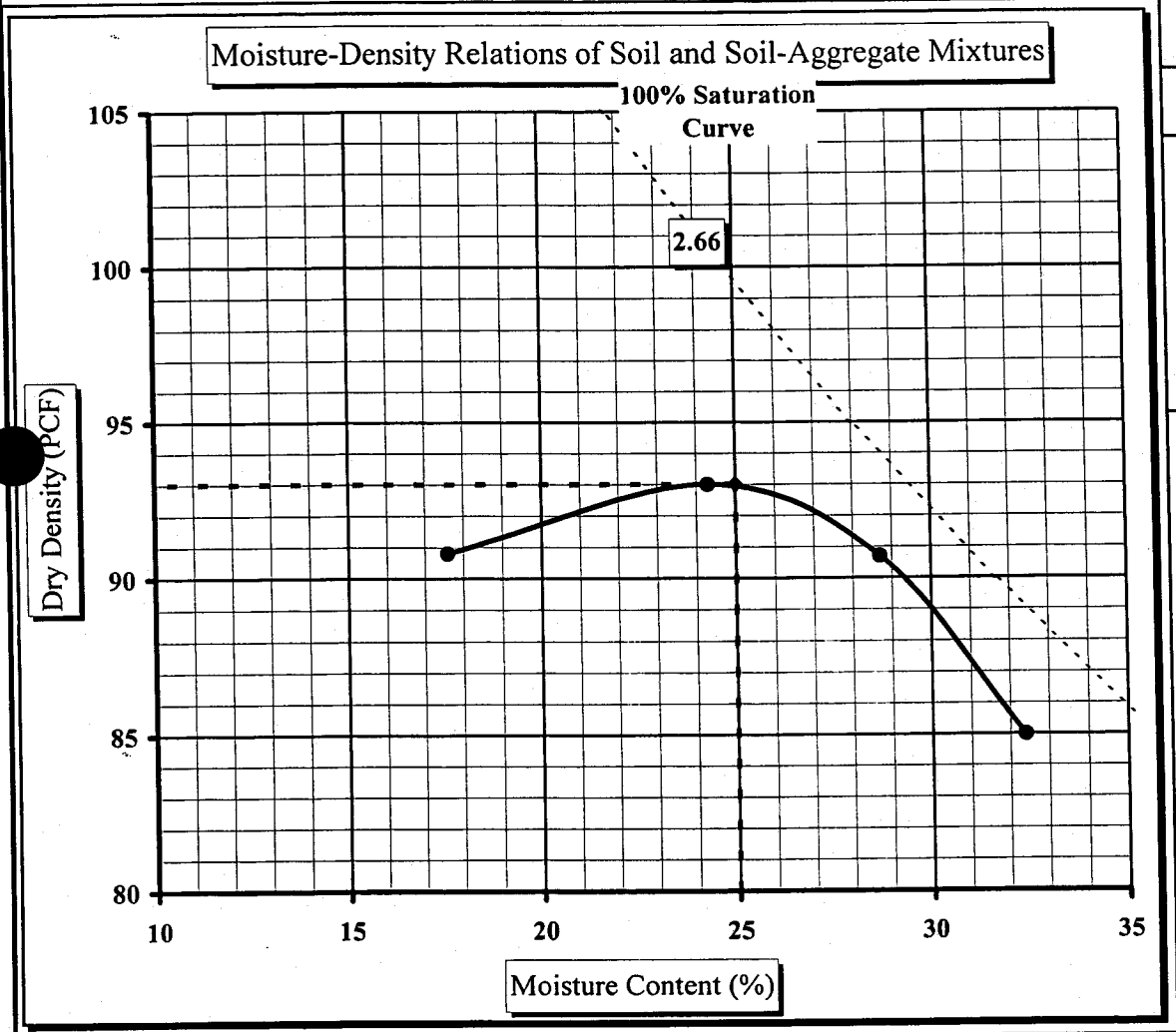
S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:

Report Date: February 12, 2003
Test Date(s): February 11, 2003

Boring #: B-6 Sample #: BAG Sample Date: 2/4/2003
Location: Offset: Depth: 0-10'
Sample Description: REDDISH BROWN MICACEOUS CLAYEY SILT

Maximum Dry Density 93.0 PCF. **Optimum Moisture Content** 25.0 %

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (1978) ☐ AASHTO Method D ☐



Soil Properties

Natural Moisture Content

Liquid Limit:	52
Plastic Limit:	41
Plastic Index:	11
Specific Gravity:	2.660

% Passing
3/4"
1/2"
3/8"
#4
#10
#40
#60
#200

Oversize Fraction
Bulk Sp. Gravity
% Moisture
Oversize Fraction

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

References: ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

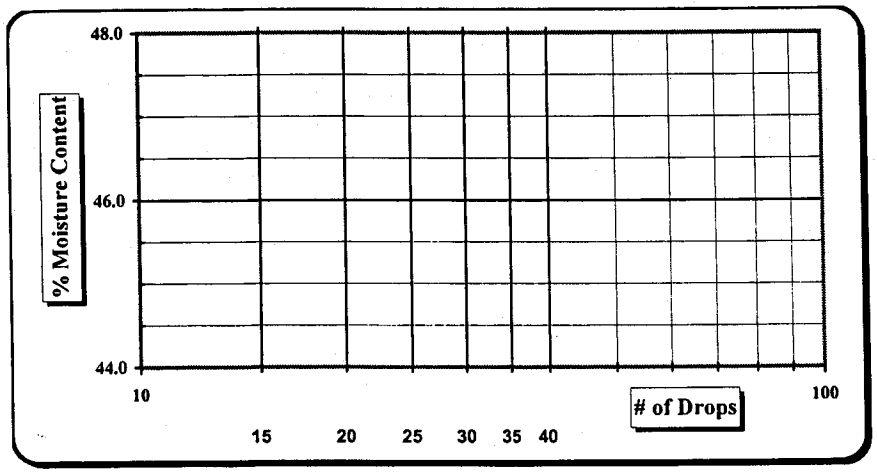
Technical Responsibility: Julie Peterson

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 28, 2003
Client Name:			
Boring #:	B-7	Sample #: S10-S12	Sample Depth: 48.5-60'
Sample Description:	GRAY BLACK WHITE SL. CLAYEY SILTY M-F SAND W/ROCK FRAGMENTS		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	
Plastic Limit	
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072 — Report Date: March 1, 2003
Project Name: Marshall Steam Station - Beneficial Fill — Test Dates(s): February 28, 2003
Client Name: Duke Energy
Boring #: B-7 — Sample #: S-10 - 12 — Sample Depth: 48.5 - 60 ft
Sample Description: Grey Black and White Slightly Clayey Silty Medium to Fine Sand with Rock Fragments

VOL. FLASK NO.	61	VOL. FLASK NO.	51	VOL. FLASK NO.	39
WT. OF SOIL & VOL. FLASK	99.04	WT. OF SOIL & VOL. FLASK	97.6	WT. OF SOIL & VOL. FLASK	92.62
WT. OF VOL. FLASK	68.44	WT. OF VOL. FLASK	67.06	WT. OF VOL. FLASK	62.06
A. WT. OF SOIL	30.6	A. WT. OF SOIL	30.54	A. WT. OF SOIL	30.56
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.14	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	166.66	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	161.65
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	187.7	C. WT. OF VOL. FLASK, SOIL & WATER	186.52	C. WT. OF VOL. FLASK, SOIL & WATER	181.3
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.77	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.86	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.80

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	61
G_s = D x K	2.77
FLASK NO.	51
G_s = D x K	2.86
FLASK NO.	39
G_s = D x K	2.80
G_s (ave) =	2.81

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S10-12
Elev. or Depth: 48.5-60' **Sample Length (in./cm.):**
Location: B-7
Description: GRAY BLACK WHITE SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS
Liquid Limit: NP **Plastic Limit:** NP
USCS Classification: SM **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	286.61
Tare =	0.00
Dry sample weight =	286.61

Sample split on number 10 sieve
Split sample data:
Sample and tare = 100.00 Tare = .00 Sample weight = 100.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
1 inch	0.00	100.0
.75 inch	20.16	93.0
.5 inch	20.16	93.0
.375 inch	33.32	88.4
# 4	36.47	87.3
# 10	40.10	86.0
# 20	5.70	81.1
# 40	16.39	71.9
# 60	35.73	55.3
# 100	56.91	37.1
# 200	75.72	20.9

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 86.0
Weight of hydrometer sample: 100.00
Hygroscopic moisture correction:
Moist weight & tare = 29.29
Dry weight & tare = 29.14
Tare = 16.19
Hygroscopic moisture= 1.2 %
Calculated biased weight= 114.95
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.79

Specific gravity correction factor= 0.970
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

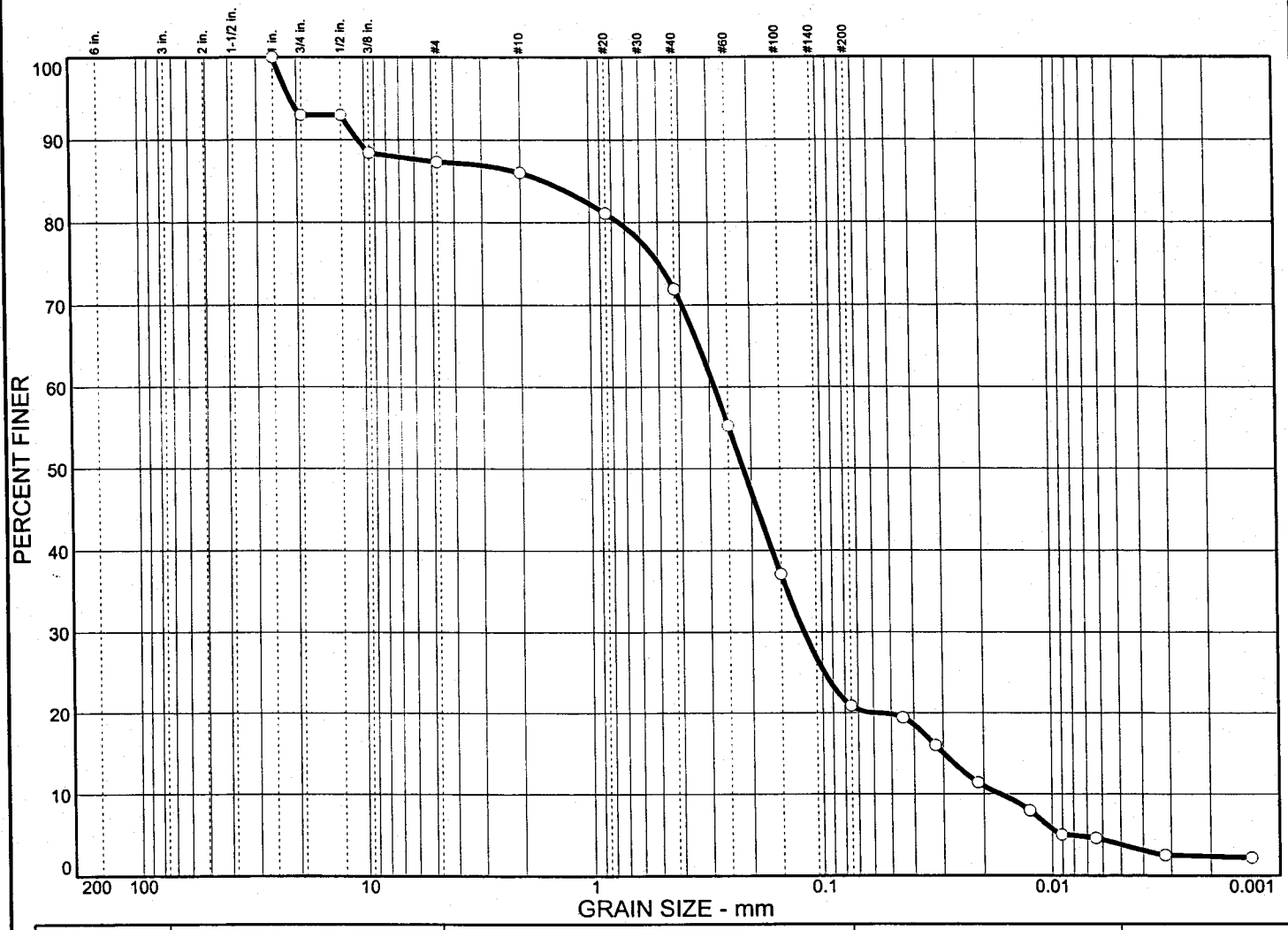
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	20.0	28.0	23.0	0.0131	29.0	11.5	0.0445	19.4
2.00	20.0	24.0	19.0	0.0131	25.0	12.2	0.0324	16.0
5.00	20.0	18.5	13.5	0.0131	19.5	13.1	0.0212	11.4
15.00	20.0	14.5	9.5	0.0131	15.5	13.8	0.0125	8.0
30.00	20.0	11.0	6.0	0.0131	12.0	14.3	0.0091	5.0
60.00	20.0	10.5	5.5	0.0131	11.5	14.4	0.0064	4.6
250.00	20.0	8.0	3.0	0.0131	9.0	14.8	0.0032	2.5
1440.00	20.5	7.5	2.6	0.0130	8.5	14.9	0.0013	2.2

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = % GRAVEL = 12.7 % SAND = 66.4
% SILT = 17.1 % CLAY = 3.8

D_{85}= 1.57 D_{60}= 0.29 D_{50}= 0.22
D_{30}= 0.12 D_{15}= 0.03 D_{10}= 0.02
C_c= 2.9424 C_u= 16.8085

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	12.7	66.4	17.1	3.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	1.57	0.285	0.216	0.119	0.0299	0.0170	2.94	16.81

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY BLACK WHITE SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-7

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

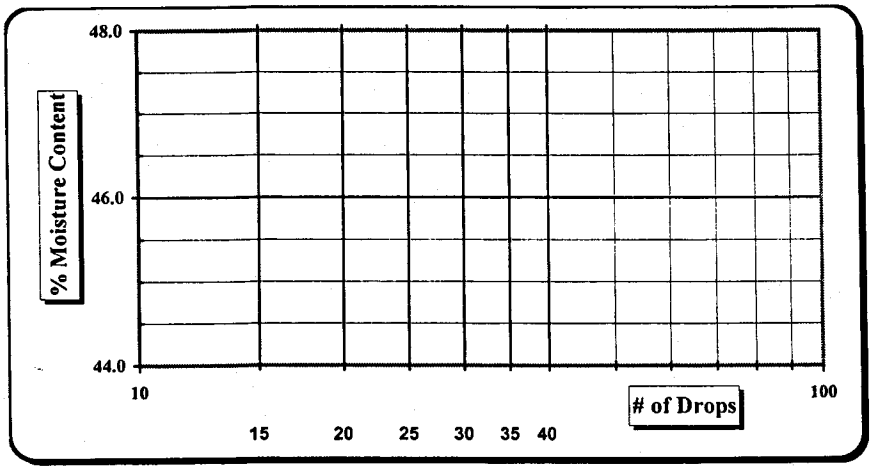
SAMPLE S10-12

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 27, 2003
Client Name:			
Boring #:	B-7	Sample #: U.D.	Sample Depth: 30-32'
Sample Description:	GRAY BROWN WHITE MICA. SL. CLAYEY SILTY M-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	
Plastic Limit	
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072
Project Name: Marshall Steam Station - Beneficial Fill
Client Name: Duke Energy
Boring #: B-7 Sample #: UD Sample Depth: 30 - 32 ft
Sample Description: Grey Brown and White Micaceous Slightly Clayey Silty Medium to Fine Sand

Report Date: March 1, 2003
Test Dates(s): February 27, 2003

VOL. FLASK NO.	33	VOL. FLASK NO.	35	VOL. FLASK NO.	70
WT. OF SOIL & VOL. FLASK	100.3	WT. OF SOIL & VOL. FLASK	101.44	WT. OF SOIL & VOL. FLASK	98.03
WT. OF VOL. FLASK	70.05	WT. OF VOL. FLASK	71.06	WT. OF VOL. FLASK	67.88
A. WT. OF SOIL	30.25	A. WT. OF SOIL	30.38	A. WT. OF SOIL	30.15
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.77	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	170.77	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	167.63
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	189.56	C. WT. OF VOL. FLASK, SOIL & WATER	190.36	C. WT. OF VOL. FLASK, SOIL & WATER	187.22
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.89	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.82	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.86

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	33
G_s = D x K	2.89
FLASK NO.	35
G_s = D x K	2.81
FLASK NO.	70
G_s = D x K	2.85
G_s (ave) =	2.85

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

lient:
roject: MARSHALL STEAM STATION
ect Number: 1264-02-578

Sample Data

Source:
Sample No.: U.D.
Elev. or Depth: 30-32'
Sample Length (in./cm.):
Location: B-7
Description: GRAY BROWN WHITE MICACEOUS SL. CLAYEY SILTY M-F SAND
Liquid Limit: NP
Plastic Limit: NP
USCS Classification: SM
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	160.81
Tare =	0.00
Dry sample weight =	160.81

Sample split on number 10 sieve
Split sample data:
Sample and tare = 100.00 Tare = .00 Sample weight = 100.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.02	100.0
# 20	16.17	83.8
# 40	37.36	62.6
# 60	56.53	43.5
# 100	74.32	25.7
# 200	88.50	11.5

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 100.00
Hygroscopic moisture correction:
Moist weight & tare = 27.10
Dry weight & tare = 26.94
Tare = 15.95
Hygroscopic moisture= 1.5 %
Calculated biased weight= 98.57
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.85
Specific gravity correction factor= 0.959
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

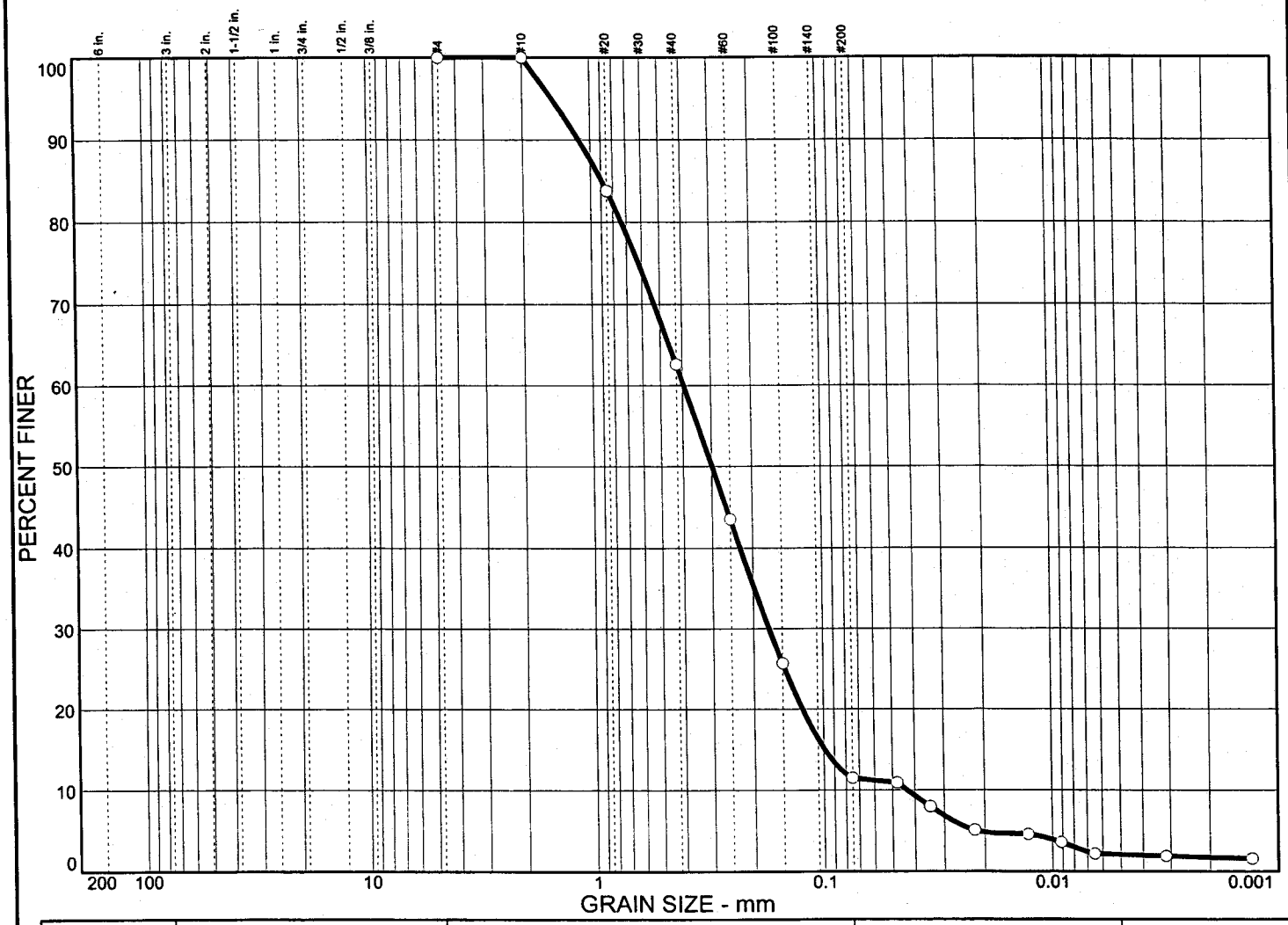
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	16.5	11.3	0.0130	17.5	13.4	0.0478	10.9
2.00	19.0	13.5	8.3	0.0130	14.5	13.9	0.0344	8.0
5.00	19.0	10.5	5.3	0.0130	11.5	14.4	0.0222	5.1
15.00	19.0	10.0	4.8	0.0130	11.0	14.5	0.0128	4.6
30.00	19.0	9.0	3.8	0.0130	10.0	14.7	0.0091	3.6
60.00	19.0	7.5	2.3	0.0130	8.5	14.9	0.0065	2.2
250.00	20.0	7.0	2.0	0.0129	8.0	15.0	0.0032	1.9
1440.00	21.0	6.5	1.7	0.0127	7.5	15.1	0.0013	1.6

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 88.5
% SILT = 9.4 **% CLAY =** 2.1

D_{85}= 0.89 D_{60}= 0.39 D_{50}= 0.30
D_{30}= 0.17 D_{15}= 0.10 D_{10}= 0.04
C_c= 1.7166 C_u= 9.1216

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	88.5	9.4	2.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.893	0.395	0.299	0.171	0.0990	0.0433	1.72	9.12

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY BROWN WHITE MICACEOUS SL. CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-7

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE B-7,U.D.

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 Project Name: MARSHALL STEAM STATION Date: 2-26-03

Sample Name: B-7 U.D. (30-32')

Sample Description: GRAY BROWN WHITE MICA. SL. CLAYEY SILTY M-F SAND

Type of Sample: UNDISTURBED (10 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.264	Tare No.	T-8	γ_{wet} (pcf)	0.0		Panel No	10
L (cm)	9.843	WWS+ Tare (gm)	305.71	γ_{dry} (pcf)			Cell P (psi)	91.0
A (cm^2)	41.44	WDS+Tare (gm)	286.57	w (%)			Soil P (psi)	81.0
V (cm^3)	407.91	WT of Water (gm)	19.14	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	709.5	WT of TARE (gm)	80.98	γ_{wet} (pcf)	108.6		Gs	2.85
		WT Dry Soil (gm)	205.59	γ_{dry} (pcf)	99.3		n	0.52
		w (%)	9.3	w (%)	9.3			

K = (Q x L) / (t x H x A)

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		0	0		14.5	0.3	24.7				
	21	0	1	60	14.5	24.7	0.4	24.4	70.4	0.9760	1.34E-03
2		0	0		14.5	0.0	24.5				
	21	0	1	60	14.5	24.4	0.2	24.4	70.4	0.9760	1.34E-03
3		0	0		14.5	0.2	25.0				
	21	0	1	60	14.5	24.0	0.6	24.1	70.4	0.9760	1.32E-03
4		0	0		14.5	0.0	24.7				
	21	0	1	60	14.5	23.9	0.2	24.2	70.4	0.9760	1.33E-03
5		0	0		14.5	0.6	24.5				
	21	0	1	60	14.5	24.7	0.5	24.1	70.4	0.9760	1.32E-03
6											
7										AVG. K	1.33E-03
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | Date: 2-28-03

Sample Name: B-7 U.D. (30-32')

Sample Description: GRAY BROWN WHITE MICA. SL. CLAYEY SILTY M-F SAND

Type of Sample: UNDISTURBED (20 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.264	Tare No.	T-8	γ_{wet} (pcf)	0.0		Panel No	10
L (cm)	9.843	WWS+ Tare (gm)	305.71	γ_{dry} (pcf)			Cell P (psi)	102.0
A (cm^2)	41.44	WDS+Tare (gm)	286.57	w (%)			Soil P (psi)	82.0
V (cm^3)	407.91	WT of Water (gm)	19.14	Actual Molding Condition			Back P (psi)	81.0
WWS (gm)	709.5	WT of TARE (gm)	80.98	γ_{wet} (pcf)	108.6		Gs	2.85
		WT Dry Soil (gm)	205.59	γ_{dry} (pcf)	99.3		n	0.52
		w (%)	9.3	w (%)	9.3			

$K = (Q \times L) / (t \times H \times A)$

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		0	0		8.4	0.2	24.0				
	21	0	1	60	8.4	24.4	0.2	24.0	70.4	0.9760	1.32E-03
2		0	0		8.4	0.5	24.3				
	21	0	1	60	8.4	24.6	0.2	24.1	70.4	0.9760	1.32E-03
3		0	0		8.4	0.1	24.5				
	21	0	1	60	8.4	24.2	0.4	24.1	70.4	0.9760	1.32E-03
4		0	0		8.4	0.5	24.5				
	21	0	1	60	8.4	24.7	0.2	24.3	70.4	0.9760	1.33E-03
5		0	0		8.4	0.2	24.5				
	21	0	1	60	8.4	24.4	0.2	24.3	70.4	0.9760	1.33E-03
6											
7										AVG. K	1.33E-03
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 Project Name: MARSHALL STEAM STATION Date: 3-4-03

Sample Name: B-7 U.D. (30-32')

Sample Description: GRAY BROWN WHITE MICA. SL. CLAYEY SILTY M-F SAND

Type of Sample: UNDISTURBED (30 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.264	Tare No.	T-8	γ_{wet} (pcf)	0.0		Panel No	10
L (cm)	9.843	WWS+ Tare (gm)	305.71	γ_{dry} (pcf)			Cell P (psi)	113.0
A (cm^2)	41.44	WDS+Tare (gm)	286.57	w (%)			Soil P (psi)	83.0
V (cm^3)	407.91	WT of Water (gm)	19.14	Actual Molding Condition			Back P (psi)	82.0
WWS (gm)	709.5	WT of TARE (gm)	80.98	γ_{wet} (pcf)	108.6		Gs	2.85
		WT Dry Soil (gm)	205.59	γ_{dry} (pcf)	99.3		n	0.52
		w (%)	9.3	w (%)	9.3			

$K = (Q \times L) / (t \times H \times A)$

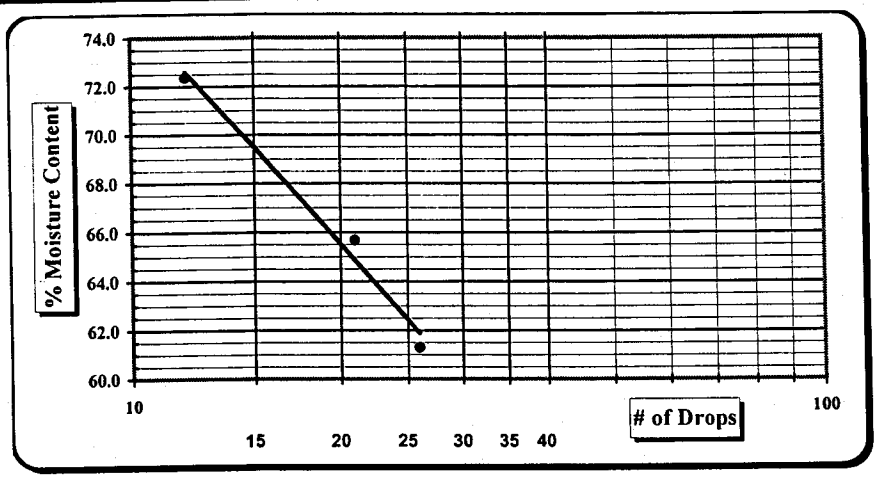
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		9	39		6.8	0.2	24.2				
	21	9	40	60	6.8	24.3	0.2	24.1	70.4	0.9760	1.32E-03
2		0	0		6.8	0.5	24.2				
	21	0	1	60	6.8	24.4	0.2	24.0	70.4	0.9760	1.31E-03
3		0	0		6.8	0.3	24.5				
	21	0	1	60	6.8	24.4	0.2	24.2	70.4	0.9760	1.33E-03
4		0	0		6.8	0.2	25.0				
	21	0	1	60	6.8	24.2	0.4	24.3	70.4	0.9760	1.33E-03
5		0	0		6.8	0.5	24.4				
	21	0	1	60	6.9	24.1	0.2	23.9	70.4	0.9760	1.31E-03
6											
7										AVG. K	1.32E-03
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	B-7	Sample #: BAG	Sample Depth: 10'
Sample Description:	RED CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	U	FF	RR				WN	Z	
A	Tare Weight	15.50	16.87	15.29				16.56	16.90	
B	Wet Soil Weight + A	25.92	26.91	24.27				23.50	25.12	
C	Dry Soil Weight + A	21.96	22.93	20.50				21.25	22.43	
D	Water Weight (B-C)	3.96	3.98	3.77				2.25	2.69	
E	Dry Soil Weight (C-A)	6.46	6.06	5.21				4.69	5.53	
F	% Moisture Content (D/E)*100	61.3%	65.7%	72.4%				48.0%	48.6%	
N	# OF DROPS	26	21	12						
Ave.	Average	66.4%						48.3%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve 2

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	62
Plastic Limit	48
Plastic Index	14
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072
Project Name: Marshall Steam Station - Beneficial Fill
Client Name: Duke Energy
Boring #: B-7 Sample #: Bag Sample Sample Depth: 10 ft
Sample Description: Red Clayey Silt

Report Date: March 3, 2003
Test Dates(s): March 1, 2003

VOL. FLASK NO.	47	VOL. FLASK NO.	63	VOL. FLASK NO.	13
WT. OF SOIL & VOL. FLASK	97.13	WT. OF SOIL & VOL. FLASK	99.34	WT. OF SOIL & VOL. FLASK	94.65
WT. OF VOL. FLASK	66.73	WT. OF VOL. FLASK	68.84	WT. OF VOL. FLASK	63.89
A. WT. OF SOIL	30.4	A. WT. OF SOIL	30.5	A. WT. OF SOIL	30.76
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	166.3	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.48	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	163.46
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	185.7	C. WT. OF VOL. FLASK, SOIL & WATER	187.85	C. WT. OF VOL. FLASK, SOIL & WATER	183.25
D. SPECIFIC GRAVITY $\frac{A}{A+(B-C)}$	2.76	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.74	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.80

SPECIFIC GRAVITY (Corrected) $G_s = D \times K =$

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	47
$G_s = D \times K$	2.76
FLASK NO.	63
$G_s = D \times K$	2.74
FLASK NO.	13
$G_s = D \times K$	2.80
G_s (ave) =	2.77

Technician Name: Karen Warner

S&ME Moisture - Density Relationship

Test Date(s): February 10, 2003
Report Date: February 11, 2003

S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:
Boring #: B-7 Sample #: BAG Sample Date: February 4, 2003
Location: Offset: Depth: 0-10'
Sample Description: RED CLAYEY SILT

Liquid Limit: 62 Specific Gravity: 2.770
Plastic Limit: 48 Plastic Index: 14

Natural Moisture Content (Total Sample):
Moisture Content of the Oversize Fraction:

NOTES:

Sieve Size	% Passing
3/4"	
1/2"	
3/8"	
#4	
#10	
#40	
#60	
#200	

MDD: 84.8 **Opt. MC %: 32.9**

Water Content

Water Content requires GP 2 Balance (0.1 gram Readability).

ASTM D2216 ☒ AASHTO T265 ☐ ASTM D4959 ☐ ASTM D4643 ☐

	Sample #:						
	Water Added:		As Is	50	125		
	Tare #:	89	JTJ	SEJ	535		
A. Tare Weight	A.	0	0	0	0		
B. Wet Wt + Tare Wt	B.	500	500	500	500		
C. Dry Wt. + Tare Wt.	C.	405.2	381.8	369.2	360.5		
D. Water Weight	B-C	94.8	118.2	130.8	139.5	0	0
E. Dry Weight	C-A	405.2	381.8	369.2	360.5	0	0
F. Moisture Content	100*D/E	**23.4%**	**31.0%**	**35.4%**	**38.7%**	**#DIV/0!**	**#DIV/0!**

Compaction Data

The Compaction Test requires a GP 5 Balance for ASTM (1 gram or .0022 Lb. readability).

G. Wt of Soil + Mold	G.	5761.000	5949.000	6000.000	5973.000		
H. Wt. of Mold	H.	4279.000	4279.000	4279.000	4279.000		
I. Wt. of Soil (g. or lbs.)	G-H	1482.000	1670.000	1721.000	1694.000	0.000	0.000
J. Wt of Soil (Lbs.)	I/453.6 or I	3.267	3.682	3.794	3.735	0.000	0.000
K. Mold Volume Factor	K.	29.97	29.97	29.97	29.97		
L. Wet Density	J*K	97.9	110.3	113.7	111.9	0.0	0.0
M. Dry Density	L/(1+F)	**79.4**	**84.3**	**84.0**	**80.7**	**#DIV/0!**	**#DIV/0!**

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (ASTM 1978) ☐ AASHTO Method D ☐

Moisture-Density Relation of: Fine Fraction ☒ Corrected for Coarse Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Hammer ☒ Manual Hammer ☐ Moist Preparation ☐ Dry Preparation ☒

Soil Plasticity: ASTM D 4318 ☐ AASHTO T 89 ☐ AASHTO T 90 ☐
Sieve Analysis / Particle Size Analysis: ASTM C136 ☐ AASHTO T 27 ☐ ASTM D 422 ☐ AASHTO T 88 ☐
Specific Gravity of Soil: ASTM D 854 ☐ AASHTO T 100 ☐
Bulk Gravity of Oversize Fraction: ASTM C 127 ☐ AASHTO T 85 ☐
Soil Classification: ASTM D 2487 ☐ ASTM D 2488 ☐ AASHTO M 145 ☐

Technician Name / Certification #: Matthew Johnson
Technical Responsibility: Julie Peterson

Moisture - Density Report

S&ME

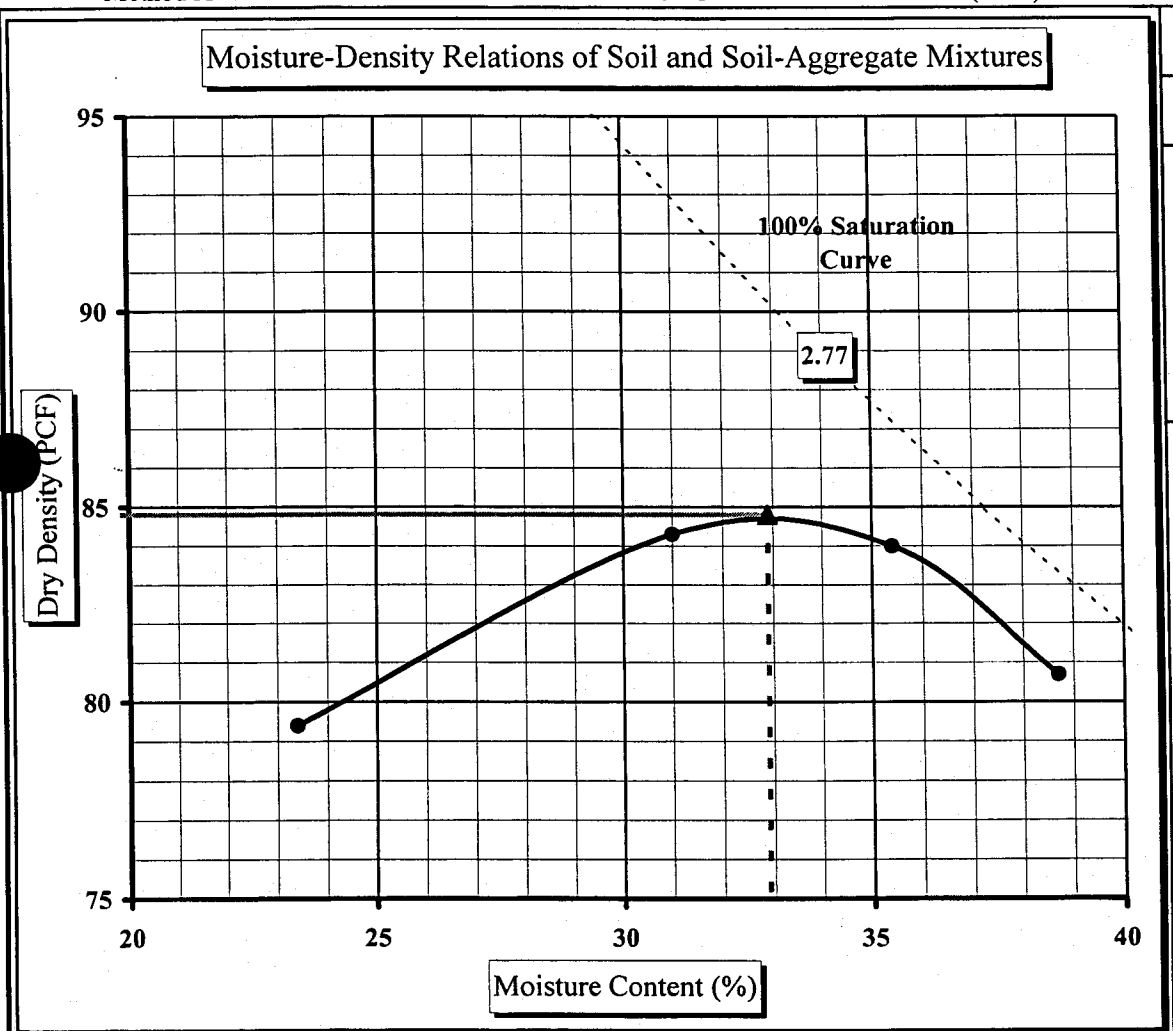
S&ME Project #: 1264-02-578
Project Name: Marshall Steam Station
Client Name:
Client Address:

Report Date: February 11, 2003
Test Date(s): February 10, 2003

Boring #: B-7 Sample #: BAG Sample Date: 2/4/2003
Location: Offset: Depth: 0-10'
Sample Description: RED CLAYEY SILT

Maximum Dry Density 84.8 PCF. **Optimum Moisture Content** 32.9 %

ASTM D558 ☐ ASTM D 698 ☒ ASTM D1557 ☐ AASHTO T99 ☐ AASHTO T180 ☐
Method A ☒ Method B ☐ Method C ☐ Method D (1978) ☐ AASHTO Method D ☐



Soil Properties

Natural Moisture Content

Liquid Limit: 62
Plastic Limit: 48
Plastic Index: 14
Specific Gravity: 2.770

% Passing
3/4"
1/2"
3/8"
#4
#10
#40
#60
#200

Oversize Fraction
Bulk Sp. Gravity
% Moisture
Oversize Fraction

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

References: ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Technical Responsibility: Julie Peterson 0

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 3/1/2003

Sample Name: B-7 BULK

Sample Description: RED CLAYEY SILT

Type of Sample: REMOLDED

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.29	Tare No.	G-1	γ_{wet} (pcf)	109.5		Panel No	4
L (cm)	7.62	WWS+ Tare (gm)	346.55	γ_{dry} (pcf)	80.6		Cell P (psi)	83.5
A (cm^2)	41.74	WDS+Tare (gm)	279.28	w (%)	35.9		Soil P (psi)	81.0
V (cm^3)	318.05	WT of Water (gm)	67.27	**Actual Molding Condition**			Back P (psi)	80.0
WWS (gm)	551.8	WT of TARE (gm)	82.82	γ_{wet} (pcf)	108.3		Gs	2.77
		WT Dry Soil (gm)	196.46	γ_{dry} (pcf)	80.7		n	0.49
		w (%)	34.2	w (%)	34.2			

$K = (Q \times L) / (t \times H \times A)$

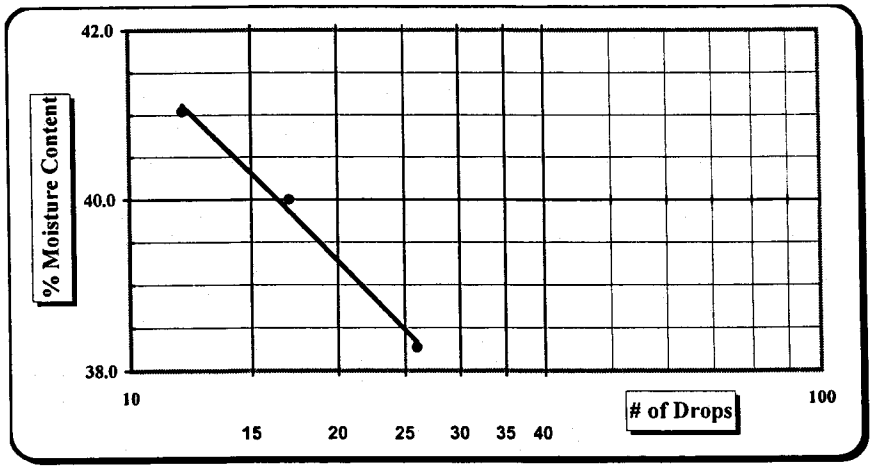
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		11	30		16.4	0.2	23.9				
	21	12	20	3000	16.4	23.1	1.2	22.8	70.4	0.9760	1.92E-05
2		13	24		16.4	0.1	24.4				
	21	14	18	3240	16.4	24.0	0.3	24.0	70.4	0.9760	1.88E-05
3		14	19		16.4	0.1	24.2				
	21	15	21	3720	16.4	24.2	0.2	24.1	70.4	0.9760	1.64E-05
4		16	1		16.5	0.1	24.3				
	21	17	0	3540	16.5	22.7	1.2	22.9	70.4	0.9760	1.63E-05
5		9	27		16.6	0.1	24.2				
	21	10	24	3420	16.6	22.8	1.2	22.9	70.4	0.9760	1.69E-05
7										AVG. K	1.71E-05
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	MS-1	Sample #: S-2	Sample Depth: 8.5-10'
Sample Description:	YELLOWISH RED SL. CLAYEY SILTY M- F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	69	73	BB				PO	BA	
A	Tare Weight	15.33	15.36	15.33				15.13	15.37	
B	Wet Soil Weight + A	23.35	24.25	24.54				22.14	21.89	
C	Dry Soil Weight + A	21.13	21.71	21.86				20.19	20.07	
D	Water Weight (B-C)	2.22	2.54	2.68				1.95	1.82	
E	Dry Soil Weight (C-A)	5.80	6.35	6.53				5.06	4.70	
F	% Moisture Content (D/E)*100	38.3%	40.0%	41.0%				38.5%	38.7%	
N	# OF DROPS	26	17	12						
Aye.	Average	39.8%						38.6%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	38
Plastic Limit	39
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-2
Elev. or Depth: 8.5-10' **Sample Length (in./cm.):**
Location: MS-1
Description: YELLOWISH RED SL. CLAYEY SILTY M-F SAND
Liquid Limit: NP **Plastic Limit:** NP
USCS Classification: SM **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	180.45
Tare =	0.00
Dry sample weight =	180.45

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 20	1.65	96.7
# 40	8.16	83.7
# 60	15.10	69.8
# 100	24.79	50.4
# 200	33.18	33.6

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 29.98
Dry weight & tare = 29.80
Tare = 15.97
Hygroscopic moisture= 1.3 %
Calculated biased weight= 49.36
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

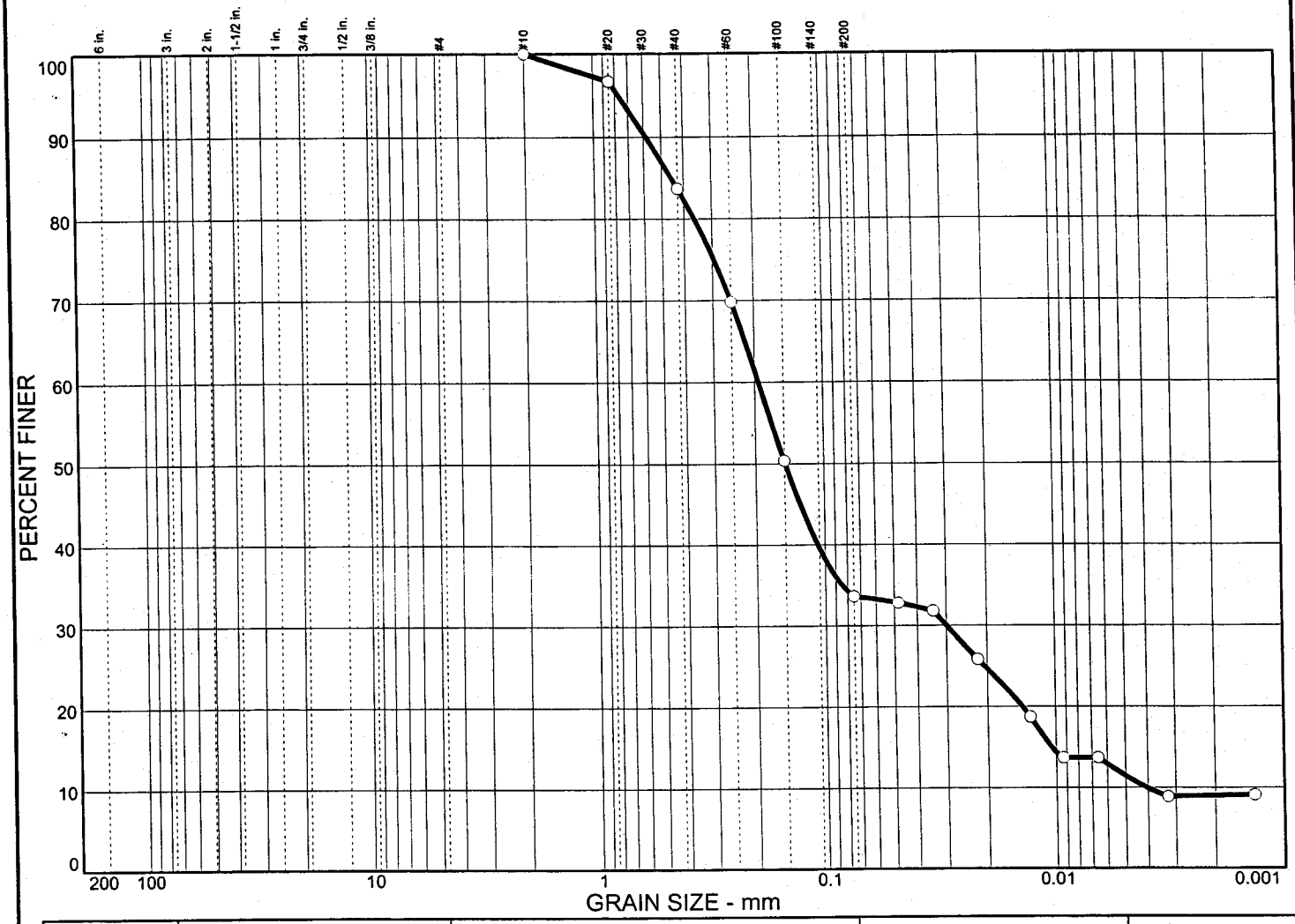
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	21.5	16.4	0.0135	22.5	12.6	0.0480	32.8
2.00	19.5	21.0	15.9	0.0135	22.0	12.7	0.0341	31.8
5.00	19.5	18.0	12.9	0.0135	19.0	13.2	0.0220	25.8
15.00	19.5	14.5	9.4	0.0135	15.5	13.8	0.0130	18.7
30.00	19.5	12.0	6.9	0.0135	13.0	14.2	0.0093	13.7
60.00	19.5	12.0	6.9	0.0135	13.0	14.2	0.0066	13.7
250.00	20.0	9.5	4.5	0.0134	10.5	14.6	0.0032	8.9
1440.00	20.5	9.5	4.6	0.0134	10.5	14.6	0.0013	9.1

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 66.4
% SILT = 22.1 **% CLAY =** 11.5

D_{85}= 0.45 D_{60}= 0.19 D_{50}= 0.15
D_{30}= 0.03 D_{15}= 0.01 D_{10}= 0.00
C_c= 1.1525 C_u= 47.5235

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	66.4	22.1	11.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.452	0.192	0.148	0.0299	0.0104	0.0040	1.15	47.52

MATERIAL DESCRIPTION	USCS	AASHTO
○ YELLOWISH RED SL. CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-1

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE S-2,MS-1

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #: 1264-02-578 Report Date: March 3, 2003

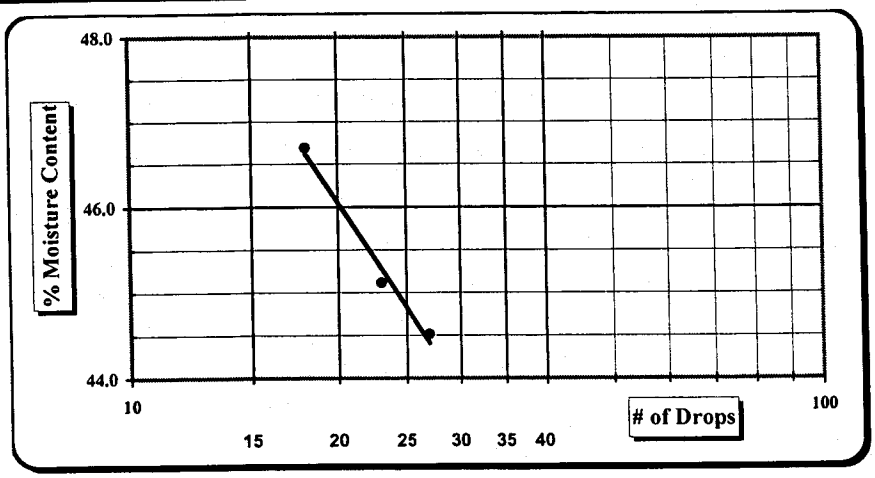
Project Name: MARSHALL STEAM STATION Test Date(s): February 27, 2003

Client Name:

Boring #: MS-1 Sample #: U.D. Sample Depth: 20-22'

Sample Description: GRAY WHITE CLAYEY M-F SANDY SILT

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	XY	ZY	XW				OO	I	
A	Tare Weight	15.93	15.53	15.21				16.32	15.36	
B	Wet Soil Weight + A	24.89	24.73	22.97				23.64	23.57	
C	Dry Soil Weight + A	22.13	21.87	20.50				21.79	21.54	
D	Water Weight (B-C)	2.76	2.86	2.47				1.85	2.03	
E	Dry Soil Weight (C-A)	6.20	6.34	5.29				5.47	6.18	
F	% Moisture Content (D/E)*100	44.5%	45.1%	46.7%				33.8%	32.8%	
N	# OF DROPS	27	23	18						
Ave.	Average	45.4%						33.3%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	45
Plastic Limit	33
Plastic Index	12
Group Symbol	ML

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072
Project Name: Marshall Steam Station - Beneficial Fill
Client Name: Duke Energy
Boring #: MS-1 Sample #: UD
Sample Description: Grey and White Clayey Medium to Fine Sandy Silt

Report Date: March 3, 2003
Test Dates(s): February 27, 2003
Sample Depth: 20 - 22 ft

VOL. FLASK NO.	43	VOL. FLASK NO.	73	VOL. FLASK NO.	57
WT. OF SOIL & VOL. FLASK	97.73	WT. OF SOIL & VOL. FLASK	99.15	WT. OF SOIL & VOL. FLASK	99.1
WT. OF VOL. FLASK	67.15	WT. OF VOL. FLASK	68.82	WT. OF VOL. FLASK	68.46
A. WT. OF SOIL	30.58	A. WT. OF SOIL	30.33	A. WT. OF SOIL	30.64
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	166.83	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.36	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.1
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	185.81	C. WT. OF VOL. FLASK, SOIL & WATER	187.26	C. WT. OF VOL. FLASK, SOIL & WATER	187.33
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.64	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.65	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.69

SPECIFIC GRAVITY (Corrected) $G_s = D \times K =$

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	43
$G_s = D \times K$	2.64
FLASK NO.	73
$G_s = D \times K$	2.65
FLASK NO.	57
$G_s = D \times K$	2.68
G_s (ave) =	2.66

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: U.D.
Elev. or Depth: 20-22'
Sample Length (in./cm.):
Location: MS-1
Description: GRAY WHITE CLAYEY M-F SANDY SILT
Liquid Limit: 45
Plastic Limit: 33
USCS Classification: ML
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	139.27
Tare =	0.00
Dry sample weight =	139.27

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	0.33	99.8
# 10	0.87	99.4
# 20	1.09	97.2
# 40	3.09	93.3
# 60	6.04	87.4
# 100	10.43	78.7
# 200	17.66	64.3

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 99.4
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 27.92
Dry weight & tare = 27.63
Tare = 15.19
Hygroscopic moisture= 2.3 %
Calculated biased weight= 49.16
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.66
Specific gravity correction factor= 0.998
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

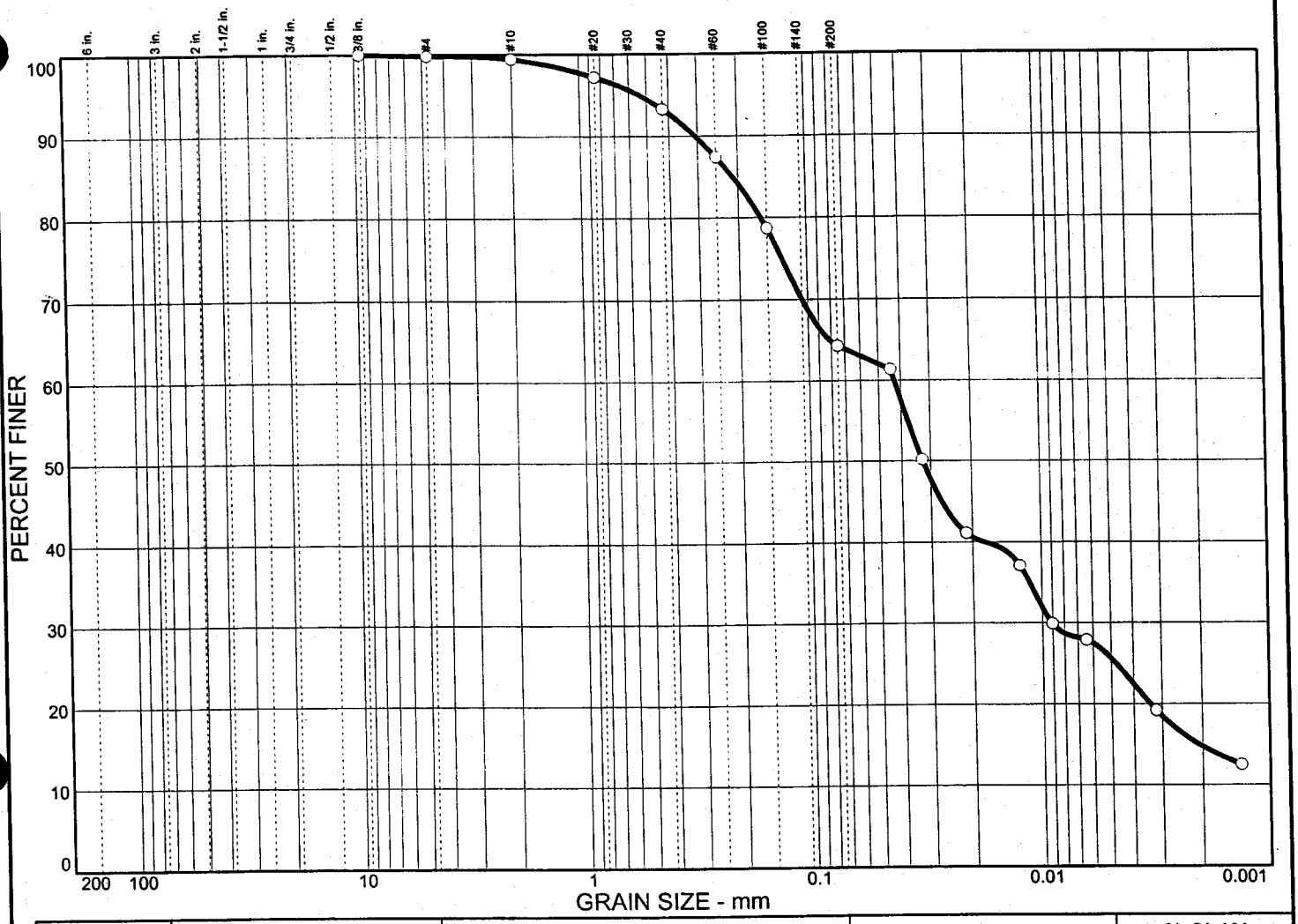
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	35.5	30.3	0.0138	36.5	10.3	0.0442	61.4
2.00	19.0	30.0	24.8	0.0138	31.0	11.2	0.0326	50.2
5.00	19.0	25.5	20.3	0.0138	26.5	11.9	0.0213	41.1
15.00	19.0	23.5	18.3	0.0138	24.5	12.3	0.0125	37.1
30.00	19.0	20.0	14.8	0.0138	21.0	12.9	0.0090	29.9
60.00	19.0	19.0	13.8	0.0138	20.0	13.0	0.0064	27.9
250.00	20.0	14.5	9.5	0.0136	15.5	13.8	0.0032	19.2
1440.00	21.0	11.0	6.2	0.0134	12.0	14.3	0.0013	12.5

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** 0.2 **% SAND =** 35.5
% SILT = 38.7 **% CLAY =** 25.6

D_{85}= 0.21 D_{60}= 0.04 D_{50}= 0.03
D_{30}= 0.01 D_{15}= 0.00

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.2	35.5	38.7	25.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	45	33	0.211	0.0427	0.0324	0.0091	0.0021			

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY WHITE CLAYEY M-F SANDY SILT	ML	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-1

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE U.D.,MS-1

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | Date: 2-26-03

Sample Name: MS-1 U.D. (20-22')

Sample Description: GRAY WHITE CLAYEY M-F SANDY SILT

Type of Sample: UNDISTURBED (10 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.29	Tare No.	S-1	γ_{wet} (pcf)	0.0		Panel No	8
L (cm)	7.303	WWS+ Tare (gm)	370.7	γ_{dry} (pcf)			Cell P (psi)	91.0
A (cm^2)	41.74	WDS+Tare (gm)	291.24	w (%)			Soil P (psi)	81.0
V (cm^3)	304.82	WT of Water (gm)	79.46	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	588.2	WT of TARE (gm)	81.47	γ_{wet} (pcf)	120.5		Gs	2.66
		WT Dry Soil (gm)	209.77	γ_{dry} (pcf)	87.4		n	0.46
		w (%)	37.9	w (%)	37.9			

$K = (Q \times L) / (t \times H \times A)$

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		8	55		13.5	0.1	24.4				
	21	17	45	31800	13.6	2.7	20.6	3.2	70.4	0.9760	2.44E-07
2		8	46		13.6	0.1	24.6				
	21	17	44	32280	13.6	2.6	21.3	2.9	70.4	0.9760	2.18E-07
3		8	45		13.7	0.0	24.5				
	21	17	23	31080	13.7	2.8	21.8	2.8	70.4	0.9760	2.15E-07
4		9	7		13.7	0.1	24.5				
	21	17	51	31440	13.7	5.6	24.1	3.0	70.4	0.9760	2.28E-07
5		8	45		13.8	0.0	24.5				
	21	17	43	32280	13.8	2.5	21.0	3.0	70.4	0.9760	2.26E-07
6											
7										AVG. K	2.21E-07
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | Date: 2-26-03

Sample Name: MS-1 U.D. (20-22')

Sample Description: GRAY WHITE CLAYEY M-F SANDY SILT

Type of Sample: UNDISTURBED (20 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.29	Tare No.	S-1	γ_{wet} (pcf)	0.0		Panel No	8
L (cm)	7.303	WWS+ Tare (gm)	370.7	γ_{dry} (pcf)			Cell P (psi)	102.0
A (cm^2)	41.74	WDS+Tare (gm)	291.24	w (%)			Soil P (psi)	82.0
V (cm^3)	304.82	WT of Water (gm)	79.46	**Actual Molding Condition**			Back P (psi)	81.0
WWS (gm)	588.2	WT of TARE (gm)	81.47	γ_{wet} (pcf)	120.5		Gs	2.66
		WT Dry Soil (gm)	209.77	γ_{dry} (pcf)	87.4		n	0.46
		w (%)	37.9	w (%)	37.9			

$K = (Q \times L) / (t \times H \times A)$

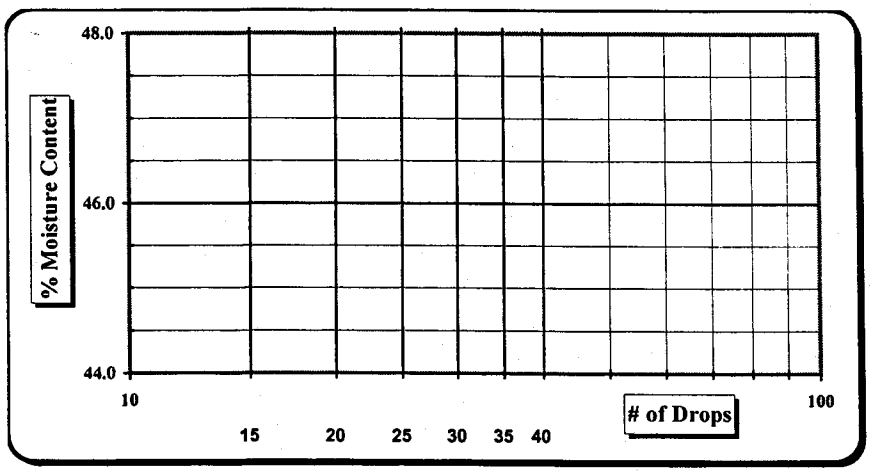
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		9	25		7.1	0.2	23.3				
	21	16	47	26520	7.1	2.3	20.7	2.4	70.4	0.9760	2.15E-07
2		8	30		7.1	0.0	24.5				
	21	14	5	20100	7.1	1.9	22.8	1.8	70.4	0.9760	2.17E-07
3		11	11		7.1	0.0	24.4				
	21	17	6	21300	7.2	1.8	22.4	1.9	70.4	0.9760	2.16E-07
										AVG. K	2.16E-07

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 27, 2003
Client Name:			
Boring #:	MS-3	Sample #: U.D.	Sample Depth: 15-17'
Sample Description:	GRAY BROWN WHITE SL. CLAYEY SILTY C-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	
Plastic Limit	
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072
Project Name: Marshall Steam Station - Beneficial Fill
Client Name: Duke Energy
Boring #: MS-3 Sample #: UD
Sample Description: Grey Brown and White Slightly Clayey Silty Coarse to Fine Sand

Report Date: March 1, 2003
Test Dates(s): February 27, 2003
Sample Depth: 15 - 17 ft

VOL. FLASK NO.	67	VOL. FLASK NO.	61	VOL. FLASK NO.	59
WT. OF SOIL & VOL. FLASK	100.35	WT. OF SOIL & VOL. FLASK	99.32	WT. OF SOIL & VOL. FLASK	99.28
WT. OF VOL. FLASK	69.85	WT. OF VOL. FLASK	68.46	WT. OF VOL. FLASK	68.47
A. WT. OF SOIL	30.5	A. WT. OF SOIL	30.86	A. WT. OF SOIL	30.81
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.56	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.14	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.12
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	188.89	C. WT. OF VOL. FLASK, SOIL & WATER	187.73	C. WT. OF VOL. FLASK, SOIL & WATER	187.75
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.73	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.74	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.76

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	67
G_s = D x K	2.73
FLASK NO.	61
G_s = D x K	2.74
FLASK NO.	59
G_s = D x K	2.75
G_s (ave) =	2.74

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: U.D.
Elev. or Depth: 15-17'
Sample Length (in./cm.):
Location: MS-3
Description: GRAY BROWN WHITE SL.CLAYEY SILTY C-F SAND
Liquid Limit: NP
Plastic Limit: NP
USCS Classification: SM
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	285.56
Tare =	0.00
Dry sample weight =	285.56

Sample split on number 10 sieve
Split sample data:
Sample and tare = 100.00 Tare = .00 Sample weight = 100.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	0.82	99.7
# 10	14.93	94.8
# 20	5.76	89.3
# 40	13.77	81.7
# 60	29.80	66.5
# 100	53.17	44.4
# 200	76.36	22.4

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 94.8
Weight of hydrometer sample: 100.00
Hygroscopic moisture correction:
Moist weight & tare = 28.55
Dry weight & tare = 28.35
Tare = 16.32
Hygroscopic moisture= 1.7 %
Calculated biased weight= 103.76
Automatic temperature correction
Composite correction at 20 deg C = -6

Meniscus correction only= 1
Specific gravity of solids= 2.74
Specific gravity correction factor= 0.980
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

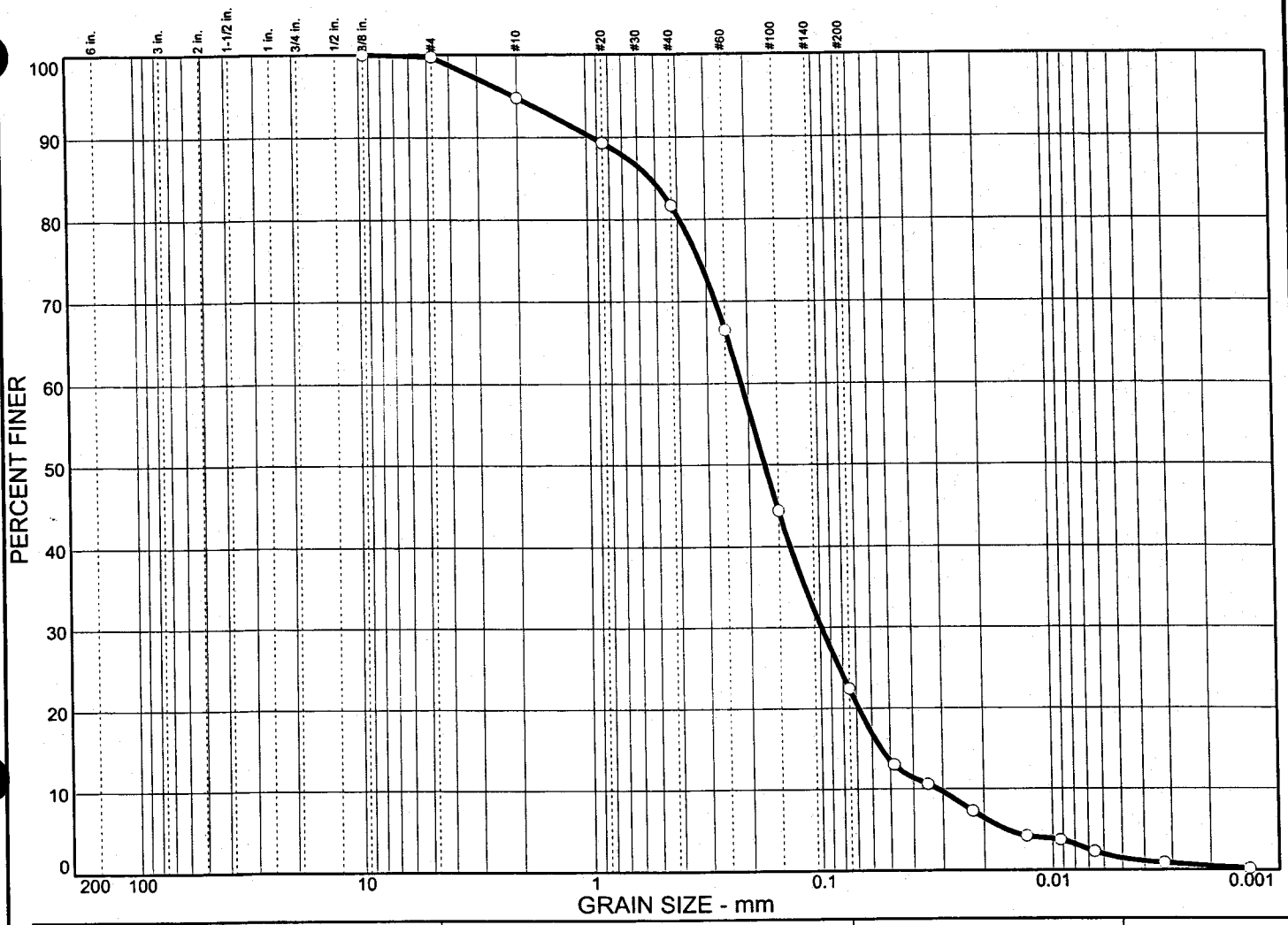
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	20.0	13.8	0.0135	21.0	12.9	0.0482	13.0
2.00	19.0	17.5	11.3	0.0135	18.5	13.3	0.0346	10.6
5.00	19.0	14.0	7.8	0.0135	15.0	13.8	0.0224	7.3
15.00	20.0	10.5	4.5	0.0133	11.5	14.4	0.0130	4.2
30.00	20.0	10.0	4.0	0.0133	11.0	14.5	0.0092	3.7
60.00	20.0	8.5	2.5	0.0133	9.5	14.7	0.0066	2.3
250.00	20.0	7.0	1.0	0.0133	8.0	15.0	0.0033	0.9
1440.00	21.0	6.0	0.2	0.0131	7.0	15.1	0.0013	0.2

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** 0.3 **% SAND =** 77.3
% SILT = 20.9 **% CLAY =** 1.5

D_{85}= 0.52 D_{60}= 0.21 D_{50}= 0.17
D_{30}= 0.10 D_{15}= 0.05 D_{10}= 0.03
C_c= 1.4459 C_u= 6.7861

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.3	77.3	20.9	1.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.524	0.214	0.171	0.0988	0.0547	0.0315	1.45	6.79

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY BROWN WHITE SL.CLAYEY SILTY C-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-3

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE U.D.,MS-3

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/26/2003

Sample Name: MS-3 U.D. (15-17')

Sample Description: GRAY BROWN WHITE SL. CLAYEY SILTY C-F SAND

Type of Sample: UNDISTURBED (10 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.264	Tare No.	G-13	γ_{wet} (pcf)	0.0		Panel No	7
L (cm)	8.89	WWS+ Tare (gm)	275.91	γ_{dry} (pcf)			Cell P (psi)	91.0
A (cm^2)	41.44	WDS+Tare (gm)	228.95	w (%)			Soil P (psi)	81.0
V (cm^3)	368.42	WT of Water (gm)	46.96	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	701.6	WT of TARE (gm)	81.28	γ_{wet} (pcf)	118.9		Gs	2.74
		WT Dry Soil (gm)	147.67	γ_{dry} (pcf)	90.2		n	0.54
		w (%)	31.8	w (%)	31.8			

$K = (Q \times L) / (t \times H \times A)$

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		0	0		10.2	0.2	23.7				
	21	0	2	120	10.2	23.8	0.1	23.6	70.4	0.9760	5.85E-04
2		0	0		10.2	0.2	23.7				
	21	0	2	120	10.2	23.8	0.1	23.6	70.4	0.9760	5.85E-04
3		0	0		10.2	0.1	24.6				
	21	0	2	120	10.2	24.6	0.2	24.5	70.4	0.9760	6.06E-04
4		0	0		10.2	0.0	24.5				
	21	0	2	120	10.2	21.1	3.1	21.3	70.4	0.9760	5.27E-04
5		0	0		10.2	0.1	24.3				
	21	0	2	120	10.2	24.3	1.9	23.3	70.4	0.9760	5.78E-04
7										AVG. K	5.74E-04
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/28/2003

Sample Name: MS-3 U.D. (15-17'

Sample Description: GRAY BROWN WHITE SL. CLAYEY SILTY C-F SAND

Type of Sample: UNDISTURBED (20 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.264	Tare No.	G-13	γ_{wet} (pcf)	0.0		Panel No	7
L (cm)	8.89	WWS+ Tare (gm)	275.91	γ_{dry} (pcf)			Cell P (psi)	102.0
A (cm^2)	41.44	WDS+Tare (gm)	228.95	w (%)			Soil P (psi)	82.0
V (cm^3)	368.42	WT of Water (gm)	46.96	Actual Molding Condition			Back P (psi)	81.0
WWS (gm)	701.6	WT of TARE (gm)	81.28	γ_{wet} (pcf)	118.9		Gs	2.74
		WT Dry Soil (gm)	147.67	γ_{dry} (pcf)	90.2		n	0.54
		w (%)	31.8	w (%)	31.8			

$K = (Q \times L) / (t \times H \times A)$

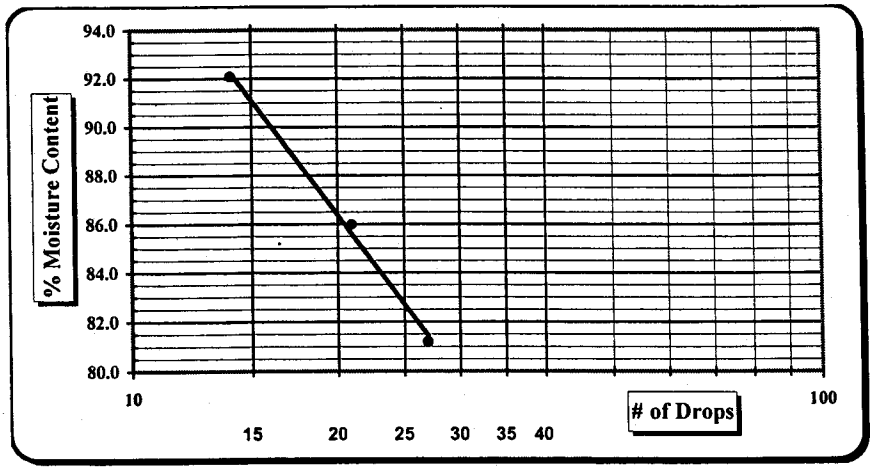
Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		0	0		9	0.0	24.4				
	21	0	2	120	9	24.3	0.0	24.4	70.4	0.9760	6.04E-04
2		0	0		9	0.0	24.3				
	21	0	2	120	9	24.0	0.2	24.1	70.4	0.9760	5.96E-04
3		0	0		9	0.1	24.6				
	21	0	2	120	9	24.5	0.1	24.5	70.4	0.9760	6.06E-04
4		0	0		9.1	0.1	24.8				
	21	0	2	120	9.1	24.7	0.1	24.7	70.4	0.9760	6.11E-04
5		0	0		9.1	0.2	24.8				
	21	0	2	120	9.1	24.6	0.2	24.5	70.4	0.9760	6.07E-04
7										AVG. K	6.05E-04
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	February 28, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	MS-4	Sample #: S-1	Sample Depth: 3.5-5'
Sample Description:	RED SL. SANDY CLAYEY SILT		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	TS	Z	JORDI				KK	XW	
A	Tare Weight	15.31	16.88	15.95				16.08	15.28	
B	Wet Soil Weight + A	22.25	23.91	24.44				23.37	21.67	
C	Dry Soil Weight + A	19.14	20.66	20.37				20.93	19.56	
D	Water Weight (B-C)	3.11	3.25	4.07				2.44	2.11	
E	Dry Soil Weight (C-A)	3.83	3.78	4.42				4.85	4.28	
F	% Moisture Content (D/E)*100	81.2%	86.0%	92.1%				50.3%	49.3%	
N	# OF DROPS	27	21	14						
Ave.	Average	86.4%						49.8%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	83
Plastic Limit	50
Plastic Index	33
Group Symbol	MH

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072 Report Date: March 1, 2003
Project Name: Marshall Steam Station - Beneficial Fill Test Dates(s): February 28, 2003
Client Name: Duke Energy
Boring #: MS-4 Sample #: S-1 Sample Depth: 3.5 - 5 ft
Sample Description: Red Slightly Sandy Clayey Silt

VOL. FLASK NO.	64	VOL. FLASK NO.	29	VOL. FLASK NO.	
WT. OF SOIL & VOL. FLASK	99.03	WT. OF SOIL & VOL. FLASK	100.35	WT. OF SOIL & VOL. FLASK	
WT. OF VOL. FLASK	68.73	WT. OF VOL. FLASK	69.8	WT. OF VOL. FLASK	
A. WT. OF SOIL	30.3	A. WT. OF SOIL	30.55	A. WT. OF SOIL	
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	168.36	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.53	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	
C. WT. OF VOL. FLASK, SOIL & WATER	187.5	C. WT. OF VOL. FLASK, SOIL & WATER	188.85	C. WT. OF VOL. FLASK, SOIL & WATER	
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.72	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.72	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	64
G_s = D x K	2.71
FLASK NO.	29
G_s = D x K	2.72
FLASK NO.	
G_s = D x K	
G_s (ave) =	2.72

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

lient:
roject: MARSHALL STEAM STATION
ro[redacted]ct Number: 1264-02-578

Sample Data

Source:
Sample No.: S-1
Elev. or Depth: 3.5-5'
Location: MS-4
Description: RED SL. SANDY CLAYEY SILT
Liquid Limit: 83
USCS Classification: MH
Testing Remarks: TESTED BY KMW

Sample Length (in./cm.):

Plastic Limit: 50
AASHTO Classification:

Mechanical Analysis Data

	Initial
Dry sample and tare=	129.73
Tare =	0.00
Dry sample weight =	129.73

Sample split on number 10 **sieve**
Split sample data:
Sample and tare = 50.00 **Tare =** .00 **Sample weight =** 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve [redacted]	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.01	100.0
# 20	0.09	99.8
# 40	0.49	99.0
# 60	2.28	95.4
# 100	5.71	88.6
# 200	8.73	82.5

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 25.26
Dry weight & tare = 25.03
Tare = 15.15
Hygroscopic moisture= 2.3 %
Calculated biased weight= 48.86
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Sp[redacted]ific gravity of solids= 2.72
Sp[redacted]ific gravity correction factor= 0.985
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

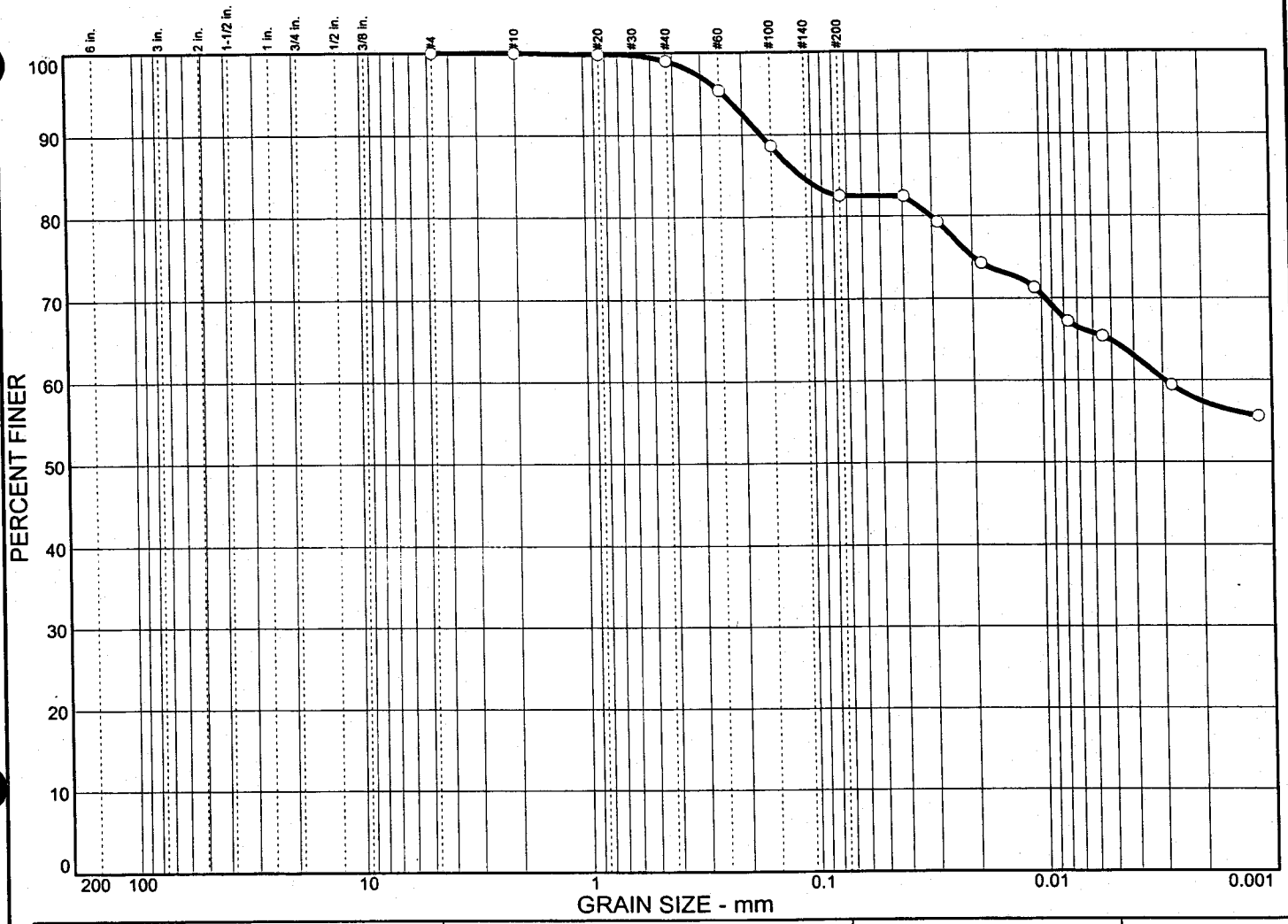
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	46.0	40.9	0.0134	47.0	8.6	0.0394	82.4
2.00	19.5	44.5	39.4	0.0134	45.5	8.8	0.0283	79.3
5.00	19.5	42.0	36.9	0.0134	43.0	9.2	0.0183	74.3
[illegible].00	19.5	40.5	35.4	0.0134	41.5	9.5	0.0107	71.3
30.00	19.5	38.5	33.4	0.0134	39.5	9.8	0.0077	67.2
60.00	20.0	37.5	32.5	0.0134	38.5	10.0	0.0055	65.4
250.00	20.0	34.5	29.5	0.0134	35.5	10.5	0.0027	59.4
1440.00	20.5	32.5	27.6	0.0133	33.5	10.8	0.0012	55.6

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = % GRAVEL = % SAND = 17.5
% SILT = 17.6 % CLAY = 64.9

D_{85}= 0.11 D_{60}= 0.00

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	17.5	17.6	64.9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	83	50	0.111	0.0029						

MATERIAL DESCRIPTION	USCS	AASHTO
○ RED SL. SANDY CLAYEY SILT	MH	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-4

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

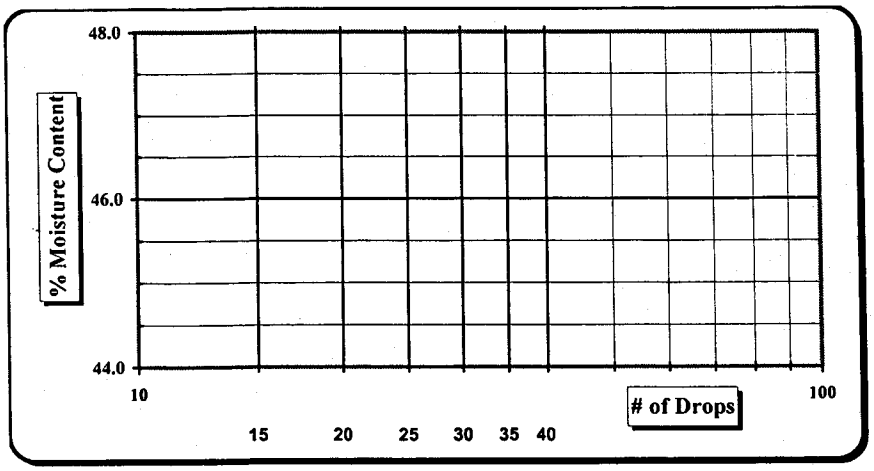
SAMPLE S-1,MS-4

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 27, 2003
Client Name:			
Boring #:	MS-5	Sample #: U.D.	Sample Depth: 32-34'
Sample Description:	GRAY TAN BROWN MICA. SL. CLAYEY SILTY C-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	
Plastic Limit	
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #:	1264-03-072	Report Date:	March 1, 2003
Project Name:	Marshall Steam Station - Beneficial Fill	Test Dates(s):	February 27, 2003
Client Name:	Duke Energy		
Boring #:	MS-5	Sample #: UD	Sample Depth: 32 - 34 ft
Sample Description:	Grey Tan and Brown Micaceous Slightly Clayey Silty Coarse to Fine Sand		

VOL. FLASK NO.	39	VOL. FLASK NO.	27	VOL. FLASK NO.	51
WT. OF SOIL & VOL. FLASK	92.92	WT. OF SOIL & VOL. FLASK	100.01	WT. OF SOIL & VOL. FLASK	97.75
WT. OF VOL. FLASK	62.06	WT. OF VOL. FLASK	69.83	WT. OF VOL. FLASK	67.19
A. WT. OF SOIL	30.86	A. WT. OF SOIL	30.18	A. WT. OF SOIL	30.56
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	161.65	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	169.54	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	166.66
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	22
C. WT. OF VOL. FLASK, SOIL & WATER	181.18	C. WT. OF VOL. FLASK, SOIL & WATER	188.57	C. WT. OF VOL. FLASK, SOIL & WATER	186.07
D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.72	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.71	D. SPECIFIC GRAVITY = $\frac{A}{A+(B-C)}$	2.74

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	39
G_s = D x K	2.72
FLASK NO.	27
G_s = D x K	2.71
FLASK NO.	51
G_s = D x K	2.74
G_s (ave) =	2.72

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: U.D.
Elev. or Depth: 32-34' **Sample Length (in./cm.):**
Location: MS-5
Description: GRAY TAN BROWN MICACEOUS SL. CLAYEY SILTY C-F SAND
Liquid Limit: NP **Plastic Limit:** NP
USCS Classification: SM **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	356.62
Tare =	0.00
Dry sample weight =	356.62

Sample split on number 10 sieve
Split sample data:
Sample and tare = 100.00 Tare = .00 Sample weight = 100.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	0.05	100.0
# 10	22.08	93.8
# 20	3.76	90.3
# 40	13.39	81.2
# 60	31.60	64.2
# 100	53.70	43.4
# 200	77.32	21.3

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 93.8
Weight of hydrometer sample: 100.00
Hygroscopic moisture correction:
Moist weight & tare = 29.47
Dry weight & tare = 29.34
Tare = 15.94
Hygroscopic moisture= 1.0 %
Calculated biased weight= 105.59
Automatic temperature correction
Composite correction at 20 deg C = -7

Meniscus correction only= 1
Specific gravity of solids= 2.72
Specific gravity correction factor= 0.985
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

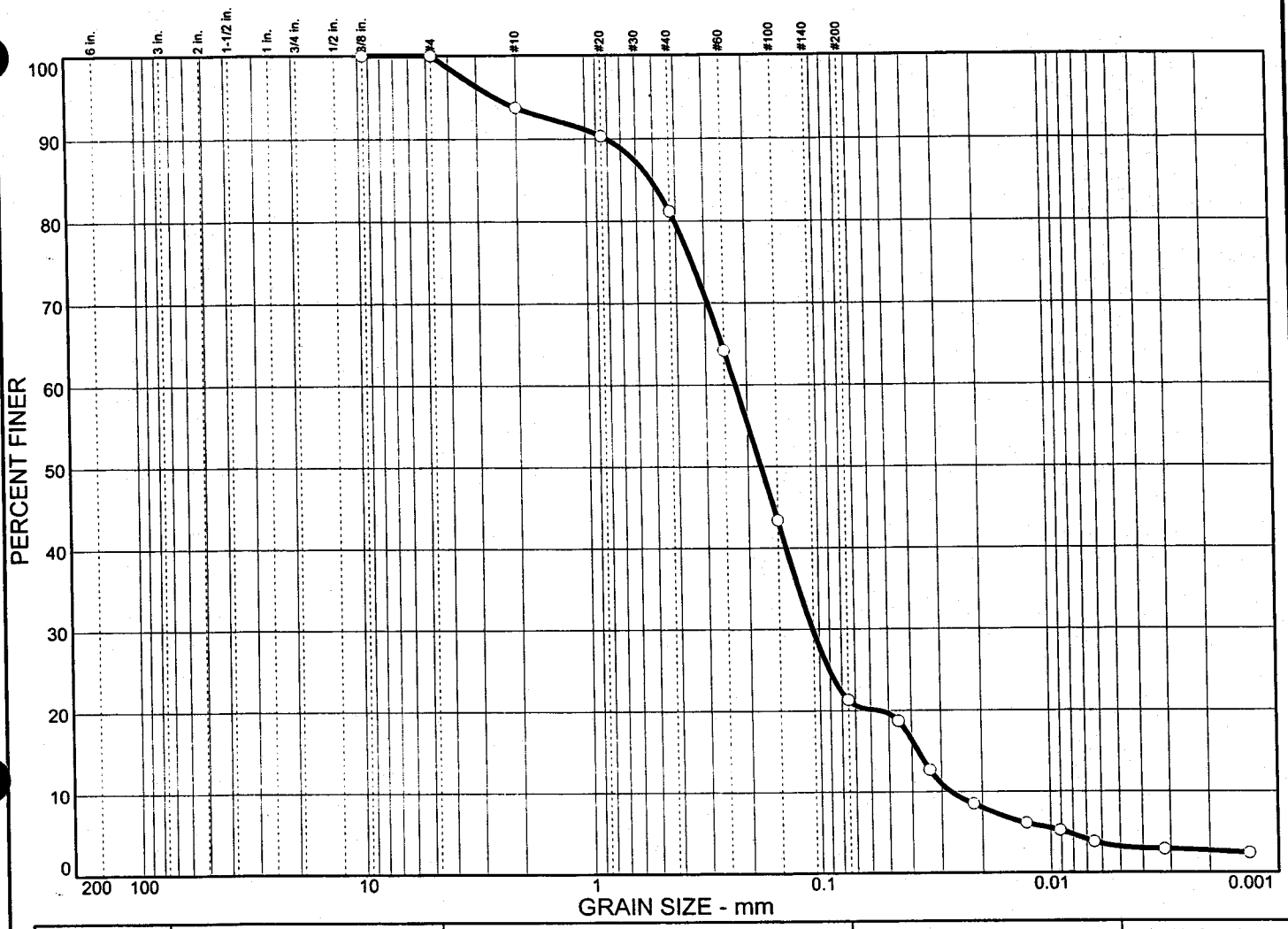
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	20.5	27.0	20.1	0.0133	28.0	11.7	0.0454	18.7
2.00	20.5	20.5	13.6	0.0133	21.5	12.8	0.0336	12.7
5.00	20.5	16.0	9.1	0.0133	17.0	13.5	0.0218	8.5
15.00	20.5	13.5	6.6	0.0133	14.5	13.9	0.0128	6.1
30.00	20.5	12.5	5.6	0.0133	13.5	14.1	0.0091	5.2
60.00	20.5	11.0	4.1	0.0133	12.0	14.3	0.0065	3.8
250.00	20.5	10.0	3.1	0.0133	11.0	14.5	0.0032	2.9
1440.00	20.5	9.5	2.6	0.0133	10.5	14.6	0.0013	2.4

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 78.7
% SILT = 18.1 **% CLAY =** 3.2

D_{85}= 0.51 D_{60}= 0.22 D_{50}= 0.18
D_{30}= 0.11 D_{15}= 0.04 D_{10}= 0.03
C_c= 1.8577 C_u= 8.1972

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	78.7	18.1	3.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.513	0.224	0.176	0.107	0.0375	0.0274	1.86	8.20

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY TAN BROWN MICACEOUS SL. CLAYEY SILTY C-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-5

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE MS-5,U.D.

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 2/28/2003

Sample Name: MS-5 U.D. (32-34')

Sample Description: GRAY TAN BROWN MICA. SL. CLAYEY SILTY C-F SAND

Type of Sample: UNDISTURBED (10 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.272	Tare No.	G-10	γ_{wet} (pcf)	0.0		Panel No	9
L (cm)	10.48	WWS+ Tare (gm)	390	γ_{dry} (pcf)			Cell P (psi)	91.0
A (cm^2)	41.53	WDS+Tare (gm)	333	w (%)			Soil P (psi)	81.0
V (cm^3)	435.19	WT of Water (gm)	57	Actual Molding Condition			Back P (psi)	80.0
WWS (gm)	838.8	WT of TARE (gm)	81.5	γ_{wet} (pcf)	120.3		Gs	2.72
		WT Dry Soil (gm)	251.5	γ_{dry} (pcf)	98.1		n	0.58
		w (%)	22.7	w (%)	22.7			

K = (Q x L) / (t x H x A)

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		0	0		14.4	0.1	24.3				
	21	0	4	240	14.4	24.1	0.2	24.1	70.4	0.9760	3.51E-04
2		0	0		14.4	0.1	24.5				
	21	0	4	240	14.4	24.0	0.5	24.0	70.4	0.9760	3.49E-04
3		0	0		14.5	0.0	24.0				
	21	0	4	240	14.5	21.5	1.3	22.1	70.4	0.9760	3.22E-04
4		0	0		14.5	0.1	24.7				
	21	0	4	240	14.6	24.3	0.2	24.4	70.4	0.9760	3.55E-04
5		0	0		14.6	0.1	24.6				
	21	0	4	240	14.6	24.3	0.2	24.3	70.4	0.9760	3.54E-04
7										AVG. K	3.45E-04
8										(Runs 2 thru 5)	
9											
10											

CONSTANT HEAD PERMEABILITY

ASTM D5084

S&ME Project Number: 1264-02-578 | Project Name: MARSHALL STEAM STATION | 3/4/2003

Sample Name: MS-5 U.D. (32-34')

Sample Description: GRAY TAN BROWN MICA. SL. CLAYEY SILTY C-F SAND

Type of Sample: UNDISTURBED (20 PSI)

Sample Data		Molding Moisture Content		Target Molding Conditon			Additonal Data	
D (cm)	7.272	Tare No.	G-10	γ_{wet} (pcf)	0.0		Panel No	9
L (cm)	10.48	WWS+ Tare (gm)	390	γ_{dry} (pcf)			Cell P (psi)	102.0
A (cm^2)	41.53	WDS+Tare (gm)	333	w (%)			Soil P (psi)	82.0
V (cm^3)	435.19	WT of Water (gm)	57	Actual Molding Condition			Back P (psi)	81.0
WWS (gm)	838.8	WT of TARE (gm)	81.5	γ_{wet} (pcf)	120.3		Gs	2.72
		WT Dry Soil (gm)	251.5	γ_{dry} (pcf)	98.1		n	0.58
		w (%)	22.7	w (%)	22.7			

$K = (Q \times L) / (t \times H \times A)$

Run	Temp. (^{0}C)	Hour	Minute	Time, t (sec)	BURRETTE 1 (cc)	BURRETTE 2 (cc)	BURRETTE 3 (cc)	Q (cc)	Δ H (cm)	Temp Corr.	K(cm/sec
1		0	0		10.2	0.2	24.9				
	21	0	3	180	10.2	24.4	0.2	24.5	70.4	0.9760	4.75E-04
2		0	0		10.2	0.3	24.3				
	21	0	3	180	10.2	24.2	0.2	24.0	70.4	0.9760	4.66E-04
3		0	0		10.3	0.2	24.5				
	21	0	3	180	10.3	24.1	0.3	24.1	70.4	0.9760	4.67E-04
4		0	0		10.3	0.2	24.5				
	21	0	3	180	10.3	24.1	0.3	24.1	70.4	0.9760	4.67E-04
5		0	0		10.3	0.1	24.3				
	21	0	3	180	10.3	23.9	0.2	24.0	70.4	0.9760	4.66E-04
7										AVG. K	4.67E-04
8										(Runs 2 thru 5)	
9											
10											

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #: 1264-02-578 Report Date: February 28, 2003

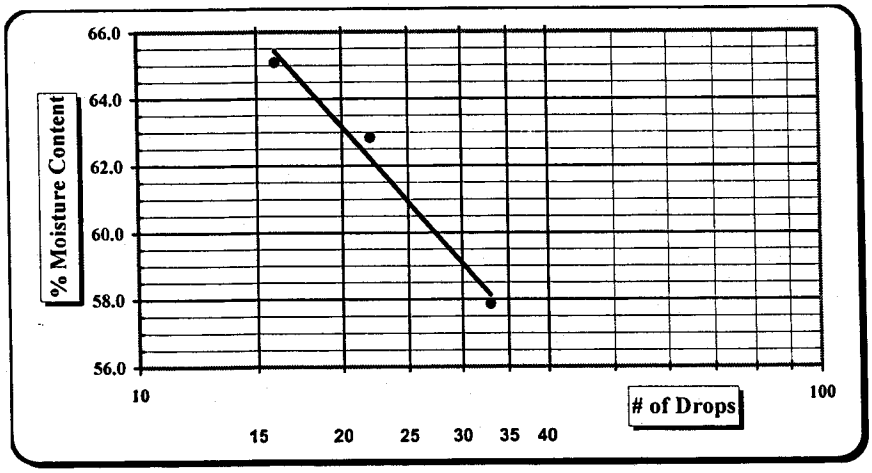
Project Name: MARSHALL STEAM STATION Test Date(s): March 1, 2003

Client Name:

Boring #: MS-7 Sample #: S-2 Sample Depth: 8.5-10'

Sample Description: GRAY REDDISH TAN M-F SANDY SILTY CLAY

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	BA	RR	MM				EE	II	
A	Tare Weight	15.37	15.28	16.57				16.87	16.90	
B	Wet Soil Weight + A	24.51	23.34	24.89				24.49	25.64	
C	Dry Soil Weight + A	21.16	20.23	21.61				22.97	23.89	
D	Water Weight (B-C)	3.35	3.11	3.28				1.52	1.75	
E	Dry Soil Weight (C-A)	5.79	4.95	5.04				6.10	6.99	
F	% Moisture Content (D/E)*100	57.9%	62.8%	65.1%				24.9%	25.0%	
N	# OF DROPS	33	22	16						
Ave.	Average	61.9%						25.0%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	
Liquid Limit	61
Plastic Limit	25
Plastic Index	36
Group Symbol	CH

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-2
Elev. or Depth: 8.5-10'
Sample Length (in./cm.):
Location: MS-7
Description: GRAY REDDISH TAN M-F SANDY SILTY CLAY
Liquid Limit: 61
Plastic Limit: 25
USCS Classification: CH
AASHTO Classification:
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	187.97
Tare =	0.00
Dry sample weight =	187.97

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.28	99.9
# 20	0.17	99.6
# 40	0.88	98.1
# 60	2.22	95.5
# 100	4.56	90.8
# 200	8.53	82.9

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 99.9
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 30.27
Dry weight & tare = 30.03
Tare = 15.29
Hygroscopic moisture= 1.6 %
Calculated biased weight= 49.25
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

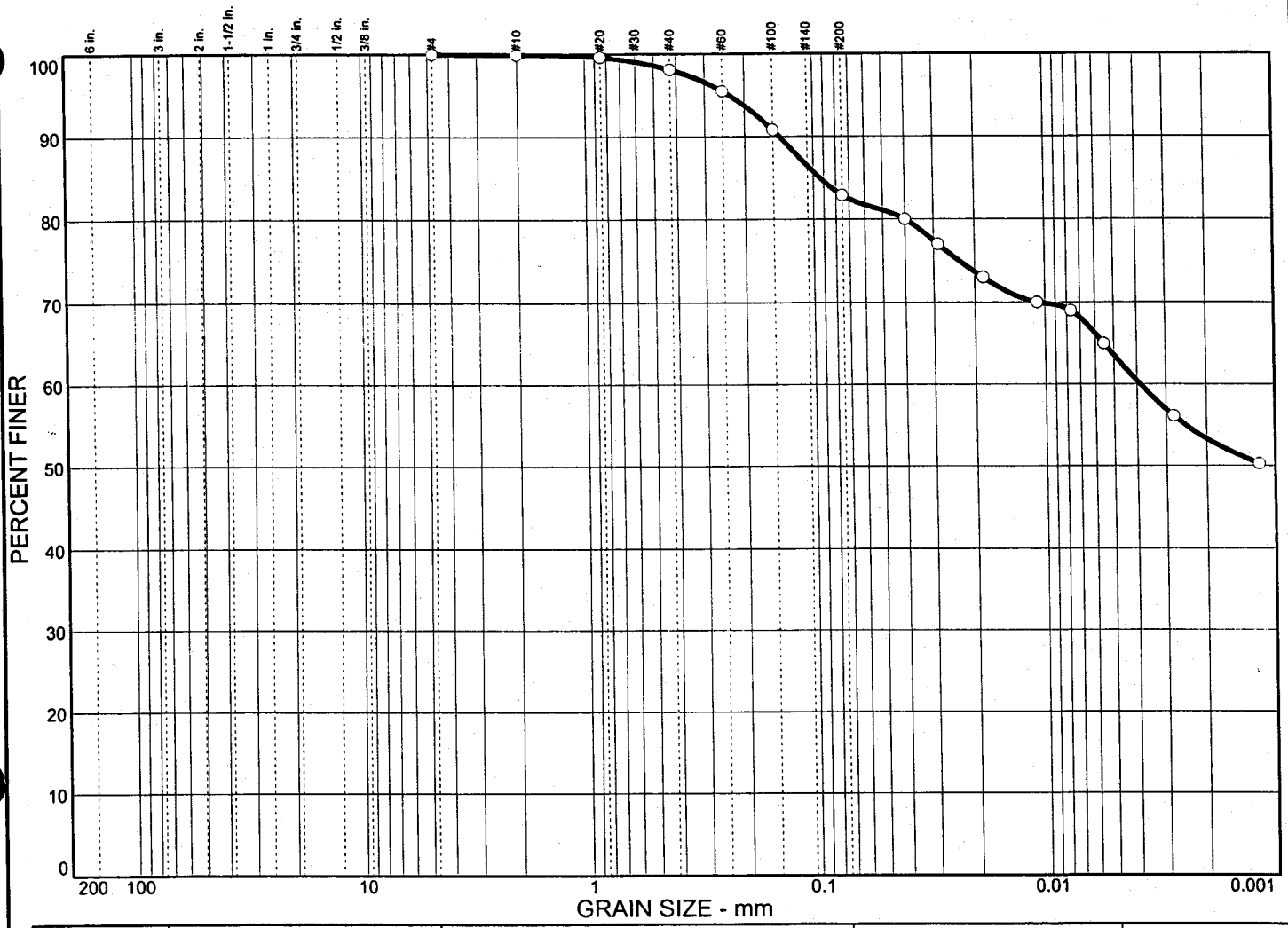
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	45.0	39.9	0.0135	46.0	8.8	0.0400	80.0
2.00	19.5	43.5	38.4	0.0135	44.5	9.0	0.0287	77.0
5.00	19.5	41.5	36.4	0.0135	42.5	9.3	0.0185	73.0
15.00	19.5	40.0	34.9	0.0135	41.0	9.6	0.0108	70.0
30.00	19.5	39.5	34.4	0.0135	40.5	9.7	0.0077	69.0
60.00	19.5	37.5	32.4	0.0135	38.5	10.0	0.0055	65.0
250.00	20.0	33.0	28.0	0.0134	34.0	10.7	0.0028	56.1
1440.00	20.5	30.0	25.1	0.0134	31.0	11.2	0.0012	50.3

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 17.1
% SILT = 19.3 **% CLAY =** 63.6

D_{85}= 0.09 D_{60}= 0.00

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	17.1	19.3	63.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	61	25	0.0938	0.0039						

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY REDDISH TAN M-F SANDY SILTY CLAY	CH	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-7

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

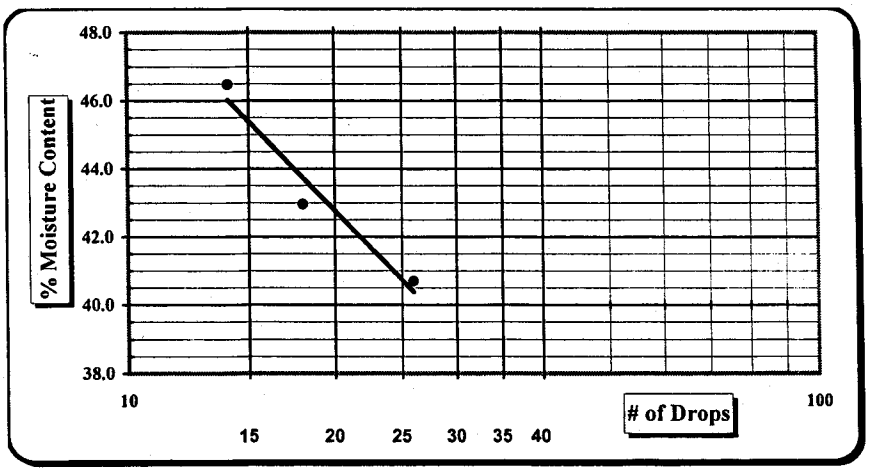
SAMPLE S-2,MS-7

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 3, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	March 1, 2003
Client Name:			
Boring #:	MS-7	Sample #: S-4	Sample Depth: 18.5-20'
Sample Description:	YELLOWISH RED MICA. SL. CLAYEY SILTY M-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #	QQ	XY	EE				JORDI	TH	
A	Tare Weight	16.89	15.95	16.90				15.97	15.31	
B	Wet Soil Weight + A	27.47	25.90	26.48				24.08	21.38	
C	Dry Soil Weight + A	24.41	22.91	23.44				21.61	19.52	
D	Water Weight (B-C)	3.06	2.99	3.04				2.47	1.86	
E	Dry Soil Weight (C-A)	7.52	6.96	6.54				5.64	4.21	
F	% Moisture Content (D/E)*100	40.7%	43.0%	46.5%				43.8%	44.2%	
N	# OF DROPS	26	18	14						
Ave.	Average	43.4%						44.0%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic	NP
Liquid Limit	41
Plastic Limit	44
Plastic Index	
Group Symbol	

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

Client:
Project: MARSHALL STEAM STATION
Project Number: 1264-02-578

Sample Data

Source:
Sample No.: S-4
Elev. or Depth: 18.5-20' **Sample Length (in./cm.):**
Location: MS-7
Description: YELLOWISH RED MICACEOUS SL. CLAYEY SILTY M-F SAND
Liquid Limit: NP **Plastic Limit:** NP
USCS Classification: SM **AASHTO Classification:**
Testing Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	187.73
Tare =	0.00
Dry sample weight =	187.73

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
#10	0.00	100.0
# 20	0.18	99.6
# 40	1.21	97.6
# 60	5.95	88.1
# 100	18.01	64.0
# 200	31.60	36.8

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 100.0
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 28.11
Dry weight & tare = 27.80
Tare = 16.17
Hygroscopic moisture= 2.7 %
Calculated biased weight= 48.70
Automatic temperature correction
Composite correction at 20 deg C = -6

Meniscus correction only= 1
Specific gravity of solids= 2.70
Specific gravity correction factor= 0.989
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.0	22.0	15.8	0.0136	23.0	12.5	0.0482	32.0
2.00	19.0	19.5	13.3	0.0136	20.5	12.9	0.0346	26.9
5.00	19.0	12.0	5.8	0.0136	13.0	14.2	0.0229	11.7
15.00	19.0	11.0	4.8	0.0136	12.0	14.3	0.0133	9.6
30.00	20.0	10.0	4.0	0.0134	11.0	14.5	0.0093	8.0
60.00	20.0	10.0	4.0	0.0134	11.0	14.5	0.0066	8.0
250.00	20.0	7.0	1.0	0.0134	8.0	15.0	0.0033	1.9
1440.00	21.0	6.5	0.7	0.0133	7.5	15.1	0.0014	1.4

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** **% SAND =** 63.2
% SILT = 31.7 **% CLAY =** 5.1

D_{85}= 0.23 D_{60}= 0.14 D_{50}= 0.11
D_{30}= 0.04 D_{15}= 0.03 D_{10}= 0.01
C_c= 0.7809 C_u= 9.4721

Particle Size Distribution Report

	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	63.2	31.7	5.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.230	0.139	0.112	0.0398	0.0254	0.0146	0.78	9.47

MATERIAL DESCRIPTION	USCS	AASHTO
○ YELLOWISH RED MICACEOUS SL. CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-7

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

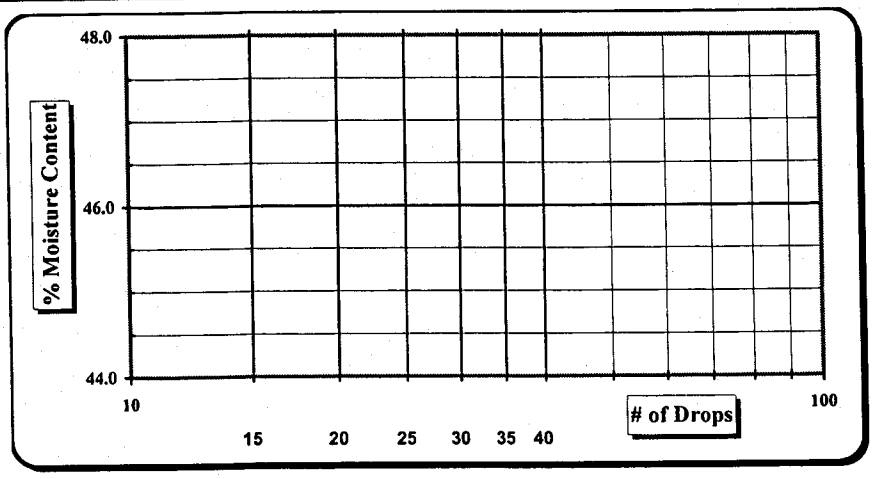
SAMPLE S-4,MS-7

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

Project #:	1264-02-578	Report Date:	March 1, 2003
Project Name:	MARSHALL STEAM STATION	Test Date(s):	February 28, 2003
Client Name:			
Boring #:	MS-8	Sample #: S-5	Sample Depth: 23.5-25'
Sample Description:	GRAYISH TAN PINKISH WHITE MICA. SL. CLAYEY SILTY C-F SAND		

Pan #		Liquid Limit						Plastic Limit		
	Test #	1	2	3	4	5	6	1	2	3
	Tare #									
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture Content (D/E)*100									
N	# OF DROPS									
Ave.	Average	#DIV/0!								



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.990	29	1.018
24	0.995	30	1.022
25	1.000		

Notes: Estimate the % Retained on the #40 Sieve

Special Sampling Methods: AIR DRIED

NP, Non-Plastic NP

Liquid Limit

Plastic Limit

Plastic Index

Group Symbol

Technician Name: Karen Warner

SPECIFIC GRAVITY
TEST METHOD A, #10 SIEVE SOIL

S&ME

Project #: 1264-03-072 Report Date: March 1, 2003
Project Name: Marshall Steam Station - Beneficial Fill Test Dates(s): February 28, 2003
Client Name: Duke Energy
Boring #: MS-8 Sample #: S-5 Sample Depth: 23.5 - 25
Sample Description: Greyish Tan and Pinkish White Micaceous Slightly Clayey Silty Coarse to Fine Sand

VOL. FLASK NO.	23	VOL. FLASK NO.	42	VOL. FLASK NO.	
WT. OF SOIL & VOL. FLASK	93.26	WT. OF SOIL & VOL. FLASK	96.43	WT. OF SOIL & VOL. FLASK	
WT. OF VOL. FLASK	62.42	WT. OF VOL. FLASK	65.93	WT. OF VOL. FLASK	
A. WT. OF SOIL	30.84	A. WT. OF SOIL	30.5	A. WT. OF SOIL	
B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	162.13	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	165.59	B. WT. OF VOL. (FROM VOL. FLASK CHART) FLASK & WATER	
WATER TEMP. (C)	22	WATER TEMP. (C)	22	WATER TEMP. (C)	
C. WT. OF VOL. FLASK, SOIL & WATER	181.54	C. WT. OF VOL. FLASK, SOIL & WATER	184.54	C. WT. OF VOL. FLASK, SOIL & WATER	
D. SPECIFIC GRAVITY = A / A+(B-C)	2.70	D. SPECIFIC GRAVITY = A / A+(B-C)	2.64	D. SPECIFIC GRAVITY = A / A+(B-C)	

SPECIFIC GRAVITY (Corrected) G_s = D x K =

WATER TEMPERATURE DEGREES C	CORRECTION FACTOR, K
18	1.0004
19	1.0002
20	1.0000
21	0.9998
22	0.9996
23	0.9993
24	0.9991
25	0.9989
26	0.9986
27	0.9983
28	0.9980
29	0.9977
30	0.9974

FLASK NO.	23
G_s = D x K	2.70
FLASK NO.	42
G_s = D x K	2.64
FLASK NO.	
G_s = D x K	
G_s (ave) =	2.67

Technician Name: Karen Warner

GRAIN SIZE DISTRIBUTION TEST DATA

lient:
roject: MARSHALL STEAM STATION
roject Number: 1264-02-578

Sample Data

ource:
ample No.: S-5
lev. or Depth: 23.5-25' **Sample Length (in./cm.):**
ocation: MS-8
escription: GRAYISH TAN, PINKISH WHITE MICACEOUS SL. CLAYEY SILTY C-F SAND
iquid Limit: NP **Plastic Limit:** NP
SCS Classification: SM **AASHTO Classification:**
esting Remarks: TESTED BY KMW

Mechanical Analysis Data

	Initial
Dry sample and tare=	227.03
Tare =	0.00
Dry sample weight =	227.03

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.00 Tare = .00 Sample weight = 50.00
Cumulative weight retained tare= .00
Tare for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
.375 inch	0.00	100.0
# 4	0.33	99.9
# 10	10.95	95.2
# 20	5.67	84.4
# 40	10.04	76.1
# 60	16.79	63.2
# 100	24.69	48.2
# 200	33.71	31.0

Hydrometer Analysis Data

Separation sieve is #10
Percent -#10 based upon complete sample= 95.2
Weight of hydrometer sample: 50.00
Hygroscopic moisture correction:
Moist weight & tare = 28.23
Dry weight & tare = 28.10
Tare = 16.33
Hygroscopic moisture= 1.1 %
Calculated biased weight= 51.95
Automatic temperature correction
Composite correction at 20 deg C = -5

Meniscus correction only= 1
Specific gravity of solids= 2.67
Specific gravity correction factor= 0.995
Hydrometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

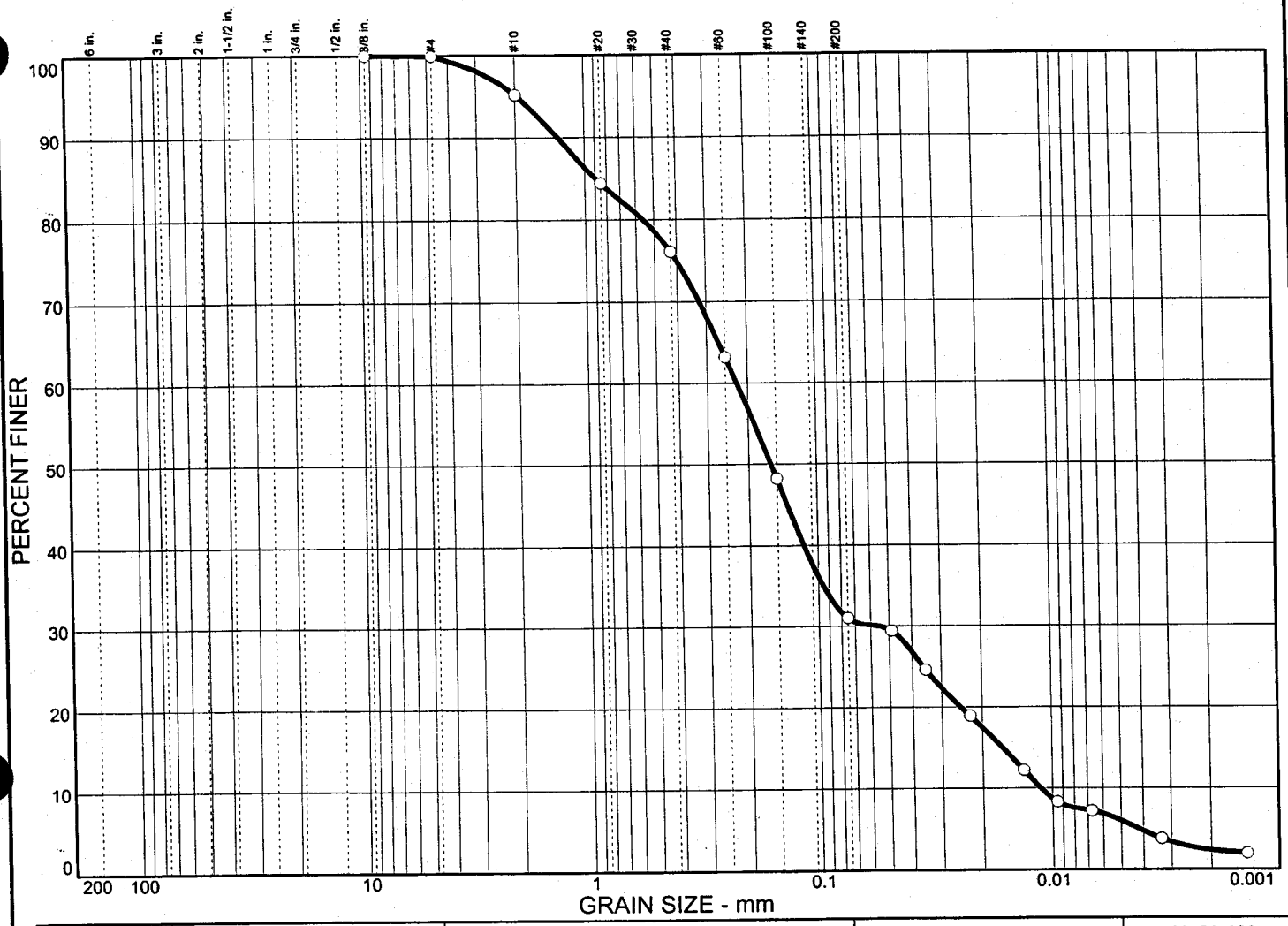
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	20.5	15.4	0.0136	21.5	12.8	0.0488	29.4
2.00	19.5	18.0	12.9	0.0136	19.0	13.2	0.0350	24.6
5.00	19.5	15.0	9.9	0.0136	16.0	13.7	0.0226	18.9
15.00	19.5	11.5	6.4	0.0136	12.5	14.2	0.0133	12.2
30.00	19.5	9.5	4.4	0.0136	10.5	14.6	0.0095	8.3
60.00	20.0	8.8	3.8	0.0136	9.8	14.7	0.0067	7.2
250.00	20.0	7.0	2.0	0.0136	8.0	15.0	0.0033	3.8
1440.00	20.5	6.0	1.1	0.0135	7.0	15.1	0.0014	2.0

Fractional Components

Gravel/Sand based on #4
Sand/Fines based on #200
% COBBLES = **% GRAVEL =** 0.1 **% SAND =** 68.9
% SILT = 25.0 **% CLAY =** 6.0

D_{85}= 0.90 D_{60}= 0.22 D_{50}= 0.16
D_{30}= 0.06 D_{15}= 0.02 D_{10}= 0.01
C_c= 1.2059 C_u= 19.8122

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.1	68.9	25.0	6.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.896	0.223	0.159	0.0551	0.0164	0.0113	1.21	19.81

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAYISH TAN, PINKISH WHITE MICACEOUS SL. CLAYEY SILTY C-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-8

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE S-5,MS-8

APPENDIX III

CALCULATIONS

Estimated Seasonal High
Total Porosity for Bulk Samples
Fetter and Bear Diagrams

ESTIMATED SEASONAL HIGH

Estimated Seasonal High Calculations

Marshall Steam Station - FGD Scrubber Landfill

S&ME Project No. 1264-02-578

		A		B		C	D	E		F	G		H		I	J	
Monitor Well ID	Ground Surface Elevation	Highest Recorded		Lowest Recorded		Difference (A - B)	Number of Data Points	Mean		STD DEV	Calculated Seasonal High (E + 1.282F)		August 2003 WL Data.		Difference (G - H)	Estimated Seasonal High	
	(ft msl)	(ft msl)	(ft bls)	(ft msl)	(ft bls)			(ft msl)	(ft bls)		(ft msl)	(ft bls)	(ft msl)	(ft bls)		(ft msl)	(ft bls)
MW-1	821.20	776.35	44.85	771.56	49.64	4.79	27	773.38	47.82	1.39	775.16	46.04	775.12	46.08	0.04	n/a	n/a
MW-2	794.90	791.77	3.13	787.92	6.98	3.85	26	789.70	5.20	0.94	790.91	3.99	790.60	4.30	0.31	n/a	n/a
MW-3	811.00	805.96	5.04	803.63	7.37	2.33	28	804.93	6.07	0.58	805.67	5.33	805.96	5.04	-0.29	n/a	n/a
MW-4	864.50	838.48	26.02	827.83	36.67	10.65	27	833.44	31.06	2.83	837.07	27.43	834.92	29.58	2.15	n/a	n/a
B-1	808.59	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	802.06	6.53	n/a	802.52	6.07
B-2	857.85	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	817.69	40.16	n/a	819.50	38.35
B-3	856.18	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	814.17	42.01	n/a	816.50	39.68
B-4	858.42	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	812.02	46.40	n/a	814.50	43.92
B-5	841.27	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	813.74	27.53	n/a	813.74	27.53
B-6	851.59	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	815.04	36.55	n/a	817.00	34.59
B-7	851.68	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	810.60	41.08	n/a	812.50	39.18
MS-1	813.33	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	806.44	6.89	n/a	808.62	4.71
MS-2	820.17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	801.17	19.00	n/a	801.63	18.54
MS-3	811.50	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	800.68	10.82	n/a	800.93	10.57
MS-4	844.60	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	810.59	34.01	n/a	812.50	32.10
MS-5	839.10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	812.05	27.05	n/a	812.15	26.95
MS-6	839.19	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	815.29	23.90	n/a	816.41	22.78
MS-7	833.14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	819.53	13.61	n/a	819.53	13.61
MS-8	848.31	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	825.85	22.46	n/a	825.85	22.46
MS-9	865.36	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	828.68	36.68	n/a	831.00	34.36
MS-10	848.29	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	836.07	12.22	n/a	836.07	12.22
MS-11	856.87	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	829.83	27.04	n/a	829.83	27.04
OW-1	839.40	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	825.72	13.68	n/a	825.72	13.68
OW-2	833.38	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	821.17	12.21	n/a	821.17	12.21
OW-3	832.70	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	816.89	15.81	n/a	818.22	14.48

Notes:

n/a - not applicable

ft msl - feet mean sea level

ft bls - feet below land surface

Historical Water Level Data
On-Site Monitor Wells
Marshall Steam Station

WELL ID:	MW-1		MW-2		MW-3		MW-4	
TOC ELEV.:	823.7		797.22		813.07		867.15	
DATE	DTW	GW ELEV.	DTW	GW ELEV.	DTW	GW ELEV.	DTW	GW ELEV.
08/29/89	49.20	774.50	nm	nm	8.90	804.17	33.70	833.45
10/16/90	48.20	775.50 •	6.10	791.12	8.65	804.42	31.95	835.20
11/12/91	nm	nm	7.10	790.12	8.60	804.47	32.20	834.95
08/27/92	49.00	774.70	6.50	790.72	8.52	804.55	31.80	835.35
03/30/93	47.35	776.35	5.45	791.77 •	7.24	805.83	28.67	838.48 •
08/02/93	47.35	776.35	6.83	790.39	8.69	804.38	29.53	837.62
02/01/94	49.90	773.80	6.47	790.75	7.99	805.08	32.18	834.97
08/08/94	49.26	774.44 •	7.30	789.92	8.40	804.67	32.09	835.06
02/01/95	50.08	773.62	6.84	790.38	7.87	805.20	32.99	834.16
03/16/95	50.34	773.36	nm	nm	7.62	805.45	nm	nm
08/08/95	50.42	773.28	7.21	790.01	8.65	804.42	33.02	834.13
02/13/96	50.87	772.83	7.83	789.39	7.48	805.59	32.30	834.85
08/23/96	50.04	773.66	8.65	788.57	7.94	805.13	32.46	834.69
09/25/96	50.44	773.26	9.30	787.92	8.42	804.65	33.14	834.01
02/12/97	51.54	772.16	8.41	788.81	7.62	805.45	32.91	834.24
08/05/97	50.00	773.70	8.05	789.17	8.01	805.06	31.18	835.97
03/11/98	50.91	772.79	7.60	789.62	7.18	805.89 •	32.45	834.70
08/05/98	50.01	773.69	9.09	788.13	8.25	804.82	31.50	835.65
02/23/99	51.25	772.45	7.77	789.45	7.70	805.37	34.16	832.99
08/25/99	51.14	772.56	9.13	788.09	8.80	804.27	34.44	832.71
02/07/00	51.92	771.78	8.20	789.02	7.97	805.10	35.89	831.26
08/09/00	51.78	771.92	7.89	789.33	8.75	804.32	36.76	830.39
02/20/01	51.86	771.84	7.42	789.80	7.85	805.22	37.62	829.53
08/06/01	51.47	772.23	7.93	789.29	8.53	804.54	38.07	829.08
02/04/02	52.14	771.56	7.41	789.81	8.11	804.96	38.83	828.32
08/21/02	51.88	771.82	7.17	790.05	9.44	803.63	39.32	827.83
02/13/03	51.83	771.87	7.14	790.08	7.76	805.31	38.65	828.50
08/08/03	48.58	775.12	6.62	790.60	7.11	805.95 •	32.23	834.92

Notes:
nm - not measured
TOC - Top of Casing
ELEV. - Elevation
DTW - Depth to Water
GW - Groundwater
All depth to water measurements taken from top of casing.

Monthly/Annual Climate Data Results

SUM of Daily Precipitation from 1989 to 2002

CATAWBA 3 NNW, NC (UCAN: 14023,COOP: 311579)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
1989	2.05	4.94	2.92	3.47	4.59	6.22	6.88	4.52	6.43	4.66	3.09	2.80	52.57
1990	1.55	6.40	5.23	2.37	7.26	2.32	4.69	3.33	0.73	11.94	1.80	3.22	50.84
1991	4.07	2.41	7.65	6.65	2.32	2.70	3.78	5.27	4.41	0.82	1.40	3.21	44.69
1992	2.47	3.26	4.02	3.35	2.87	3.94	2.11	2.74	3.98	4.34	6.98	4.19	44.25
1993	6.28	3.55	7.00	3.14	3.16	1.82	6.62	3.18	3.12	1.36	4.28	4.44	47.95
1994	5.02	2.99	7.03	2.35	2.74	7.57	9.29	4.60	4.39	1.64	2.94	1.47	52.03
1995	3.95	3.64	2.75	0.36	2.99	8.03	2.07	4.66	4.48	7.58	3.84	1.69	46.04
1996	2.90	3.80	4.07	2.39	3.57	4.46	2.01	7.73	3.83	1.45	4.95	5.16	46.32
1997	3.54	4.99	4.76	7.14	1.71	2.24	8.20	1.07	3.18	3.58	2.66	7.84	50.91
1998	7.90	3.87	3.09	5.45	2.40	4.24	2.00	2.21	2.84	1.55	1.81	4.60	41.96
1999	4.46	3.01	2.72	3.29	2.42	3.99	1.56	5.28	3.38	3.35	2.01	2.49	37.96
2000	4.16	2.01	3.50	5.79	1.52	3.35	1.87	2.89	7.50	0.00	2.10	2.05	36.74
2001	2.37	2.56	5.25	1.52	1.19	4.20	6.87	2.57	1.70	0.98	0.80	3.16	33.17
2002	4.94	1.53	3.99	0.46	3.31	2.39	5.32	5.53	4.38	6.67	4.47	5.58	48.57
AVG	3.98	3.50	4.57	3.41	3.00	4.11	4.52	3.97	3.88	3.57	3.08	3.71	

Data Display Results

Date Range: From 01/01/2003 To 08/12/2003
All Dates Displayed in Time Zone: LST

CATAWBA 3 NNW, NC (UCAN: 14023,COOP: 311579)

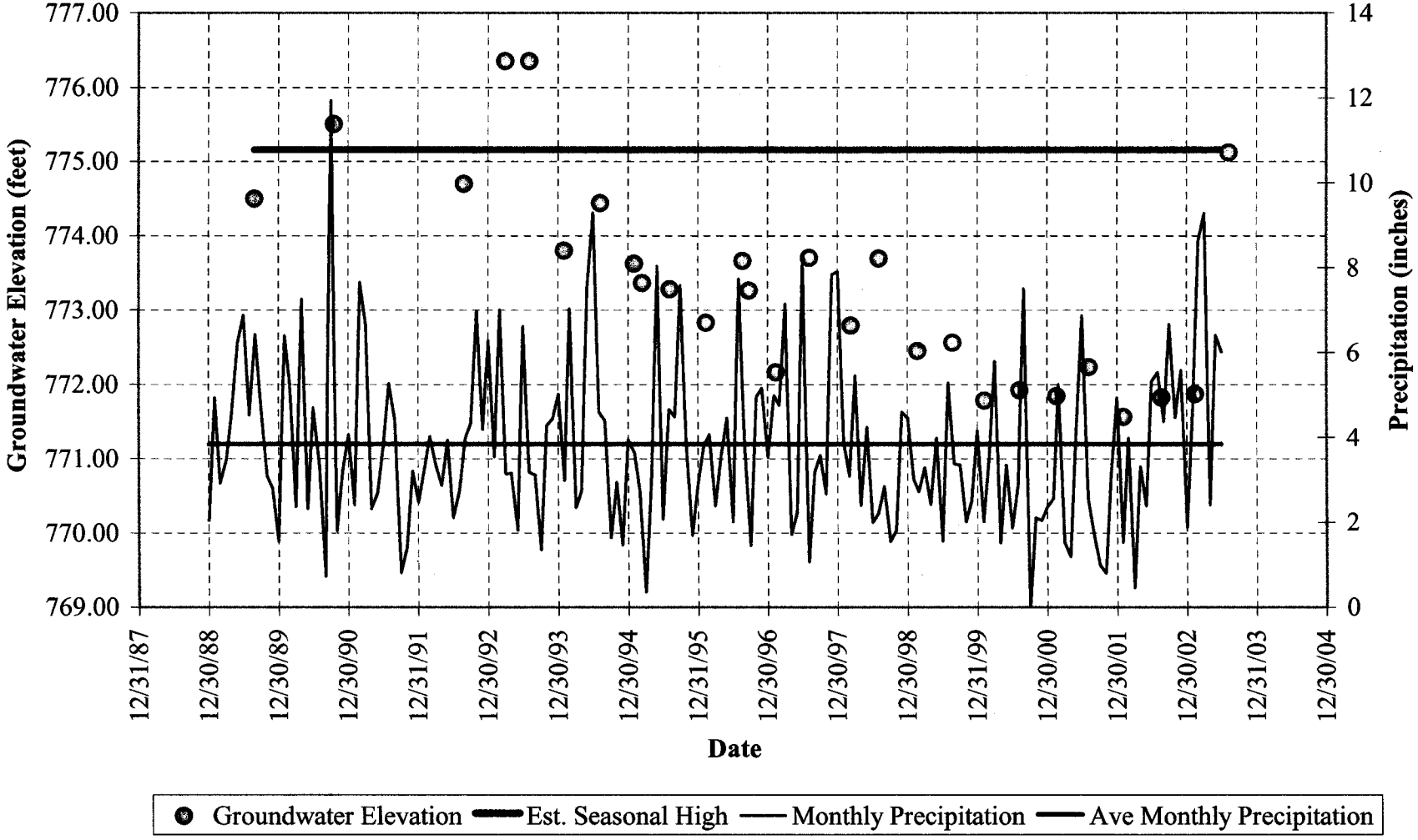
Date	SUM
	Precip
	(In)
2003/01	1.88
2003/02	4.75
2003/03	8.64
2003/04	9.28
2003/05	2.41
2003/06	6.41
2003/07	6.02
2003/08	1.85
Sum/Avg	41.24

The status of Daily data in the CIRRUS database is as follows:

Provisional data available through '09-AUG-03'.
Preliminary data from National Climatic Data Center through 'MAR-2003'.
Final quality-controlled data from National Climatic Data Center through 'JAN-2003'.

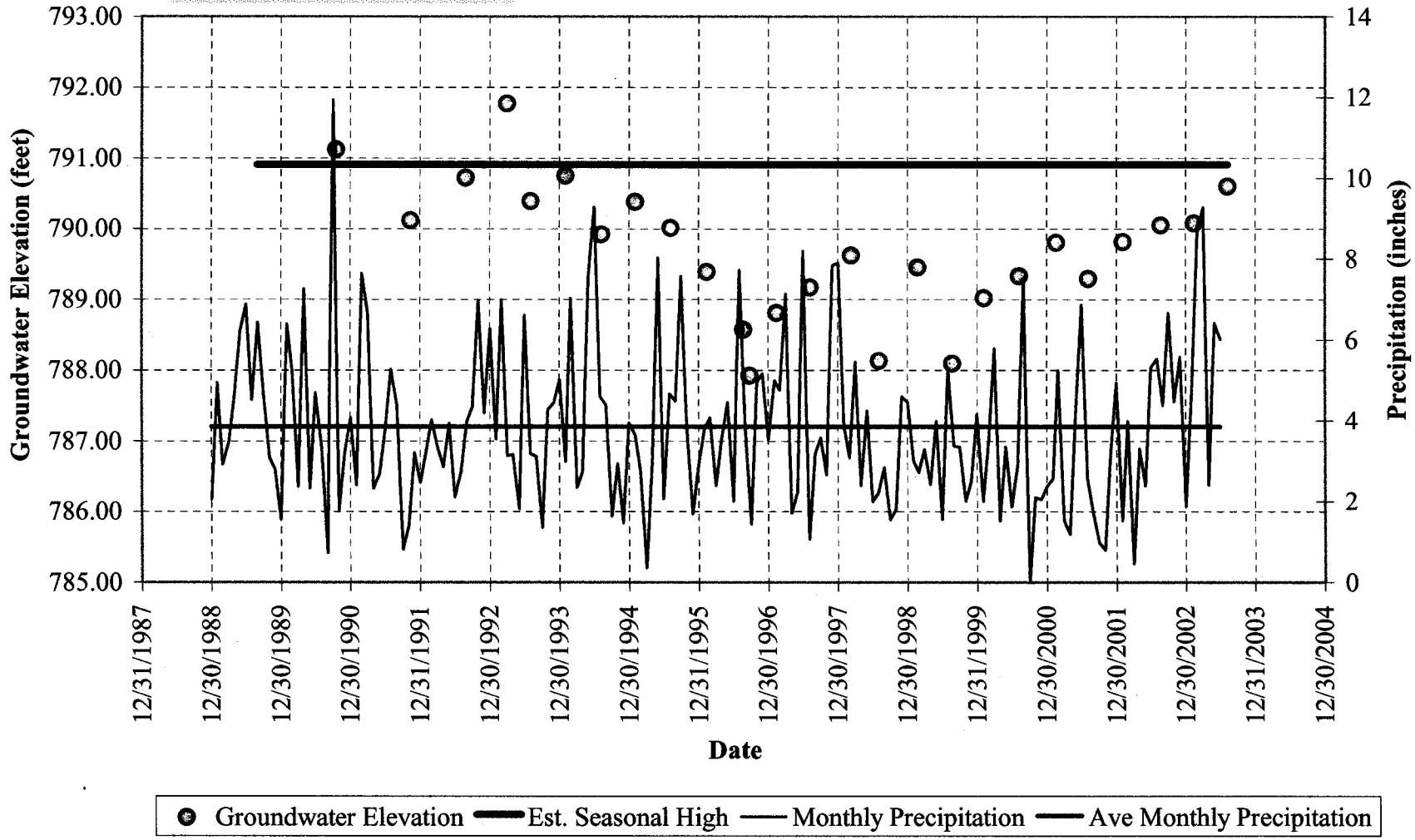
Hydrograph
MW-1
Marshall Steam Station

Highest Recorded = 776.35, 3/30/93
Lowest Recorded = 771.56, 2/4/02
Difference = 4.79 ft



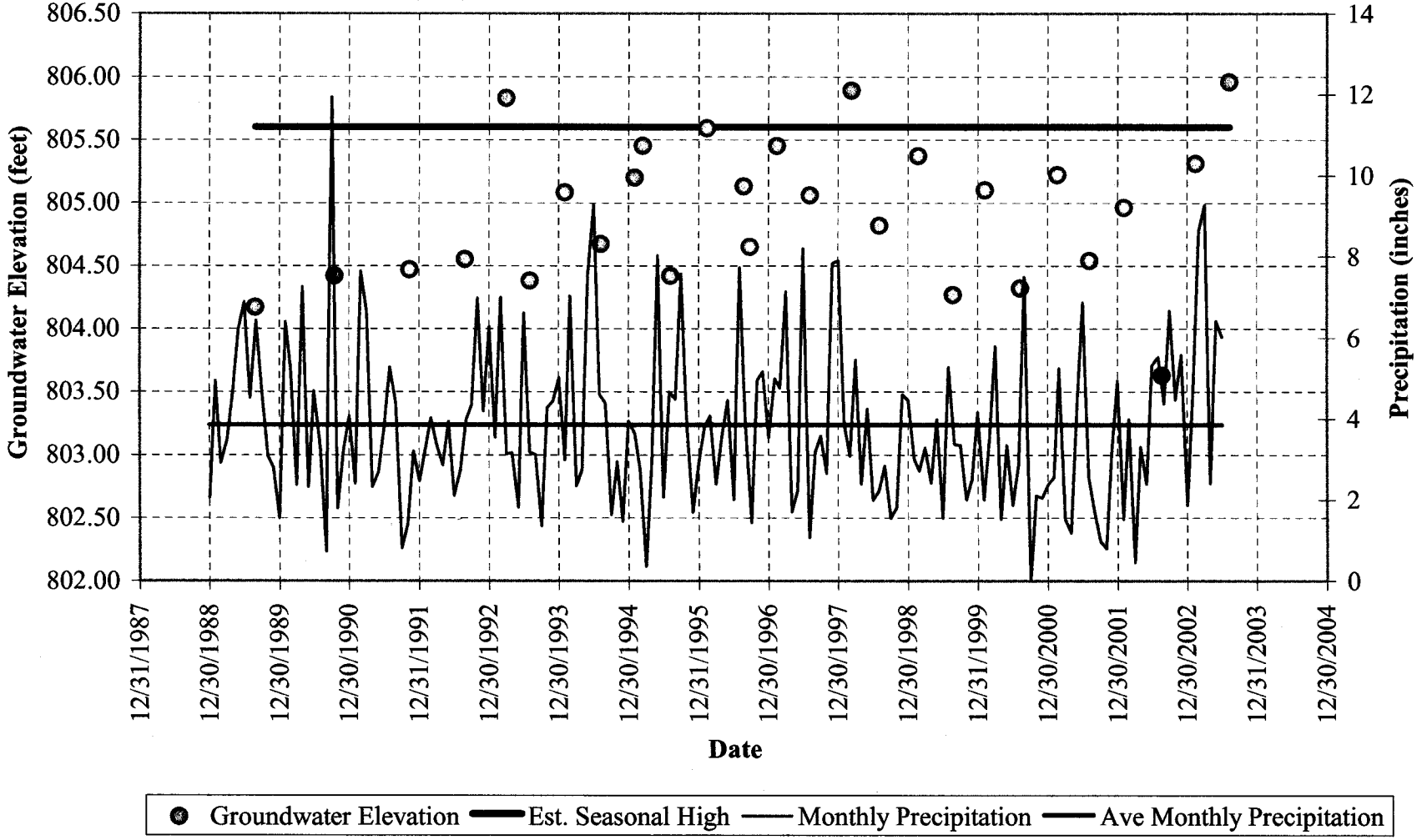
Hydrograph
MW-2
Marshall Steam Station

Highest Recorded = 791.77, 3/30/93
Lowest Recorded = 787.92, 9/25/96
Difference = 3.85 ft



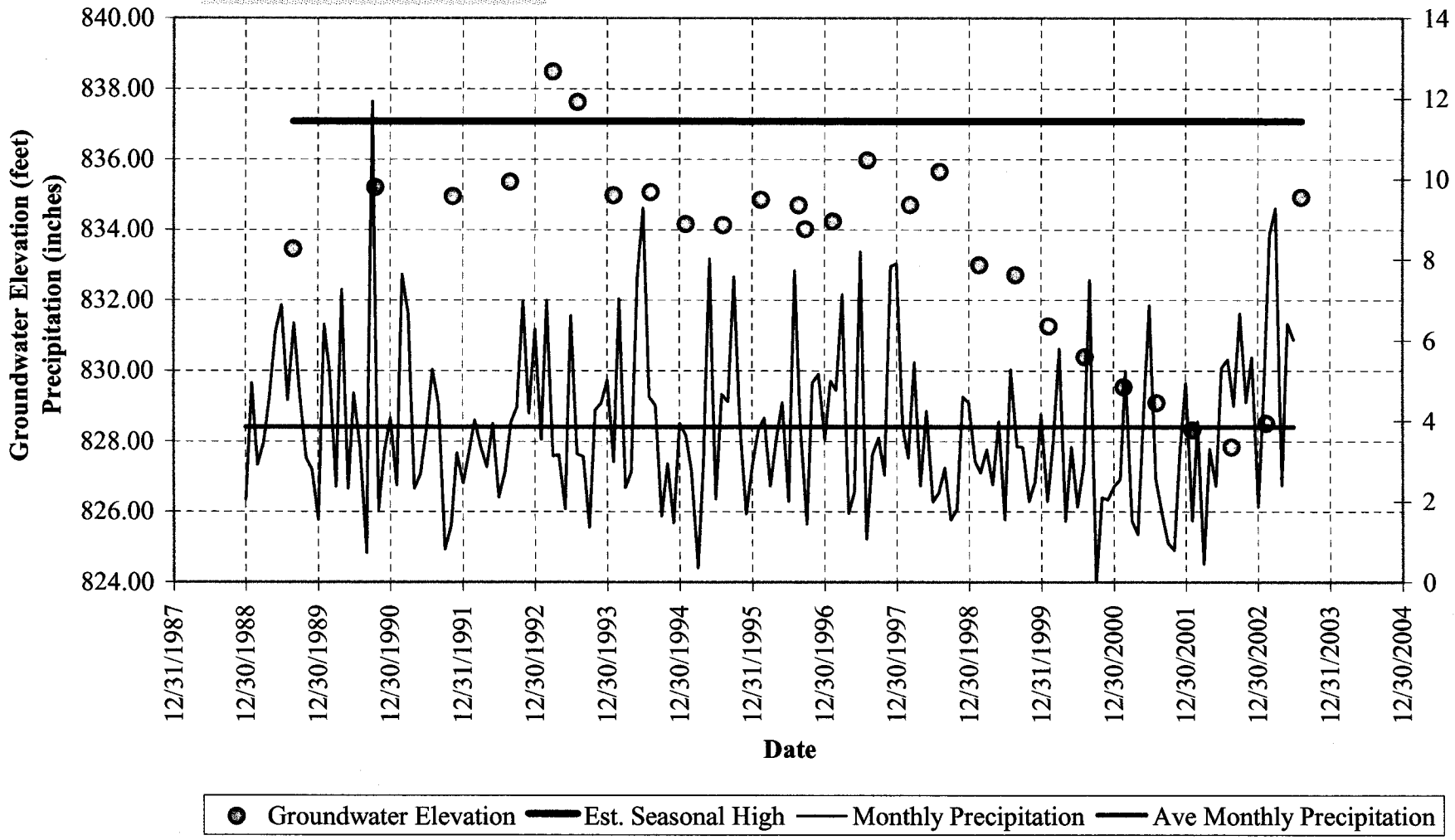
Hydrograph
MW-3
Marshall Steam Station

Highest Recorded = 805.96, 8/08/03
Lowest Recorded = 803.63, 8/21/02
Difference = 2.33 ft

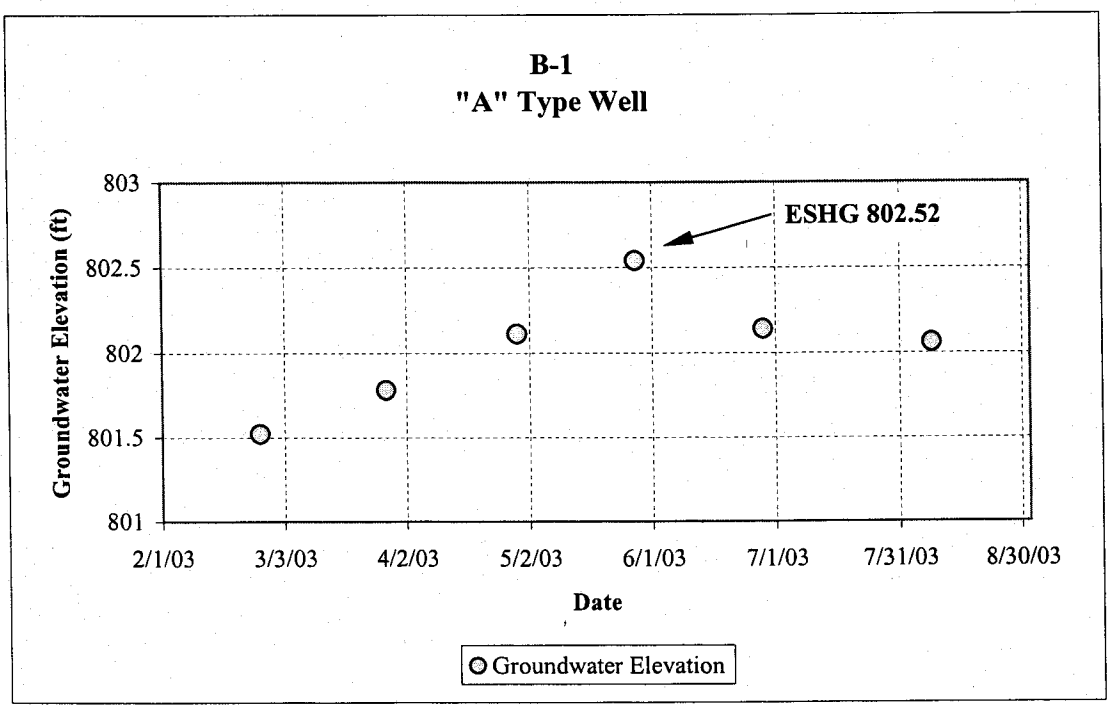


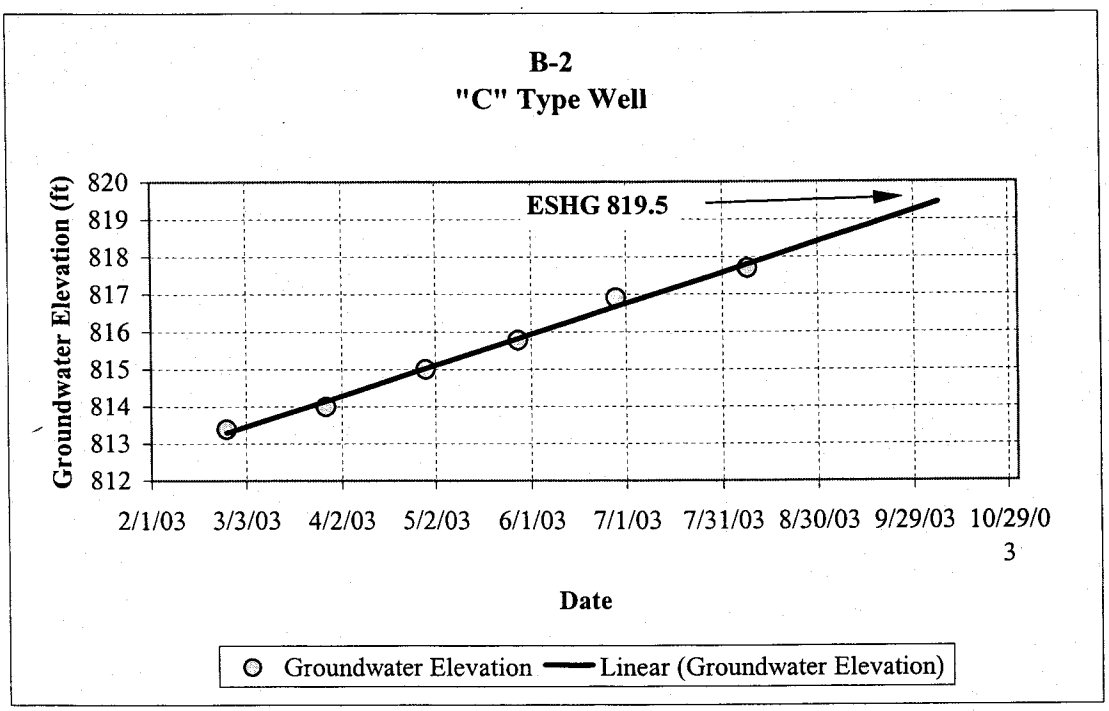
Hydrograph
MW-4
Marshall Steam Station

Highest Recorded = 838.48, 3/30/93
Lowest Recorded = 827.83, 8/21/02
Difference = 10.65 ft

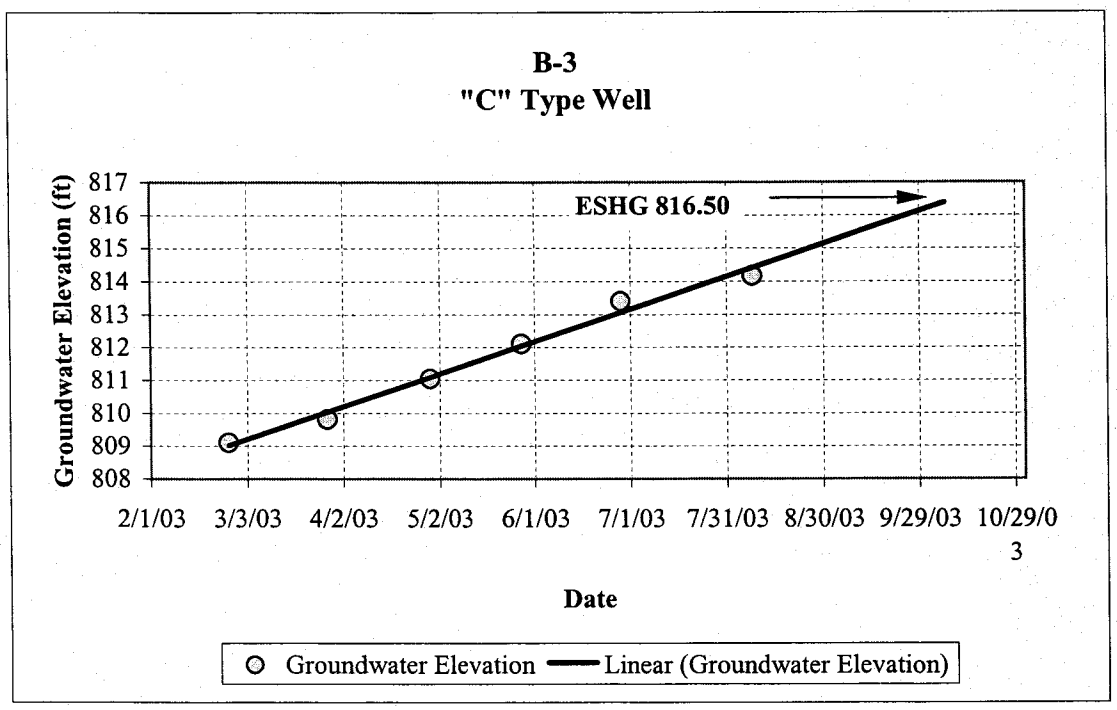


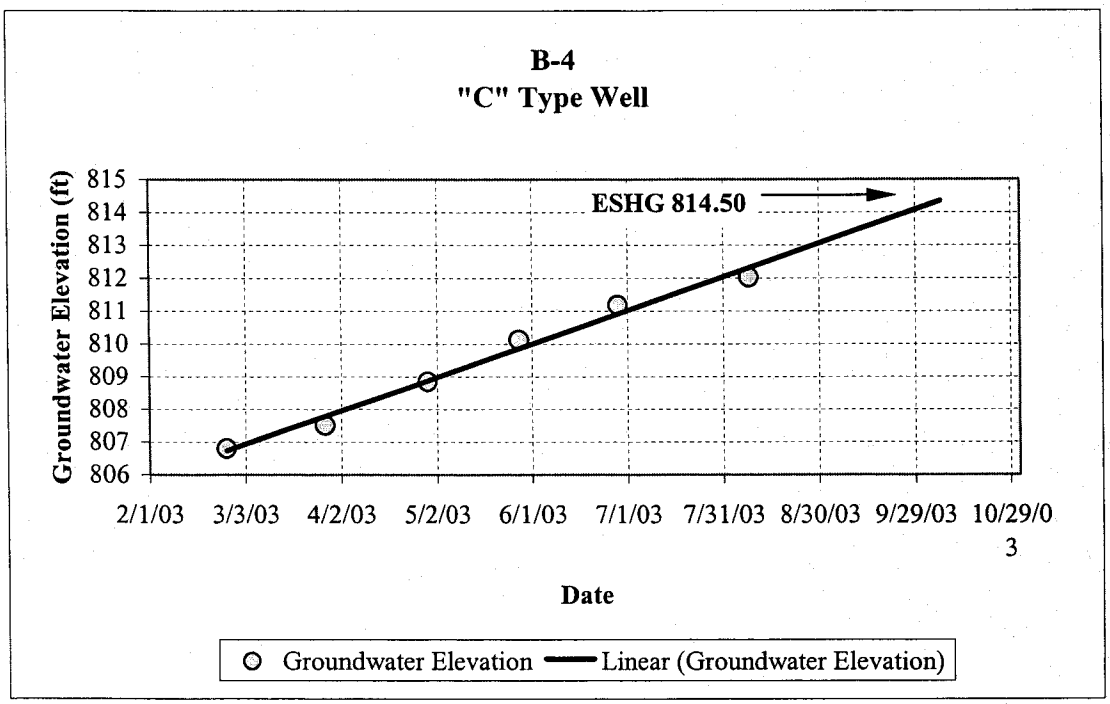
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



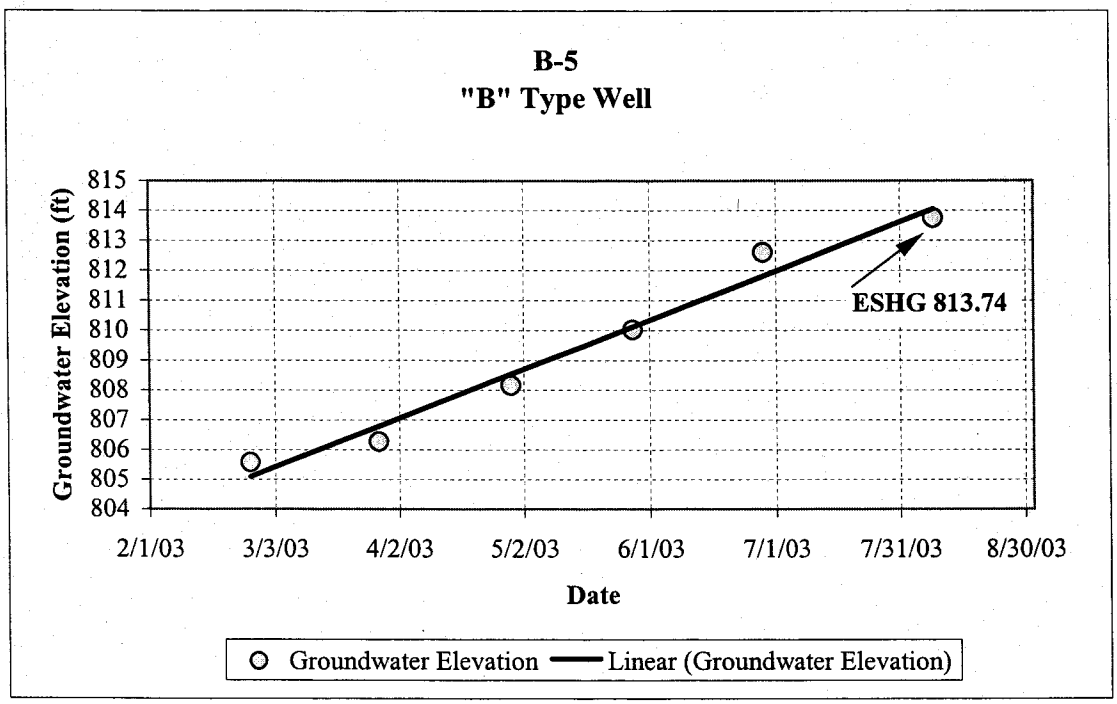


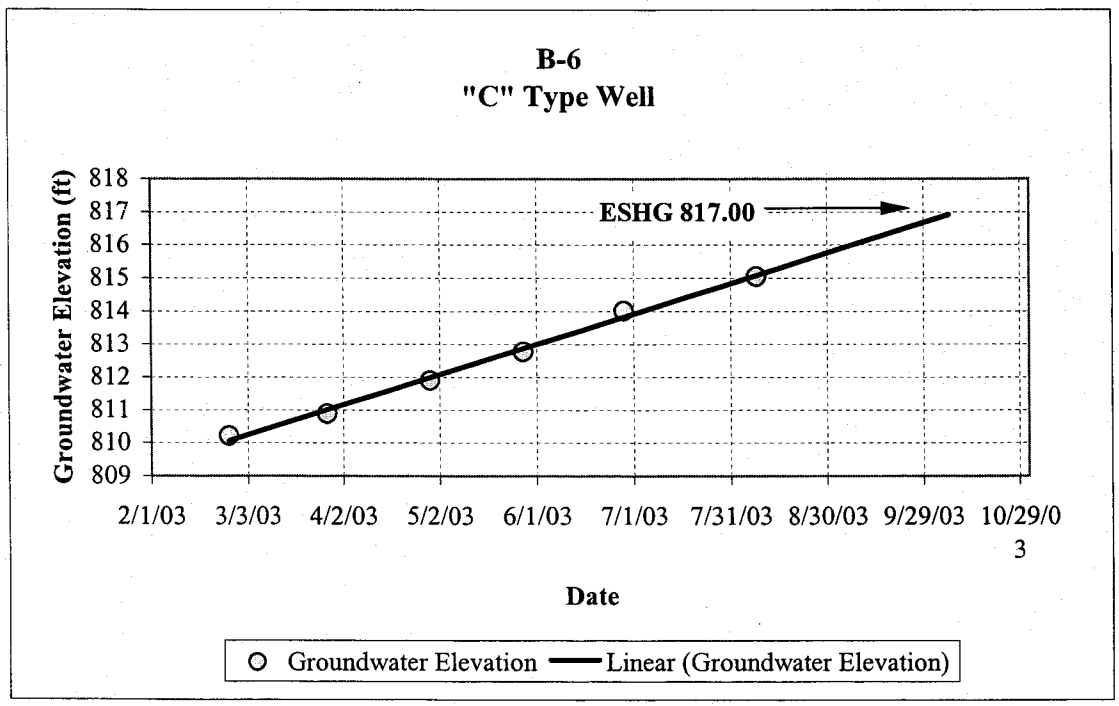
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



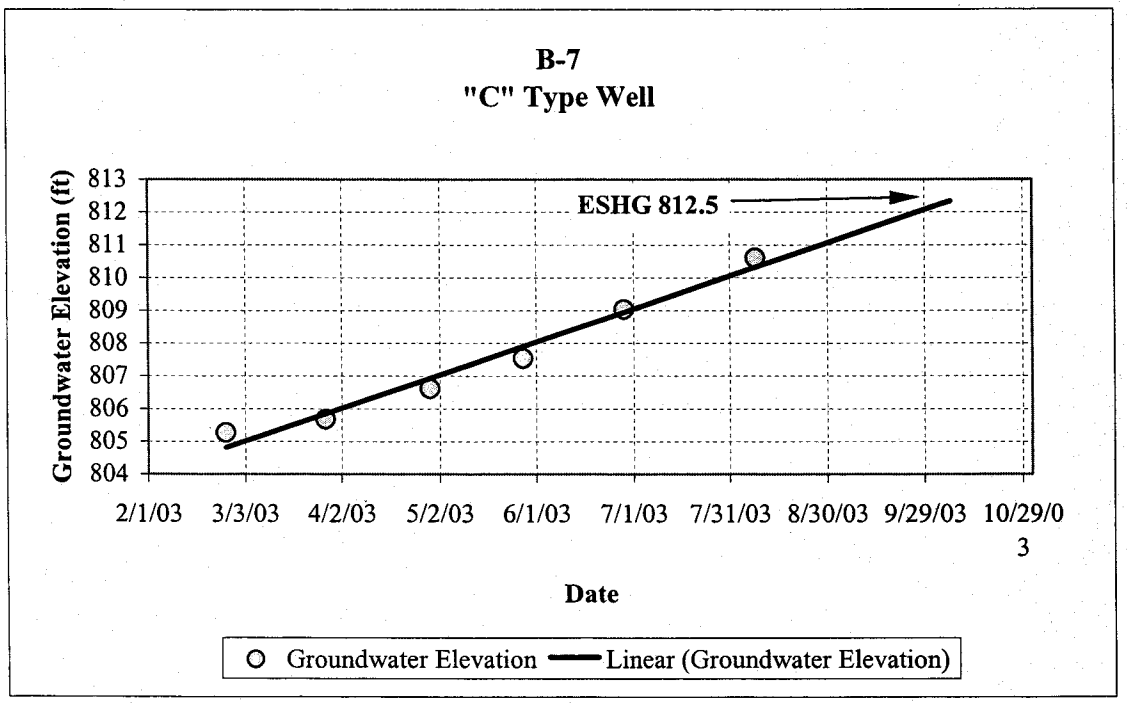


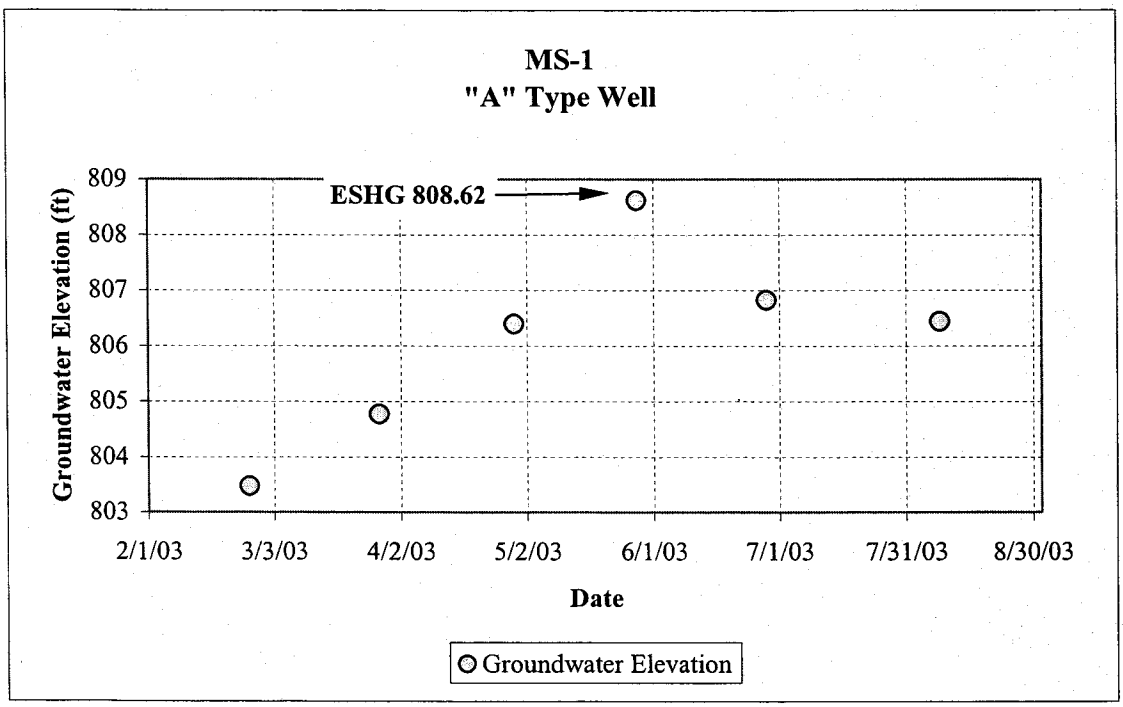
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



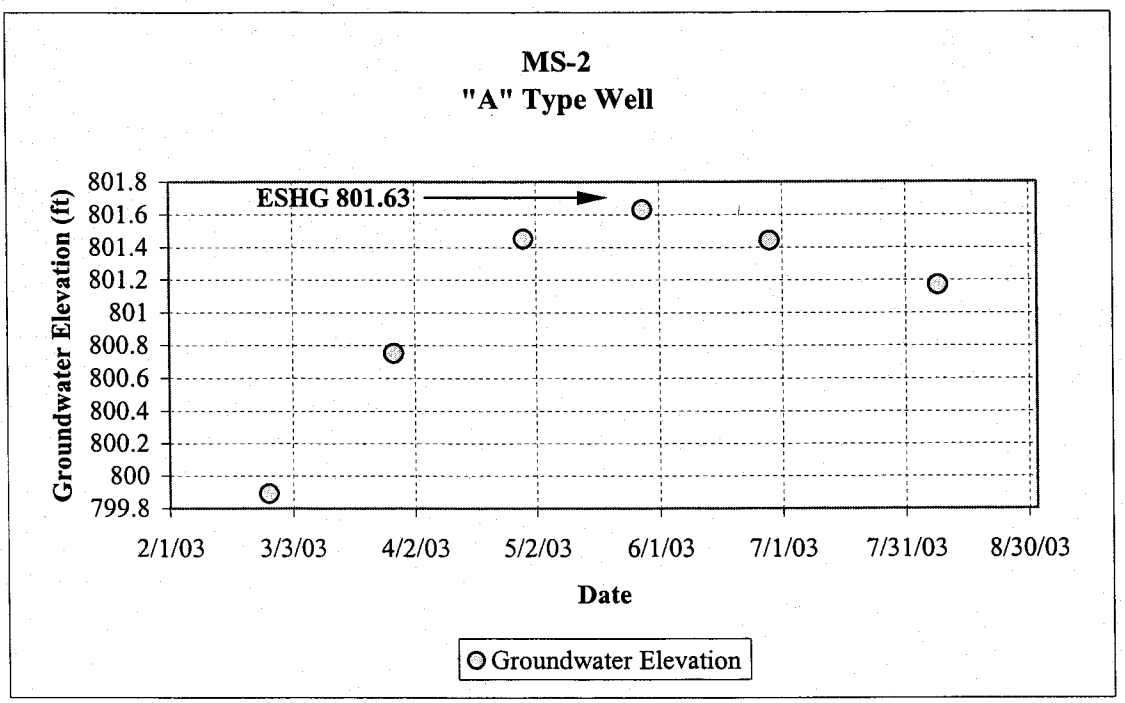


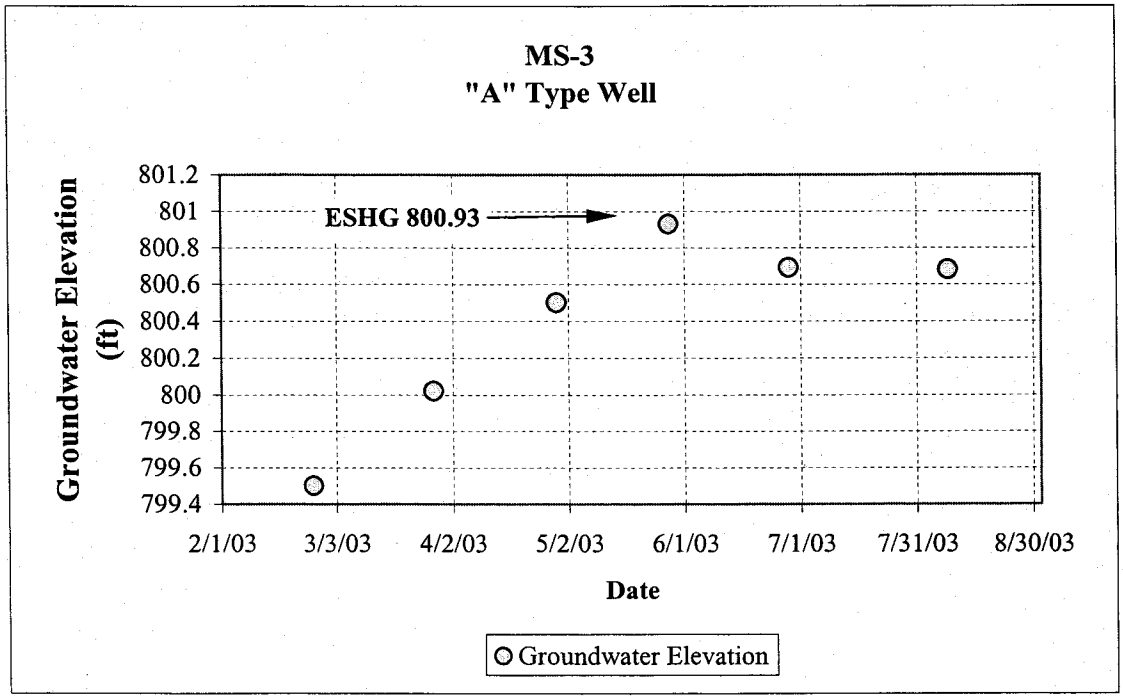
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



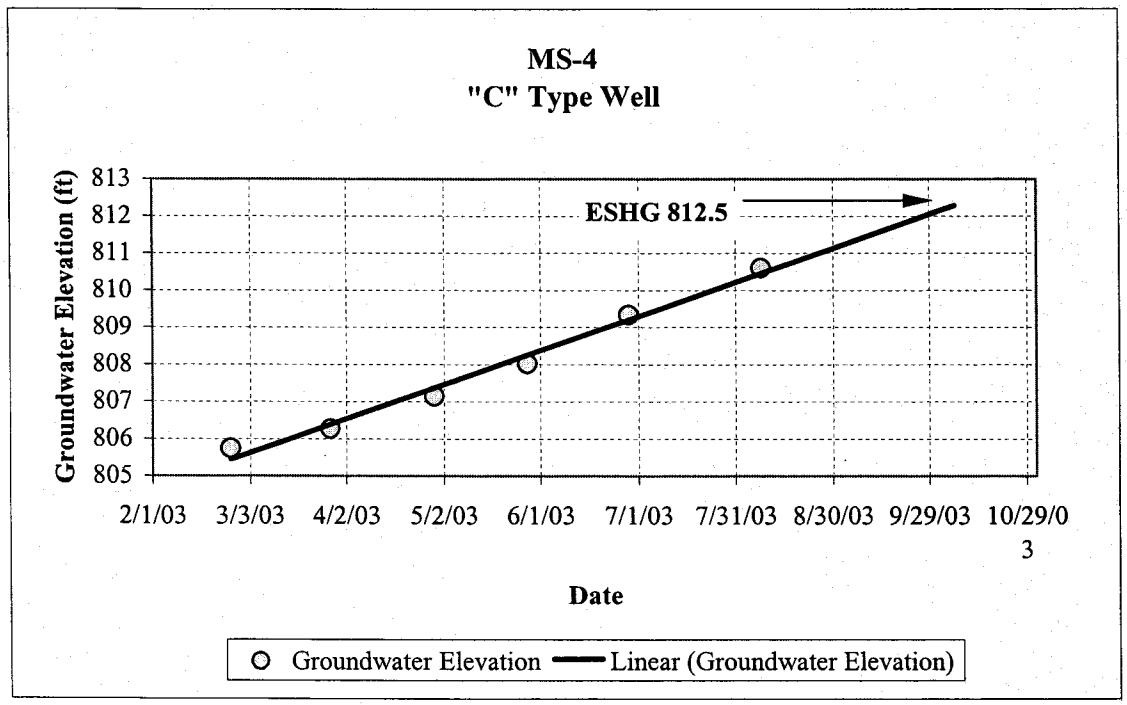


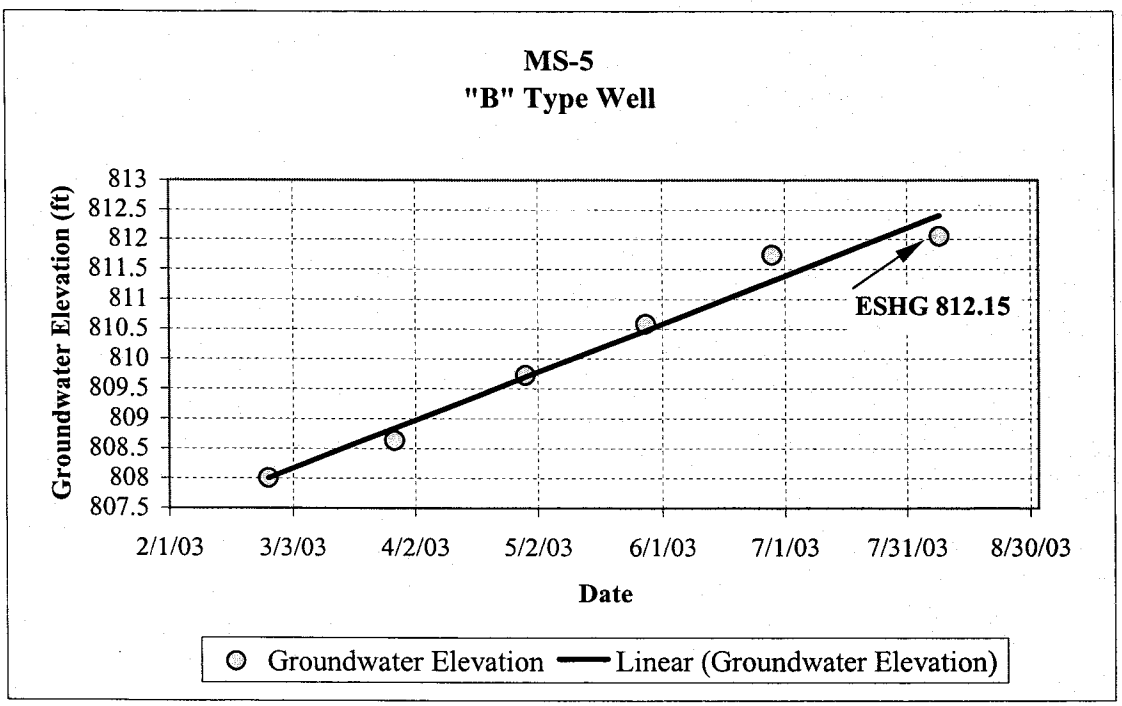
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



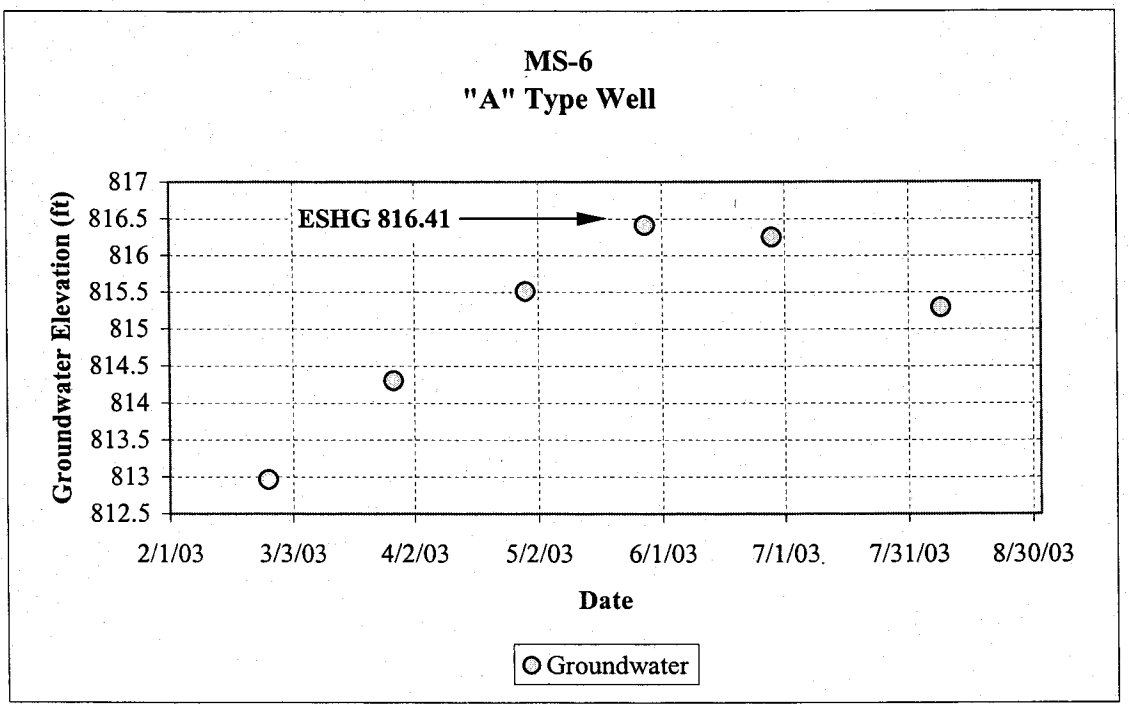


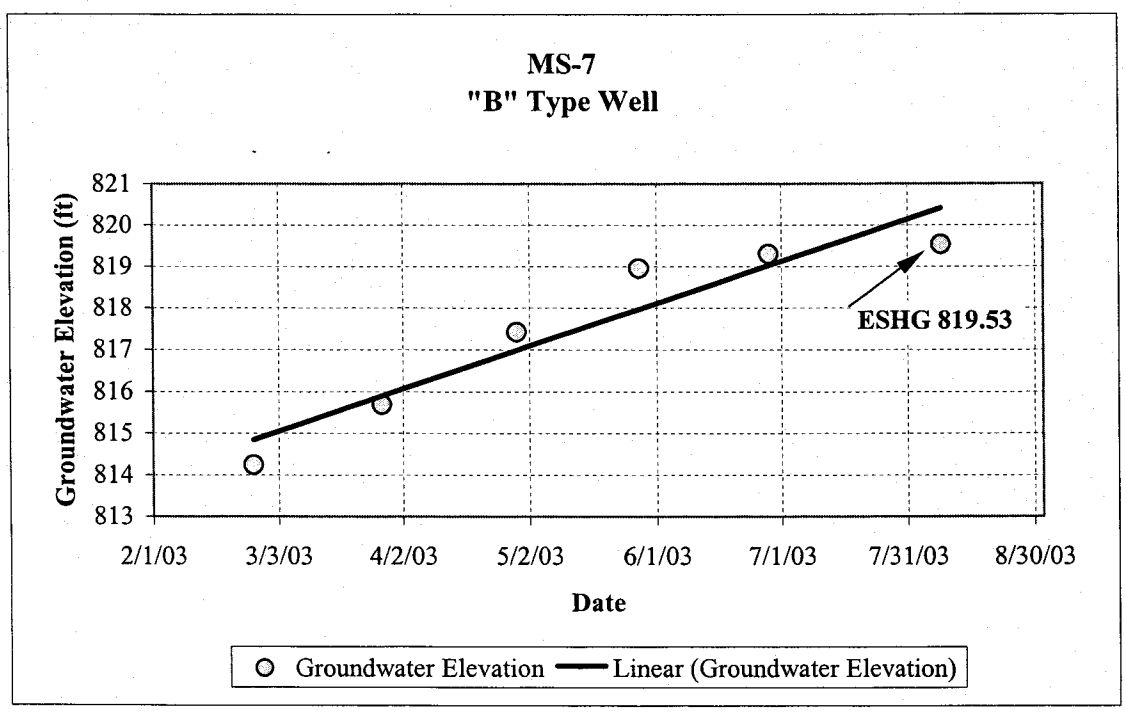
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



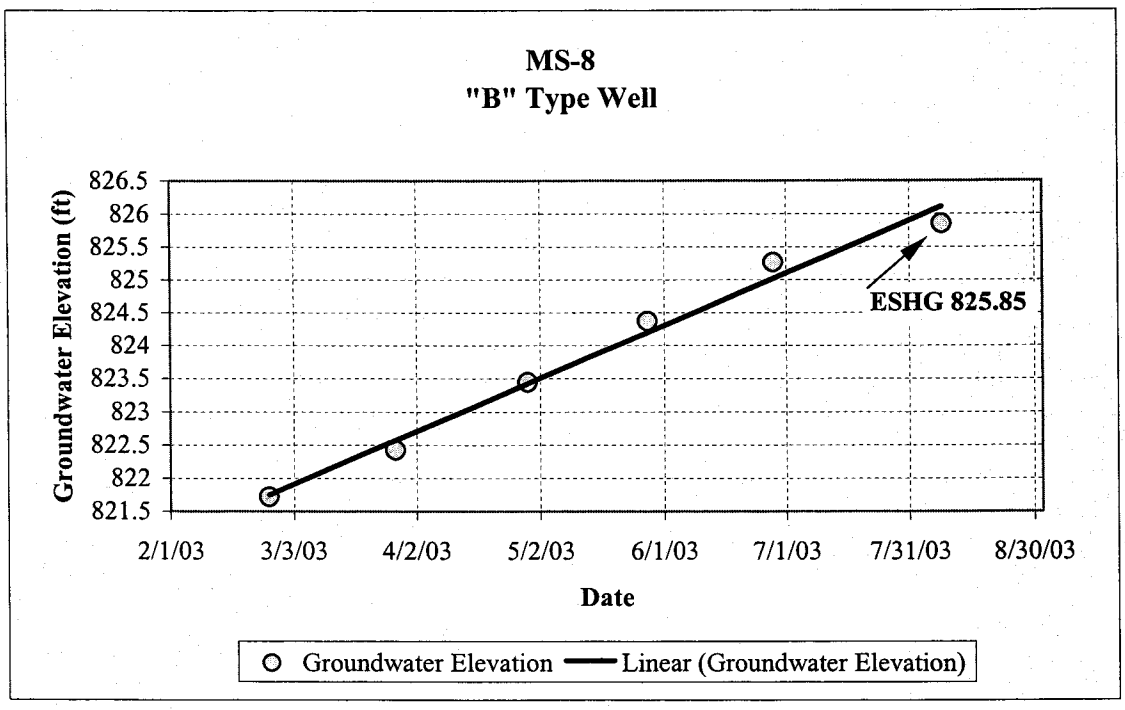


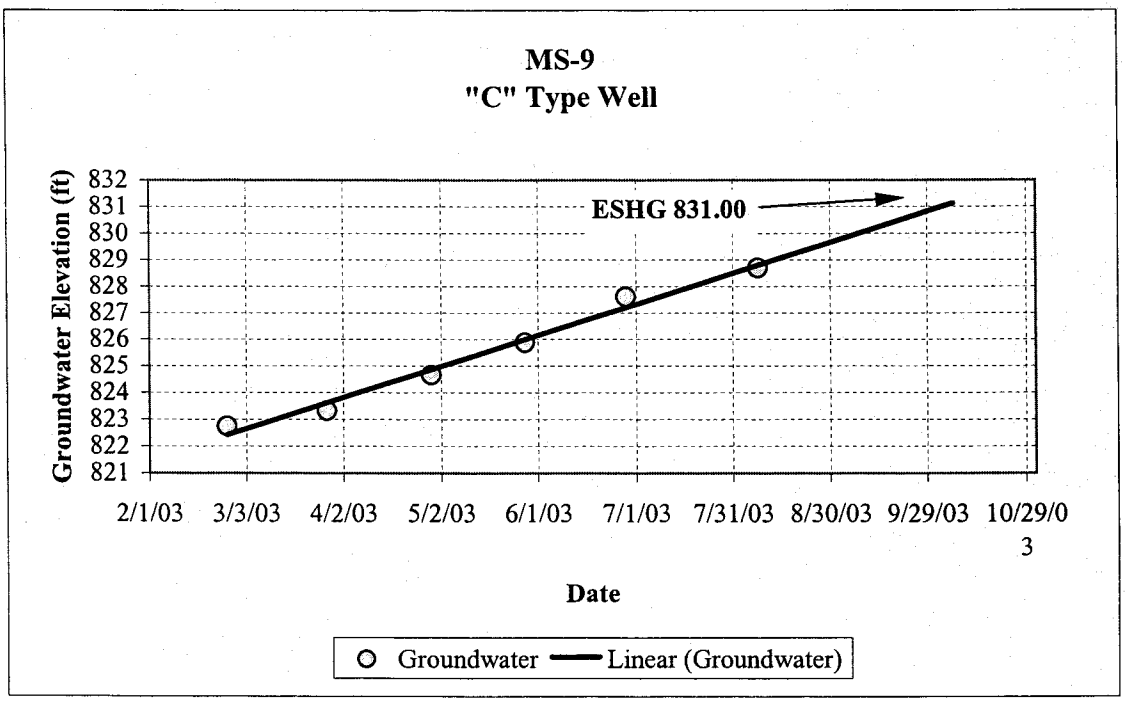
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



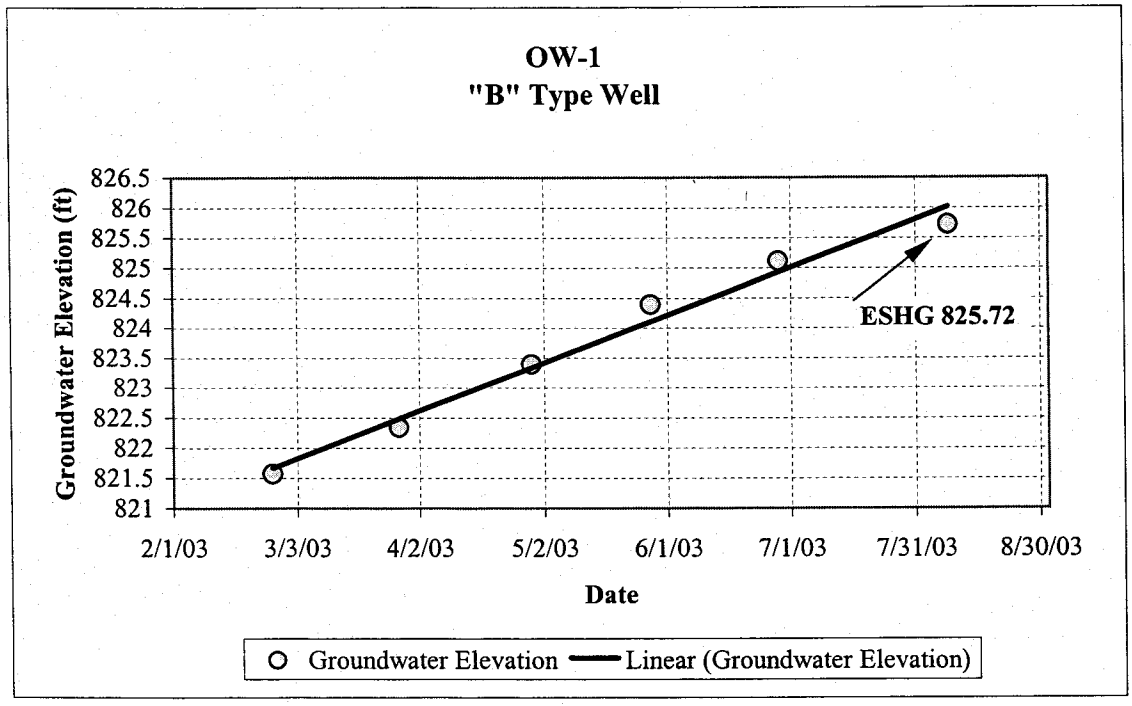


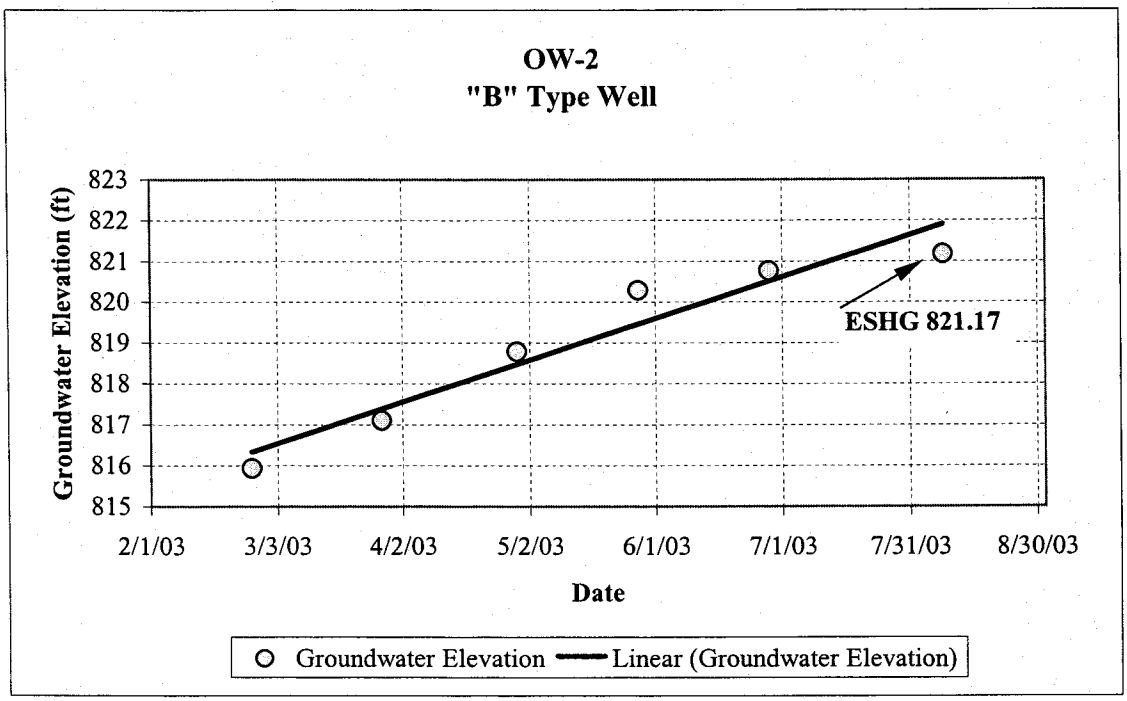
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



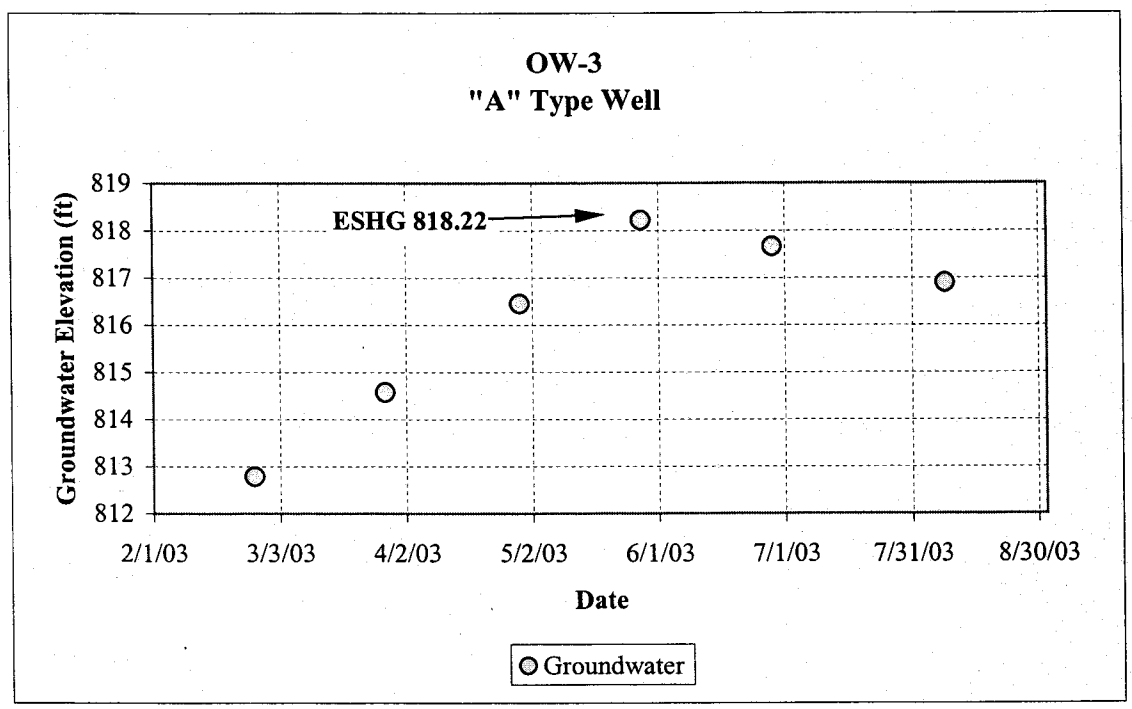


Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578

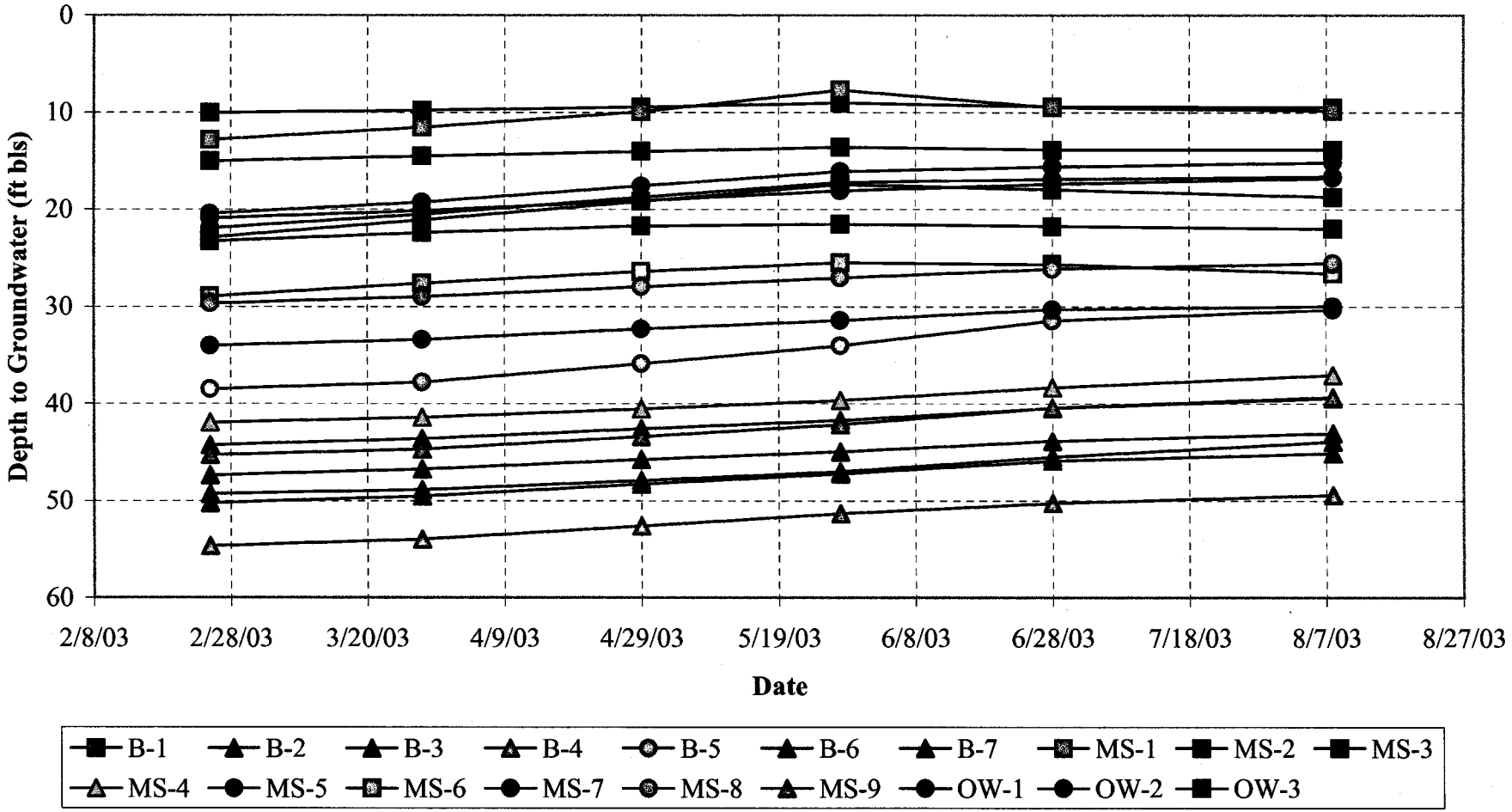




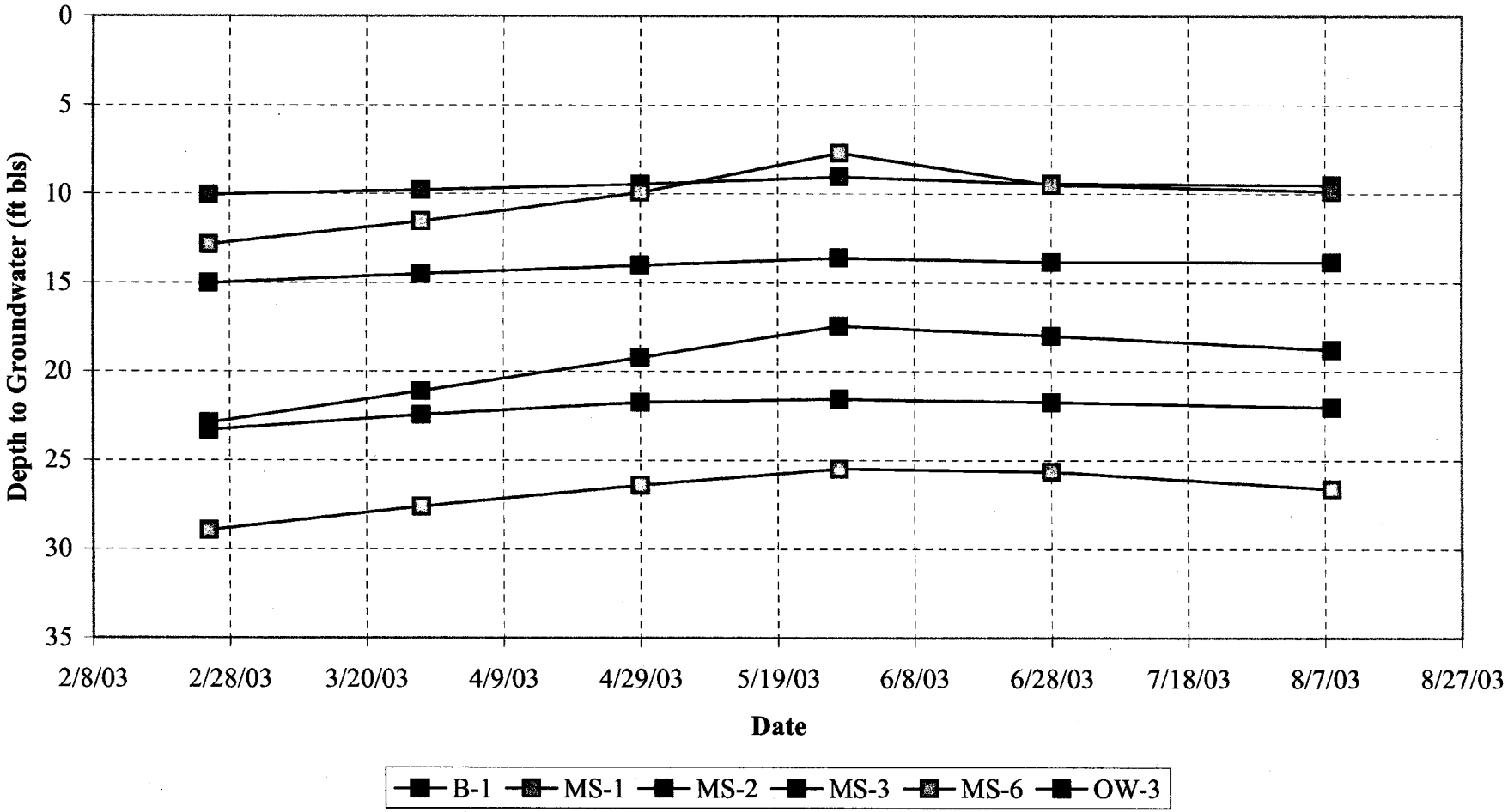
Hydrographs - Observation Wells
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578



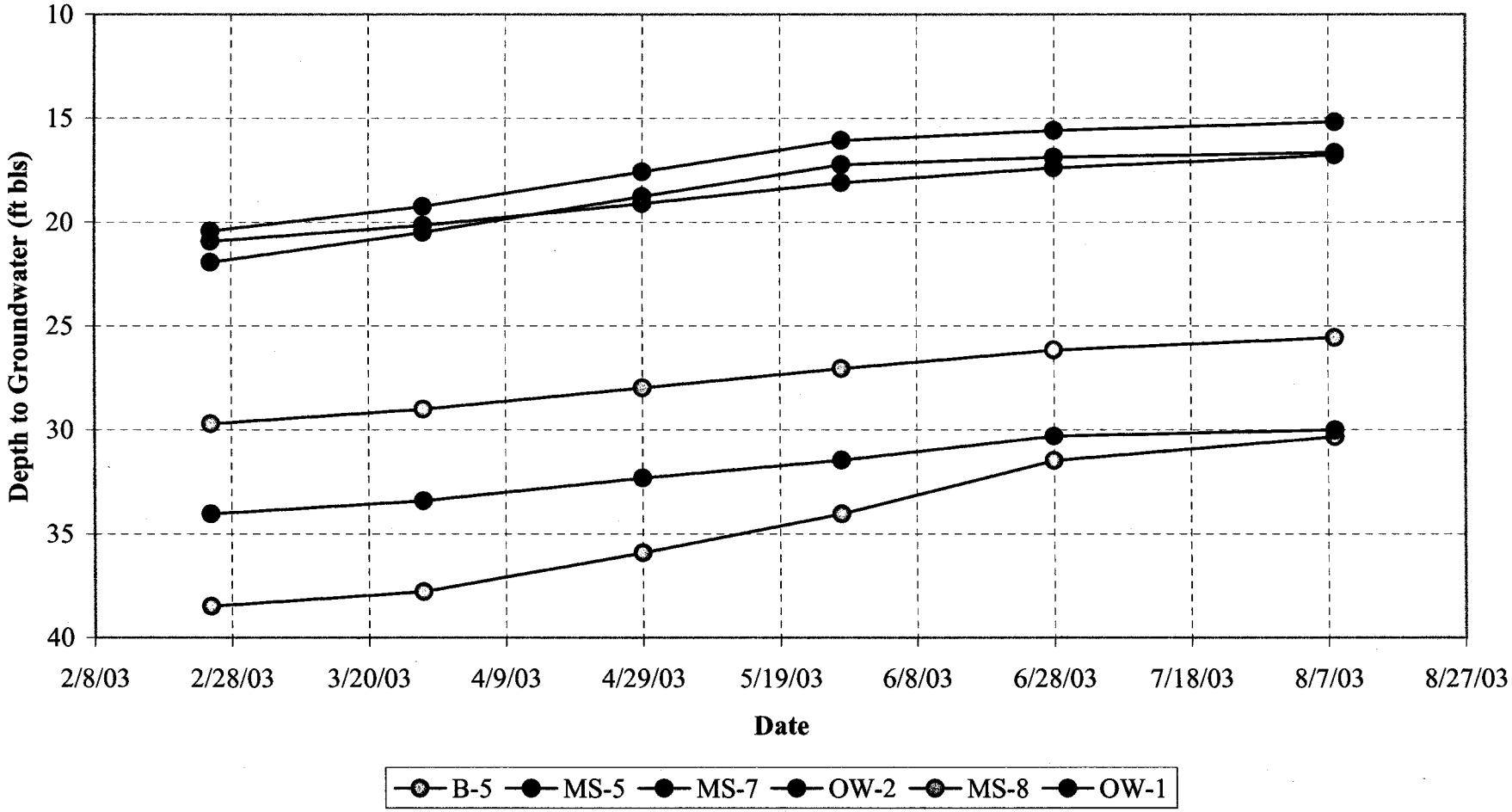
Hydrograph
Depth to Groundwater
All Wells
Marshall Steam Station



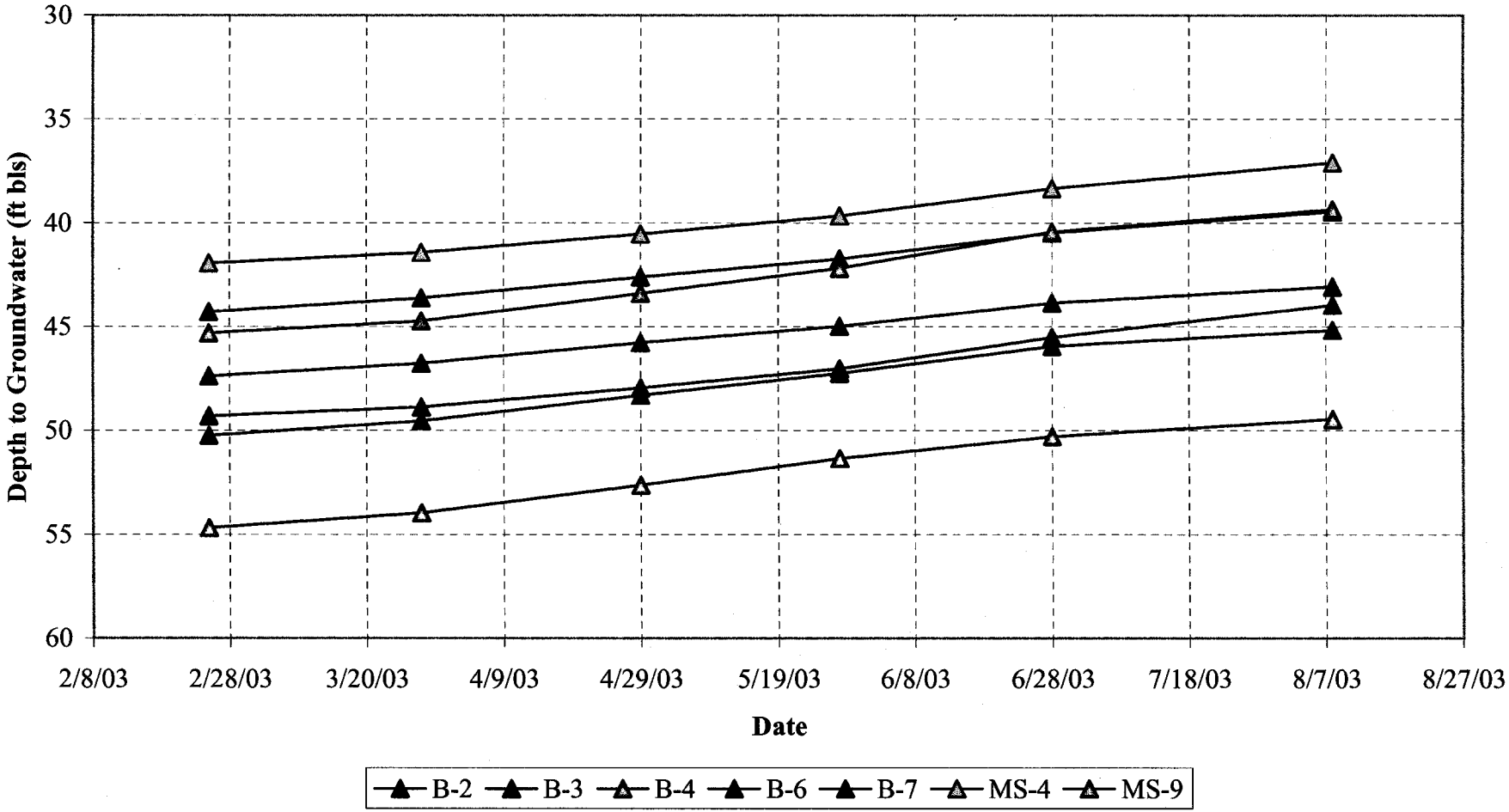
Hydrograph
Depth to Groundwater
"A" Type Wells
Marshall Steam Station



Hydrograph
Depth to Groundwater
"B" Type Wells
Marshall Steam Station



Hydrograph
Depth to Groundwater
"C" Type Wells
Marshall Steam Station



TOTAL POROSITY FOR BULK SAMPLES

Total Porosity Calculations for Bag Samples
Marshall Steam Station - FGD Scrubber Landfill
S&ME Project No. 1264-02-578

Formula

$$n = 1 - \frac{\gamma_d}{G\,\rho_\omega}$$

Where

n = total porosity
γ_d = dry density (from lab proctor data)
G = specific gravity (from lab data)
ρ_ω = density of water (constant 62.4 pcf)

B-1 Bag Sample 10' bls

γ_d = 108.4 pcf
G = 2.63
ρ_ω = 62.4 pcf

$$n = 1 - \frac{108.4}{2.63 * 62.4} = \mathbf{0.34}$$

B-2 Bag Sample 10' bls

γ_d = 89.7 pcf
G = 2.67
ρ_ω = 62.4 pcf

$$n = 1 - \frac{89.7}{2.67 * 62.4} = \mathbf{0.46}$$

B-3 Bag Sample 10' bls

γ_d = 92.4 pcf
G = 2.68
ρ_ω = 62.4 pcf

$$n = 1 - \frac{92.4}{2.68 * 62.4} = \mathbf{0.45}$$

B-4 Bag Sample 10' bls

γ_d = 88 pcf
G = 2.73
ρ_ω = 62.4 pcf

$$n = 1 - \frac{88}{2.73 * 62.4} = \mathbf{0.48}$$

B-5 Bag Sample 10' bls

γ_d = 90.9 pcf
G = 2.75
ρ_ω = 62.4 pcf

$$n = 1 - \frac{90.9}{2.75 * 62.4} = \mathbf{0.47}$$

B-6 Bag Sample 10' bls

γ_d = 93 pcf
G = 2.66
ρ_ω = 62.4 pcf

$$n = 1 - \frac{93}{2.66 * 62.4} = \mathbf{0.44}$$

B-7 Bag Sample 10' bls

γ_d = 84.8 pcf
G = 2.77
ρ_ω = 62.4 pcf

$$n = 1 - \frac{84.8}{2.77 * 62.4} = \mathbf{0.51}$$

FETTER AND BEAR DIAGRAMS

Example for Calculating Percentages
for use in the Fetter Diagram

Sample : B-5
Depth : 33.5-35 ft bls

Using the Particle Size Distribution Report, the percentages passing the 2 mm, 0.065 mm and 0.004 mm were calculated.

For B-5, 33.5-35' the percentages passing are as follows:

Percent passing 2 mm (#10 sieve) =	99.3%	=	66.8% Sand
Percent passing 0.065 mm (estimated from graph) =	32.5%	=	28.5% Silt
Percent passing 0.004 mm (estimated from graph) =	4.0%	=	4% Clay
			98.3% Total

Because the Fetter Diagram classifies sand from 2mm to 0.065mm, any amount of sample above the 2mm range was disregarded. For B-5, that amount was 0.7%.

The adjusted percentages passing are as follows:

Percent Sand =	67.3%
Percent Silt =	28.7%
Percent Clay =	4.0%
	100% Total

The following are the grain size percents to be plotted on the Fetter Diagram:

% Sand	2 mm - 0.0065 mm	67.3%
% Silt	0.0065 mm - 0.004 mm	28.7%
% Clay	<0.004 mm	4.0%

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

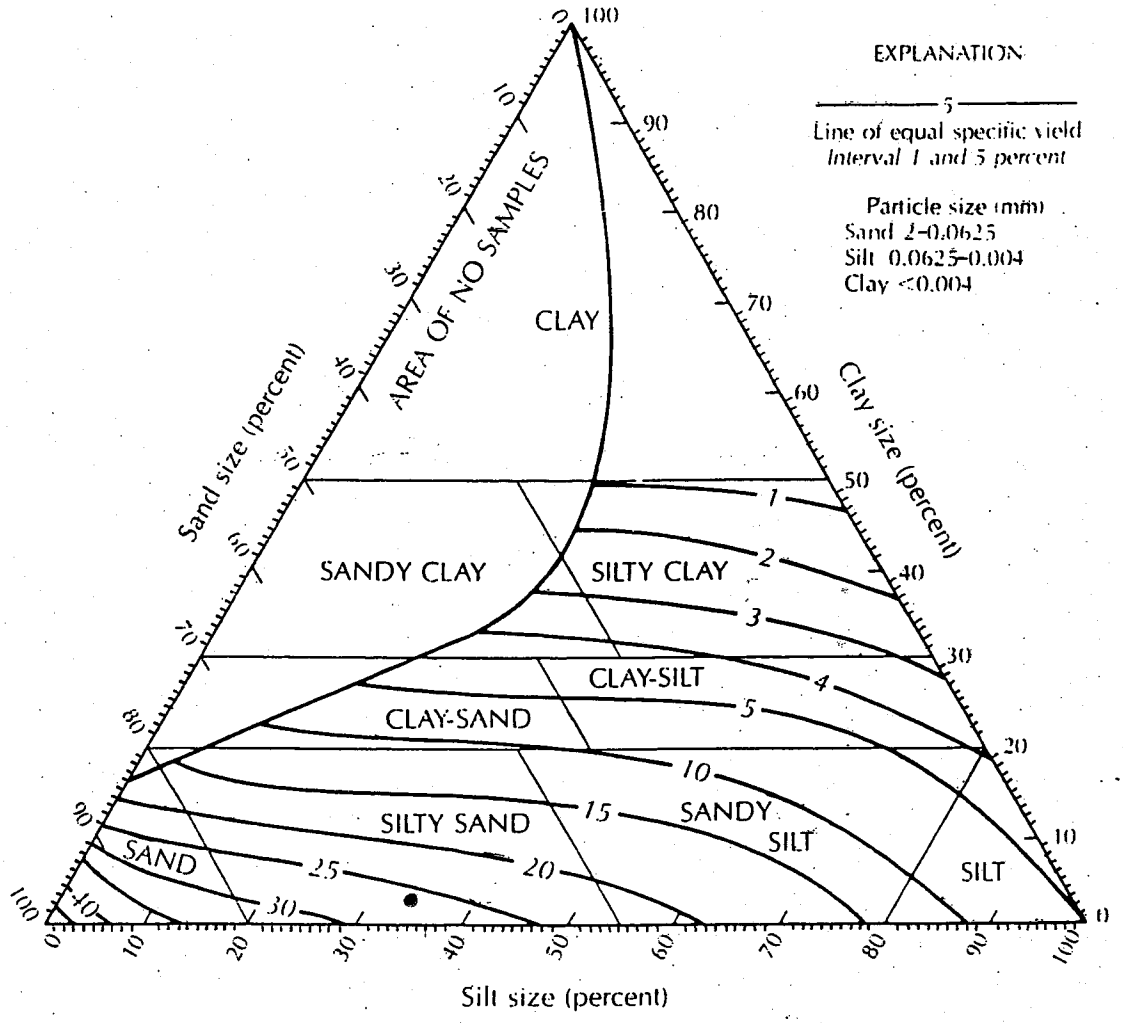


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

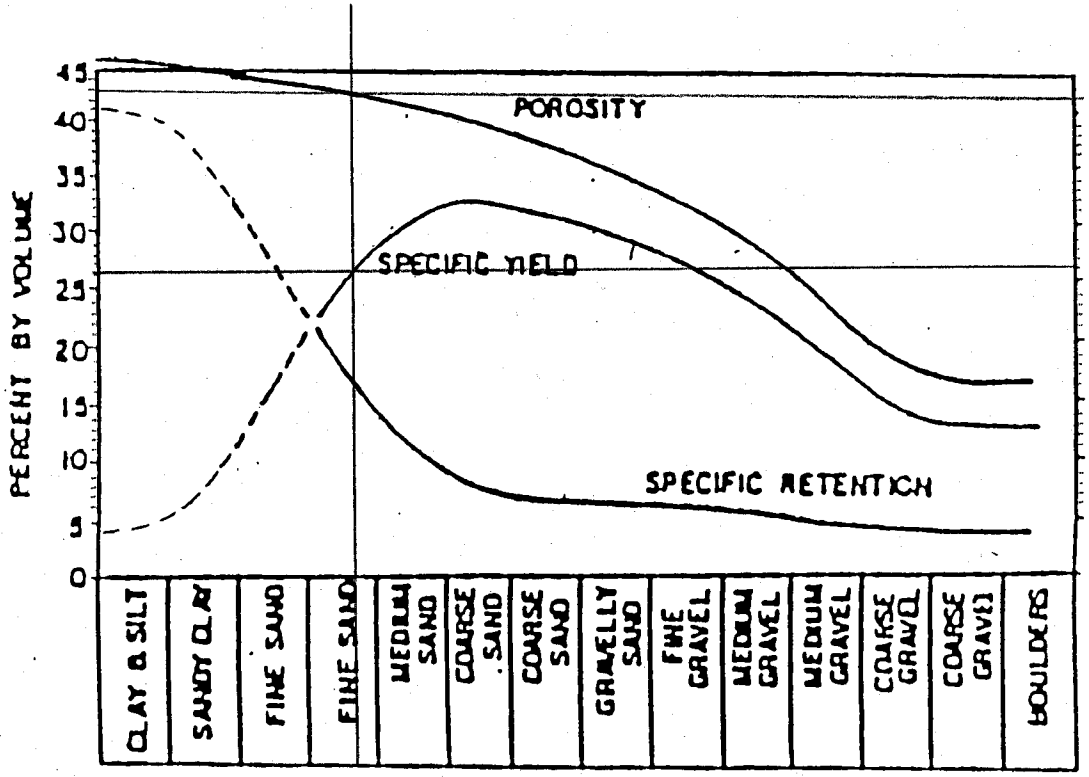
Boring Number: B-2
Sample Number: S-10
Sample Depth: 48.5 TO 50
Sample Type: Split Spoon

Sand Size Percent: 63 %
Silt Size Percent: 34 %
Clay Size Percent: 3 %

Specific Yield: 26

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



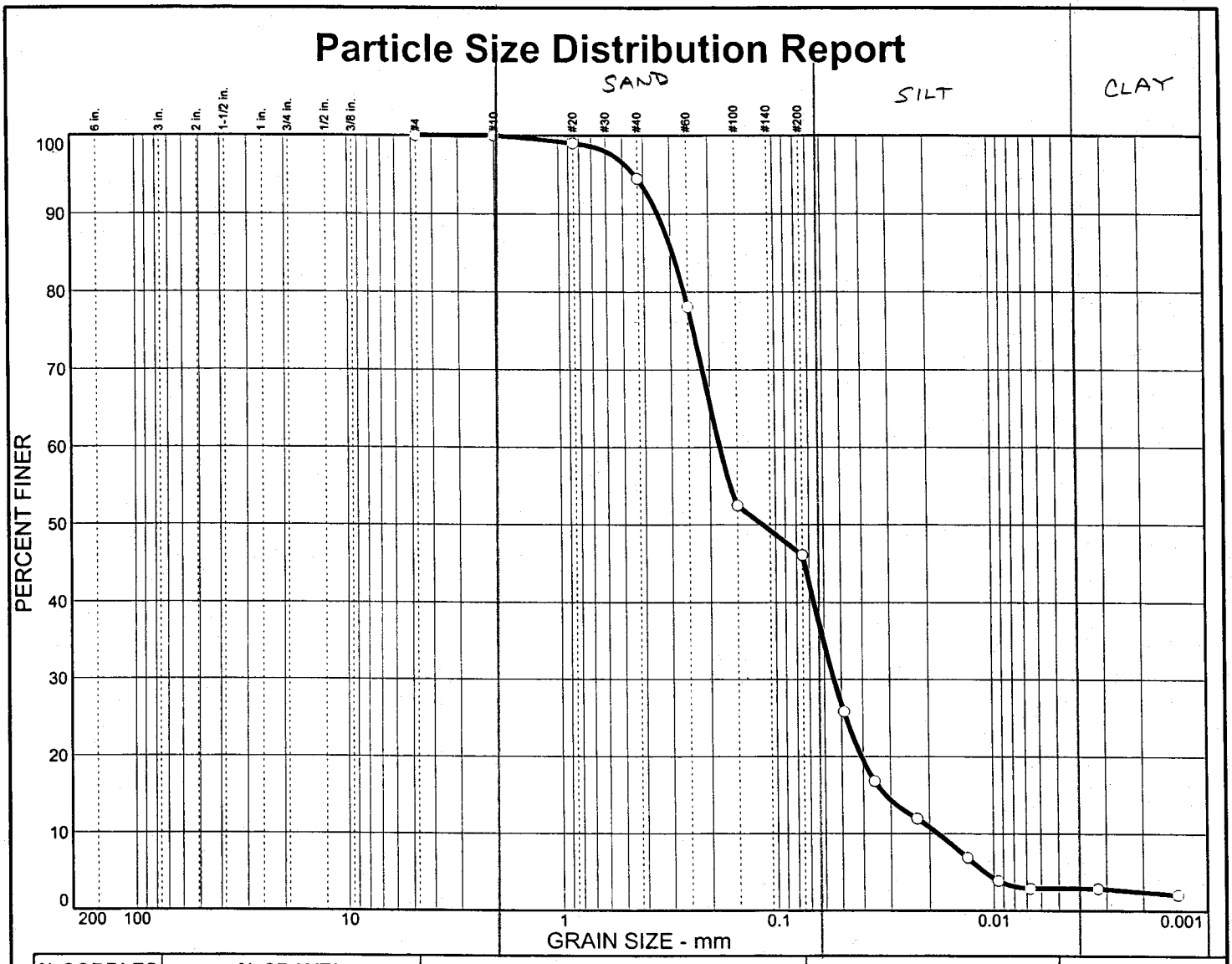
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: B-2 Sample Depth: 48.5 to 50 Specific Yield: 26

Sample Number: S-10 Sample Type: Split Spoon **Porosity:** 43

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	53.9	43.2	2.9
			100 - 37 = 63	37-3 = 34	3

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.293	0.180	0.114	0.0541	0.0317	0.0183	0.89	9.85

MATERIAL DESCRIPTION	USCS	AASHTO
○ GREYISH TAN WHITE MICACEOUS SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-2

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE S-10,B-2

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

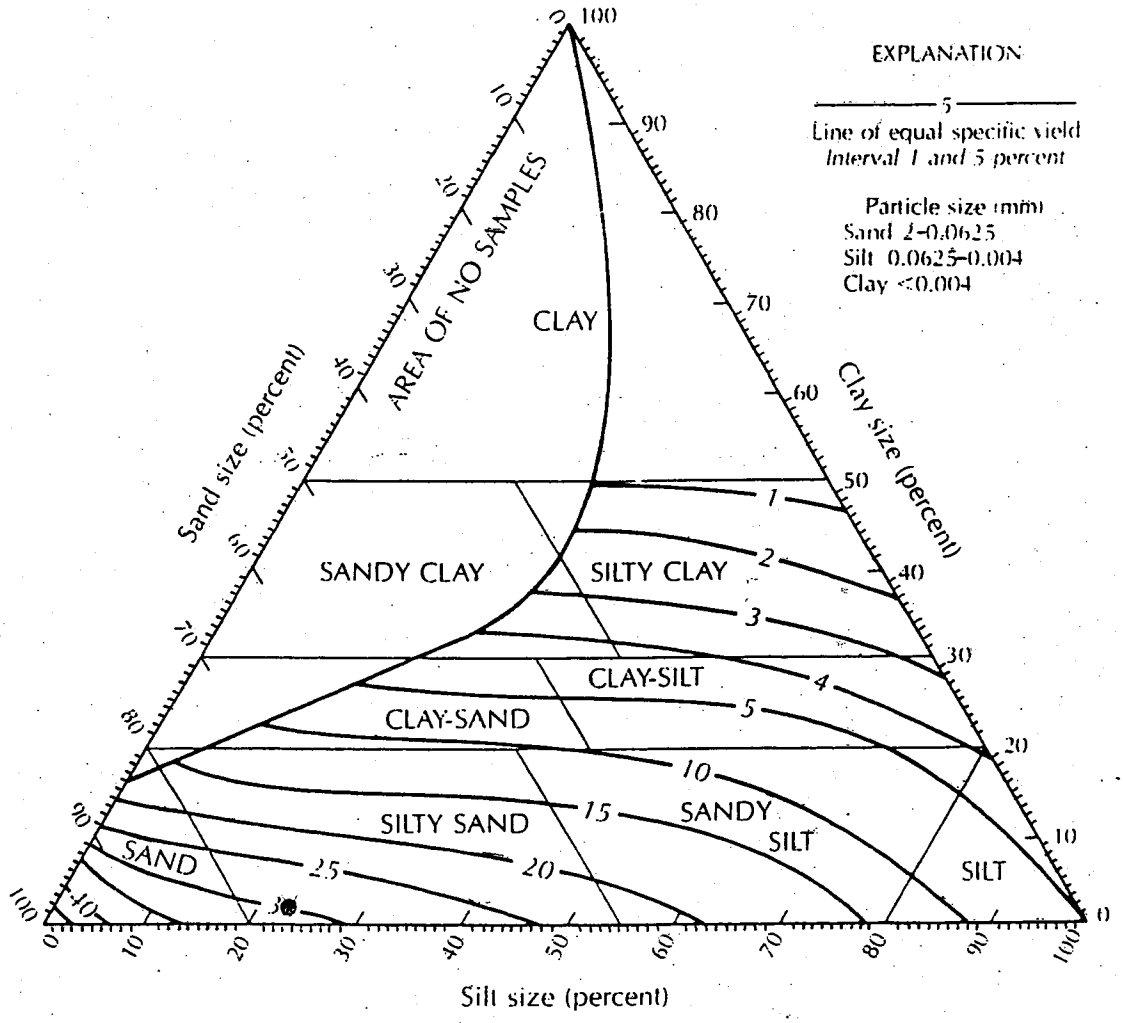


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

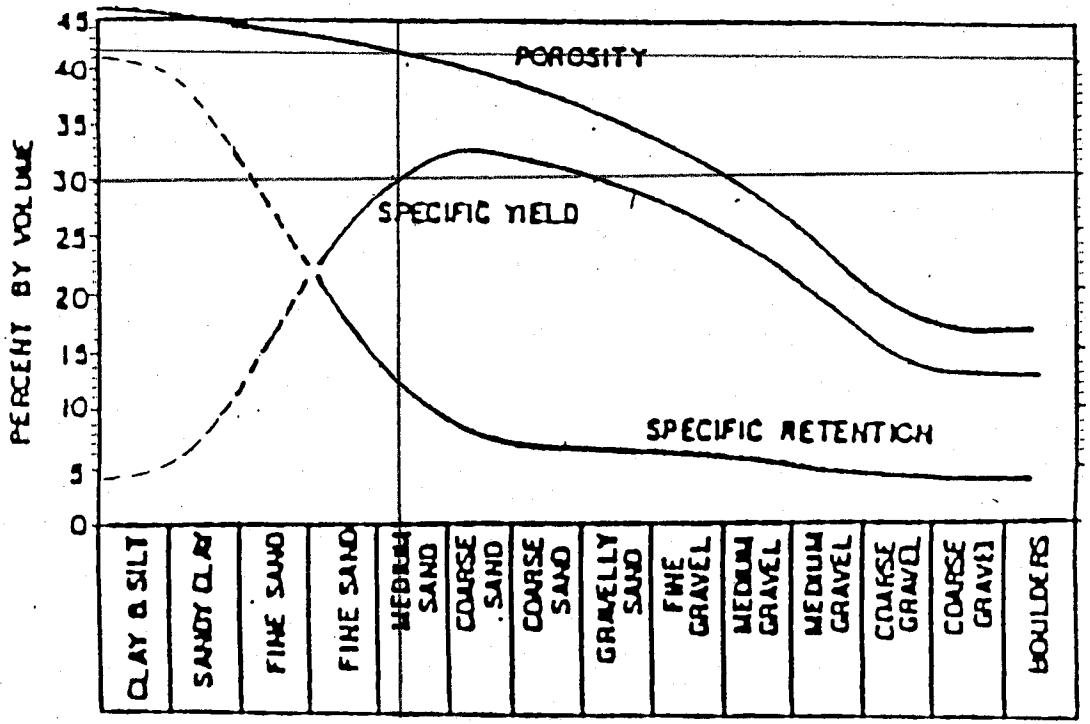
Boring Number: B-3
Sample Number: NONE
Sample Depth: 50 to 52
Sample Type: U.D.

Sand Size Percent: 75 %
Silt Size Percent: 22.5 %
Clay Size Percent: 2.5 %

Specific Yield: 30

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



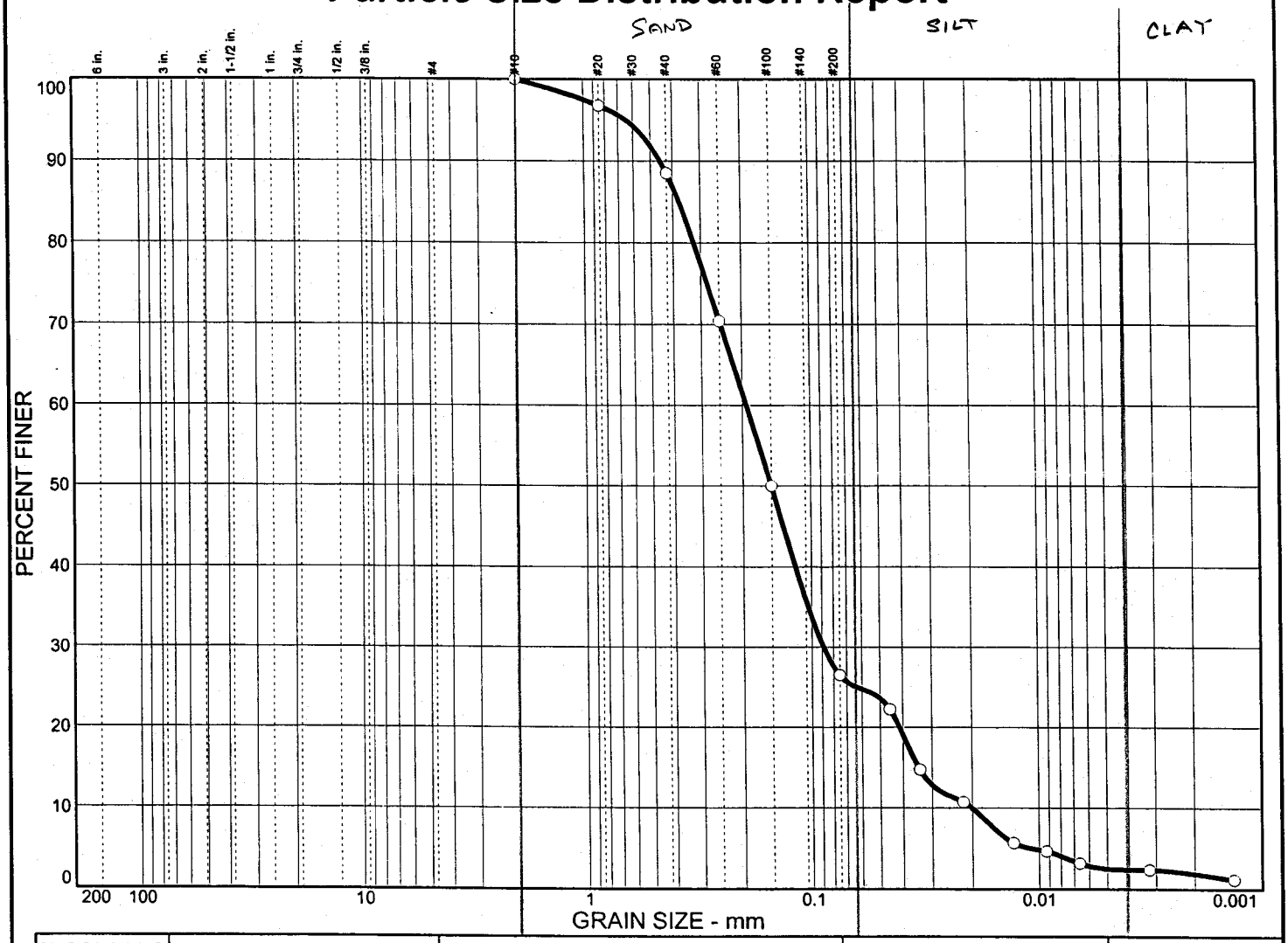
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: B-3 Sample Depth: 50 to 52 Specific Yield: 30

Sample Number: NONE Sample Type: U.D. **Porosity:** 42

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	73.5	24.0	2.5
			100 - 25 = 75	25 - 2.5 = 22.5	2.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.375	0.192	0.150	0.0885	0.0343	0.0201	2.03	9.52

MATERIAL DESCRIPTION	USCS	AASHTO
○ TANNISH BROWN MICACEOUS SL.CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-3

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE B-3 U.D.

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

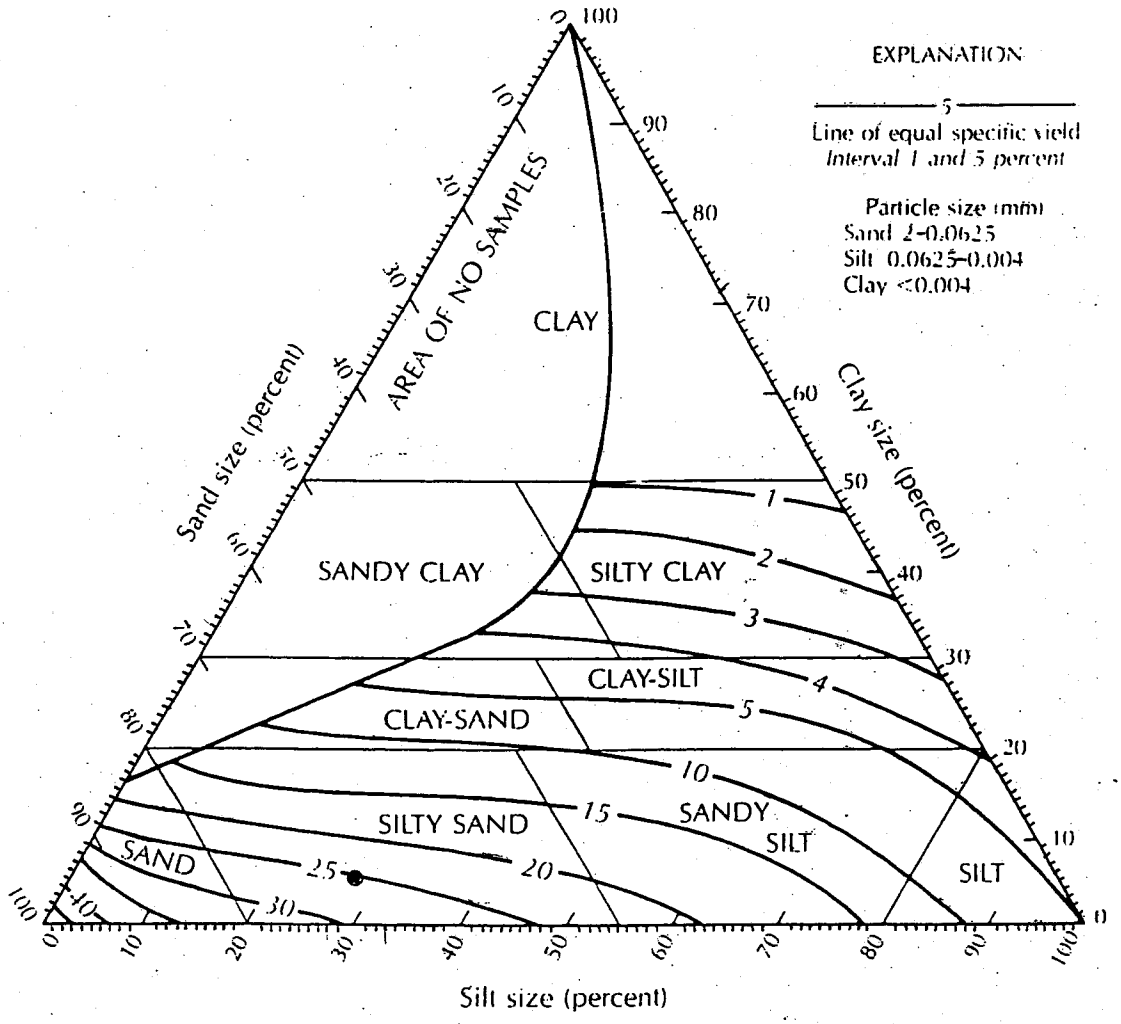


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

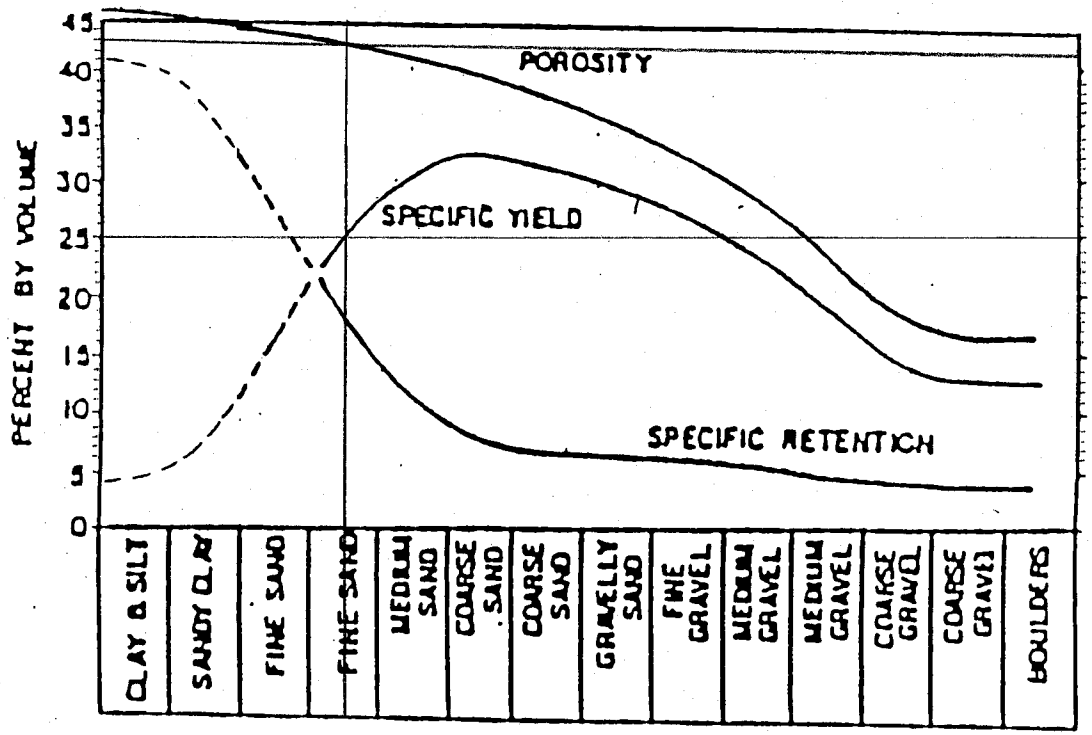
Boring Number: B-5
Sample Number: S-7
Sample Depth: 33.5 to 35
Sample Type: Split Spoon

Sand Size Percent: 67.3 %
Silt Size Percent: 28.7 %
Clay Size Percent: 4 %

Specific Yield: 25

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM

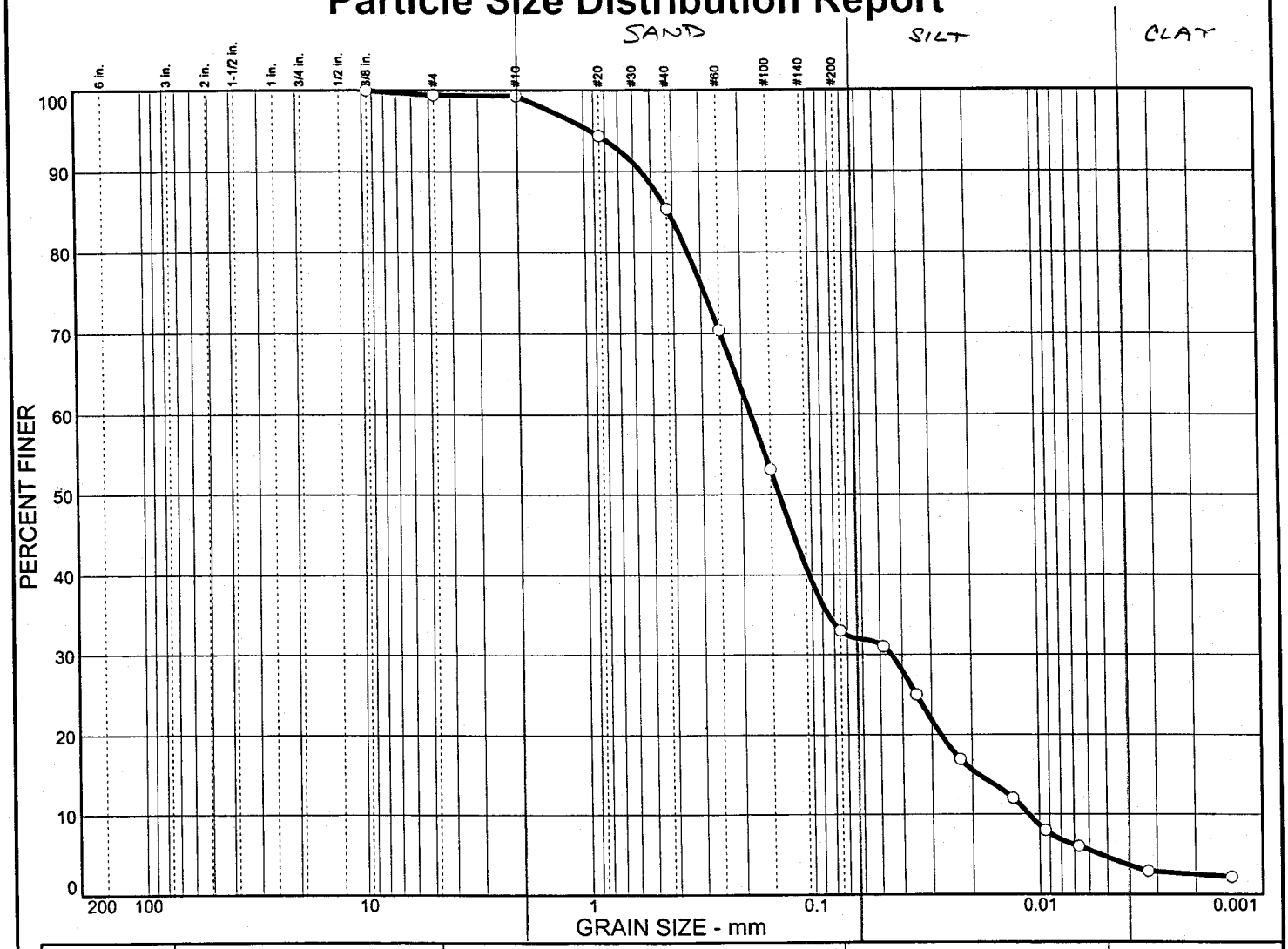


Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: B-5
Sample Number: S-7
Sample Depth: 33.5 to 35
Sample Type: Split Spoon
Specific Yield: 25
Porosity: 43

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.6	66.4	28.4	4.6
			99.3 - 32.5 = 66.8	32.5 - 4 = 28.5	4
			ADJ 67.3	28.7	4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.417	0.182	0.137	0.0447	0.0188	0.0112	0.98	16.33

MATERIAL DESCRIPTION	USCS	AASHTO
○ TANNISH BROWN WHITE MICACEOUS SL. CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-5

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE S-7,B-5

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

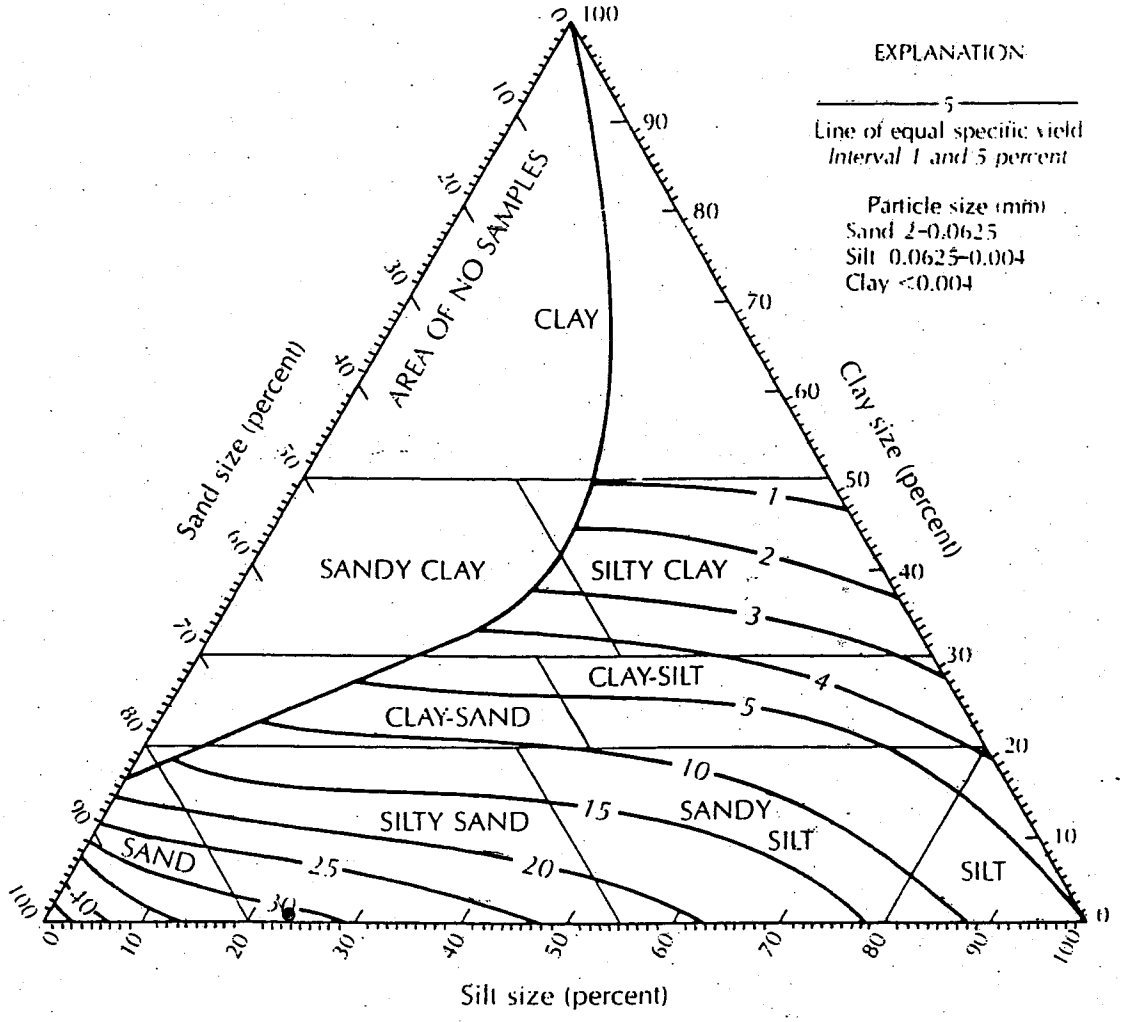


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

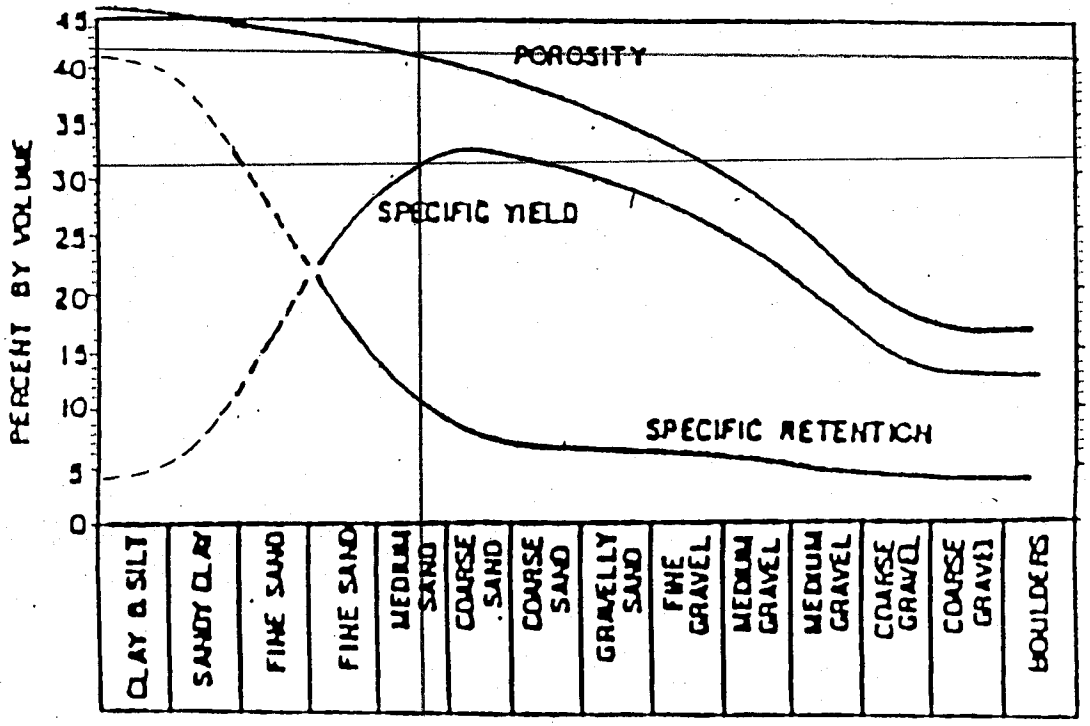
Boring Number: B-6
Sample Number: NONE
Sample Depth: 43 TO 45
Sample Type: U. D.

Sand Size Percent: 76.4 %
Silt Size Percent: 23.6 %
Clay Size Percent: 6 %

Specific Yield: 31

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



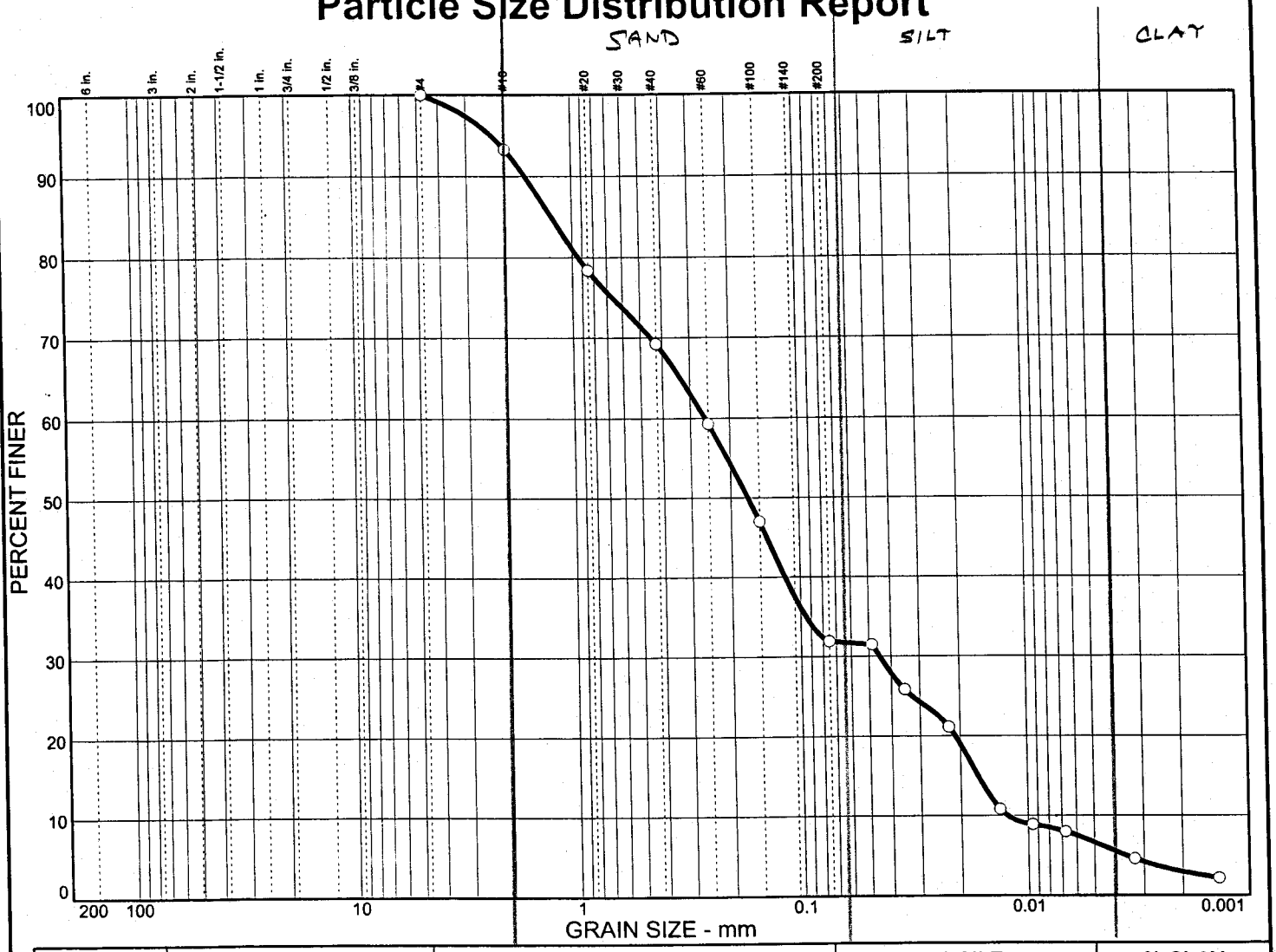
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: B-6 Sample Depth: 43 TO 45 Specific Yield: 31

Sample Number: NONE Sample Type: U.D. **Porosity:** 42

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	68.1	25.2	6.7
			93.3 - 22 = 71.3	22 - 5.5 = 16.5	5.5
			ADJ 76.4	23.6	6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	1.24	0.258	0.168	0.0449	0.0167	0.0124	0.63	20.78

MATERIAL DESCRIPTION	USCS	AASHTO
○ PINKISH BROWN SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-6

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE B-6,U.D.

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

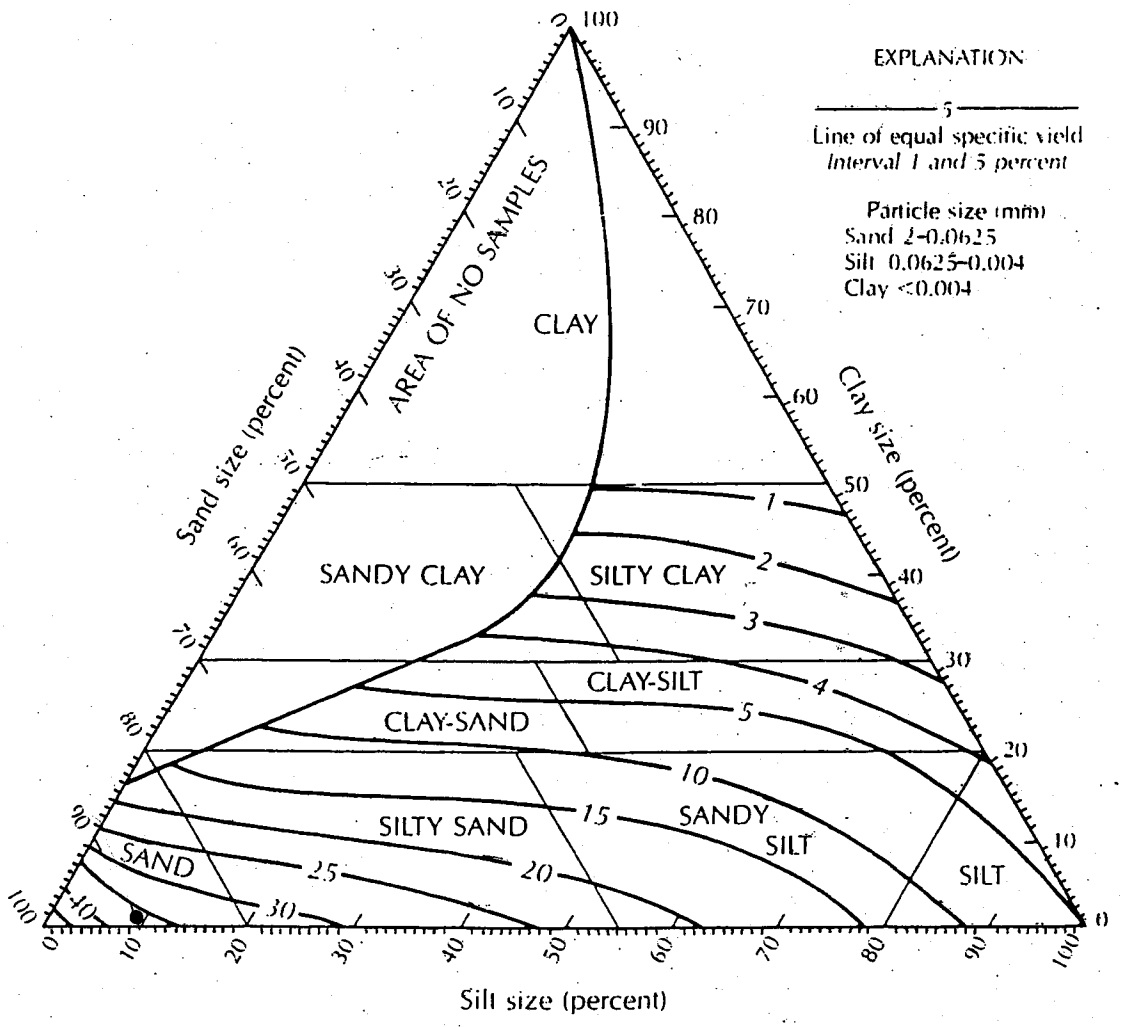


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

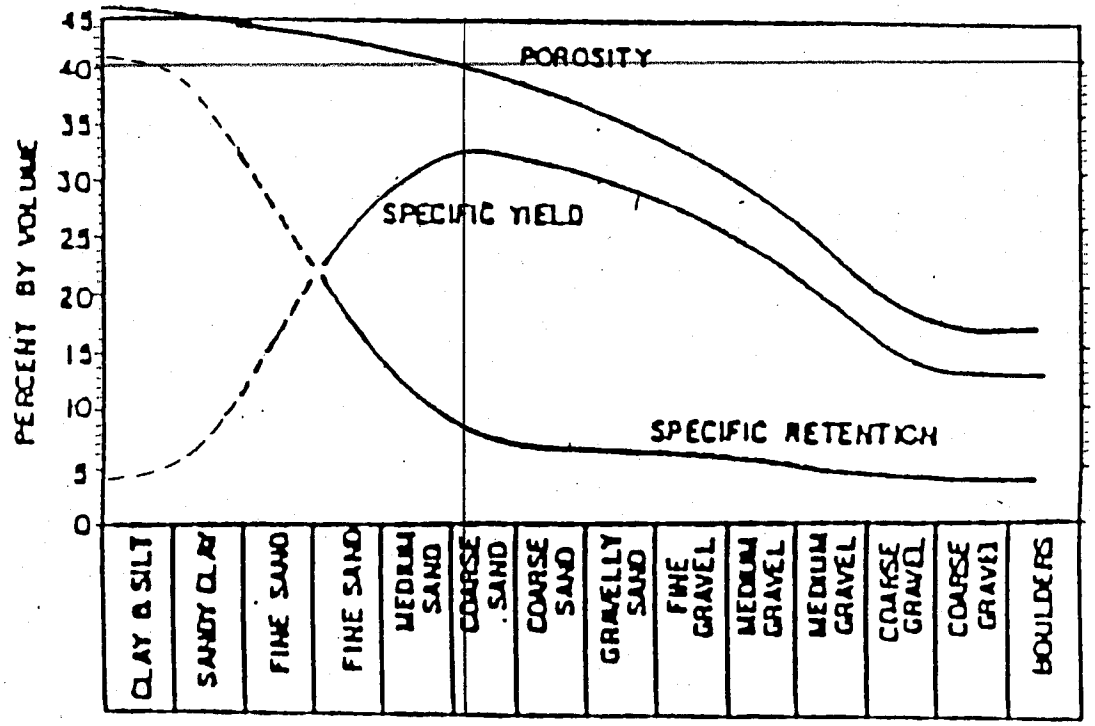
Boring Number: B-7
Sample Number: NONE
Sample Depth: 30 TO 32
Sample Type: U.D.

Sand Size Percent: 88.5 %
Silt Size Percent: 9.4 %
Clay Size Percent: 2.1 %

Specific Yield: 37

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



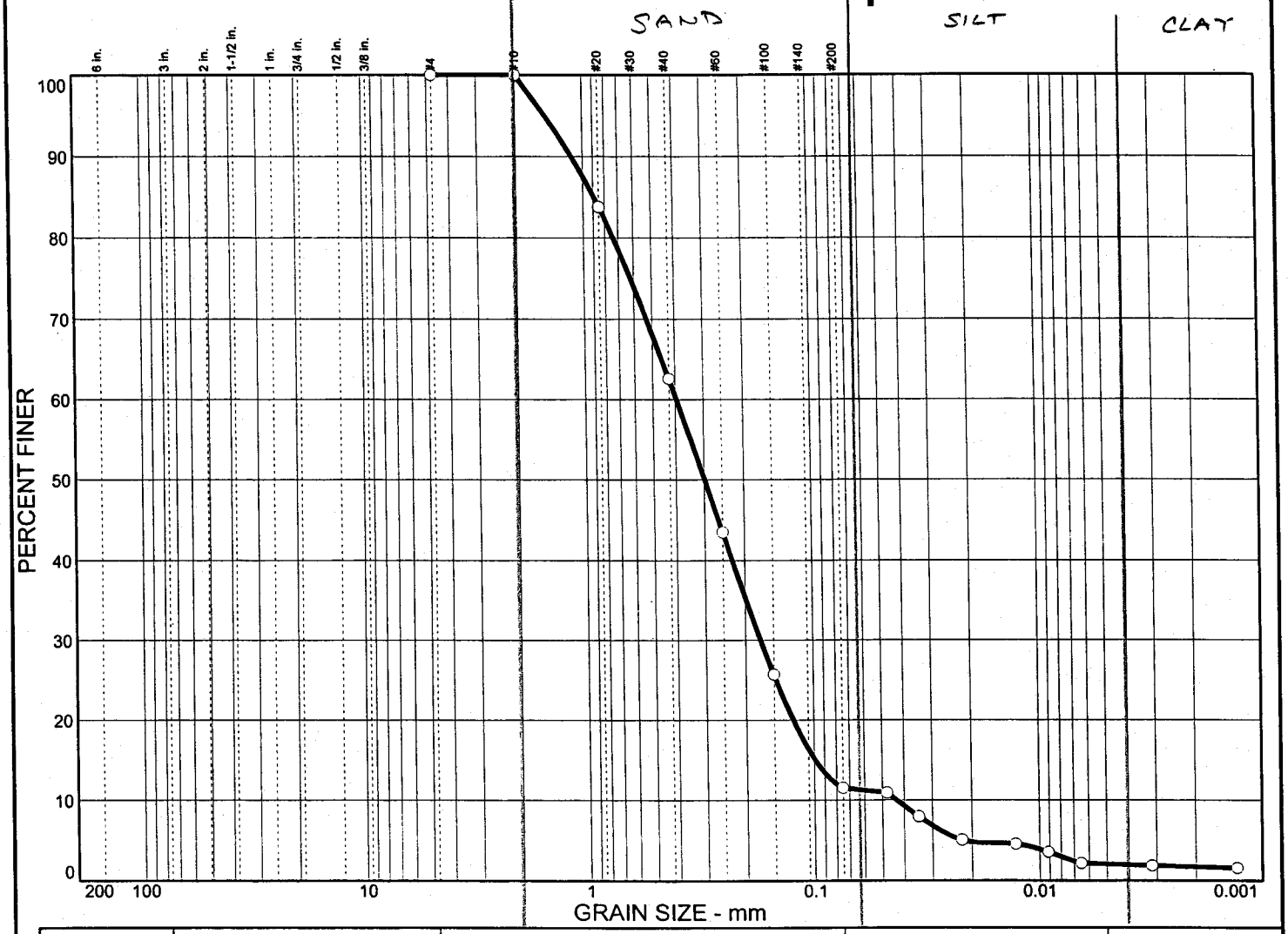
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: B-7 Sample Depth: 30 TO 32 Specific Yield: 37

Sample Number: NONE Sample Type: U.D. **Porosity:** 40

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	88.5	9.4	2.1
			100 - 11.5 = 88.5	11.5 - 2.1 = 9.4	2.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.893	0.395	0.299	0.171	0.0990	0.0433	1.72	9.12

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY BROWN WHITE MICACEOUS SL. CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-7

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE B-7,U.D.

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

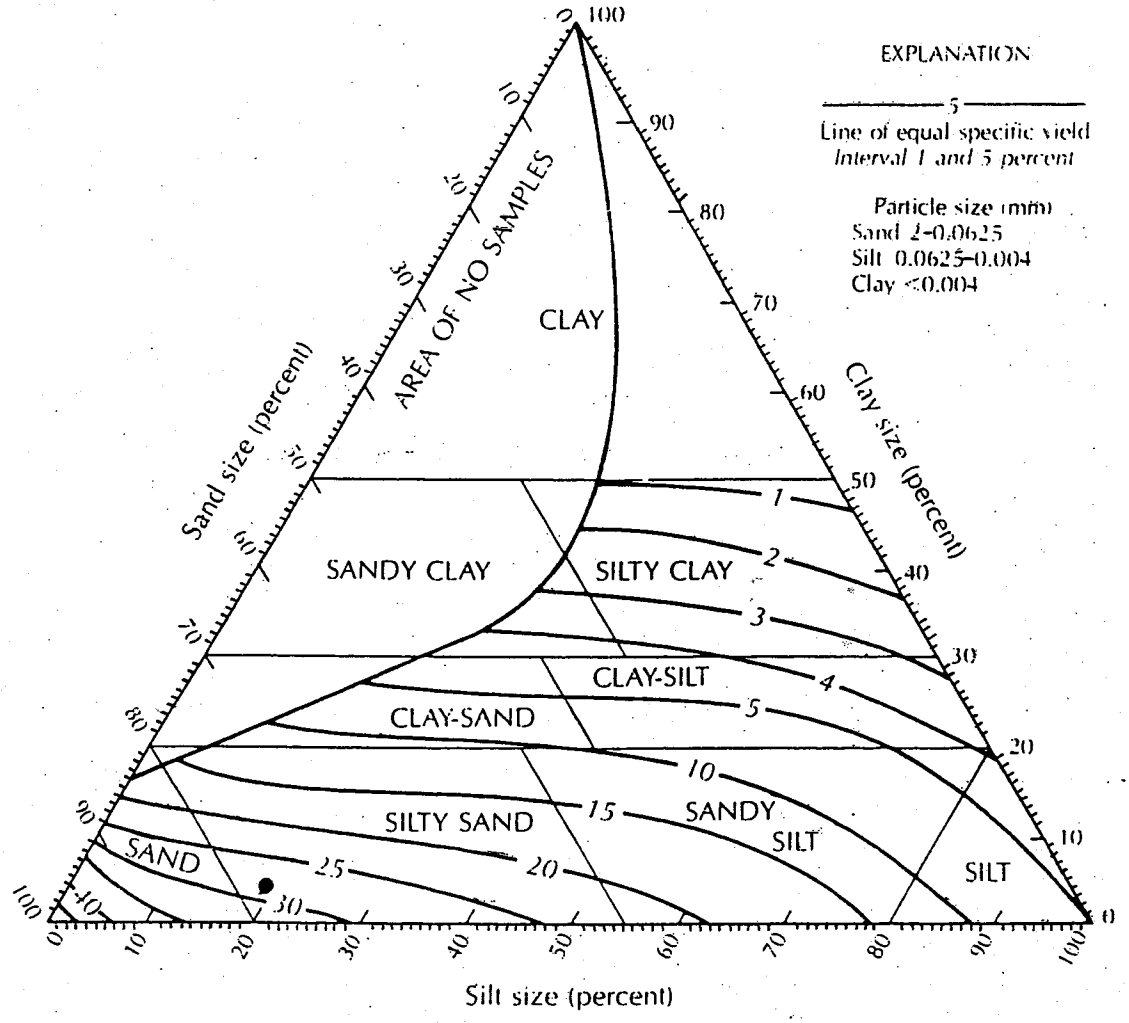


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

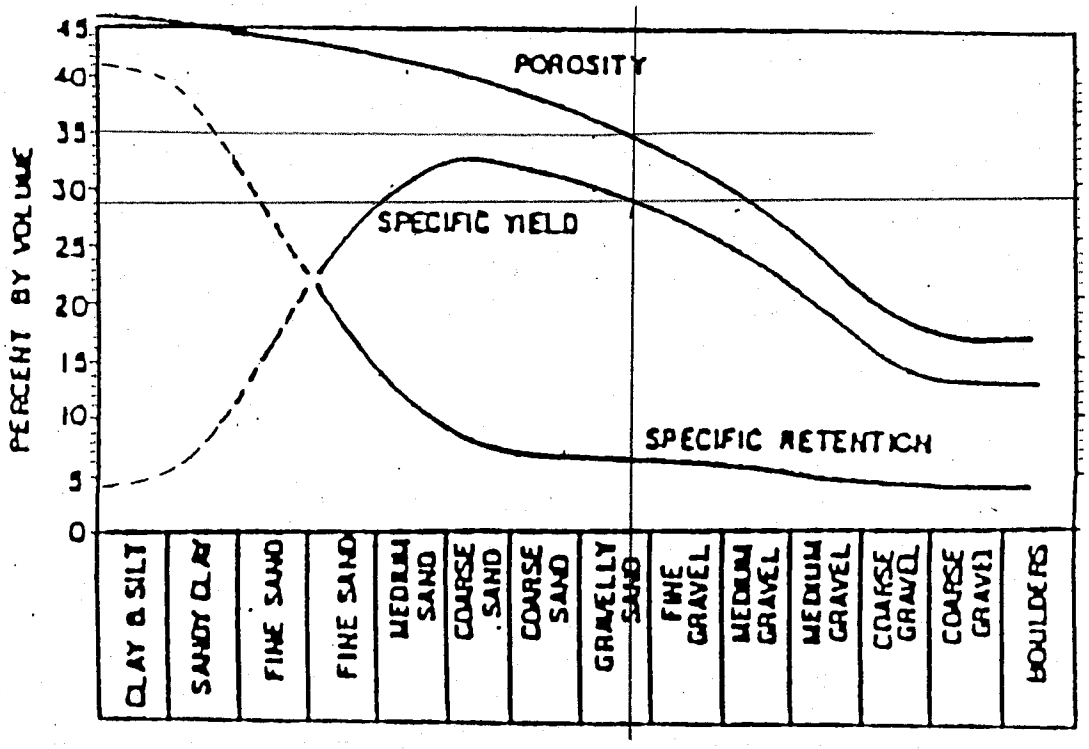
Boring Number: B-7
Sample Number: S-10 thru 12
Sample Depth: 48.5 To 60
Sample Type: Split Spoon

Sand Size Percent: 76.7 %
Silt Size Percent: 19.2 %
Clay Size Percent: 4.1 %

Specific Yield: 29

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



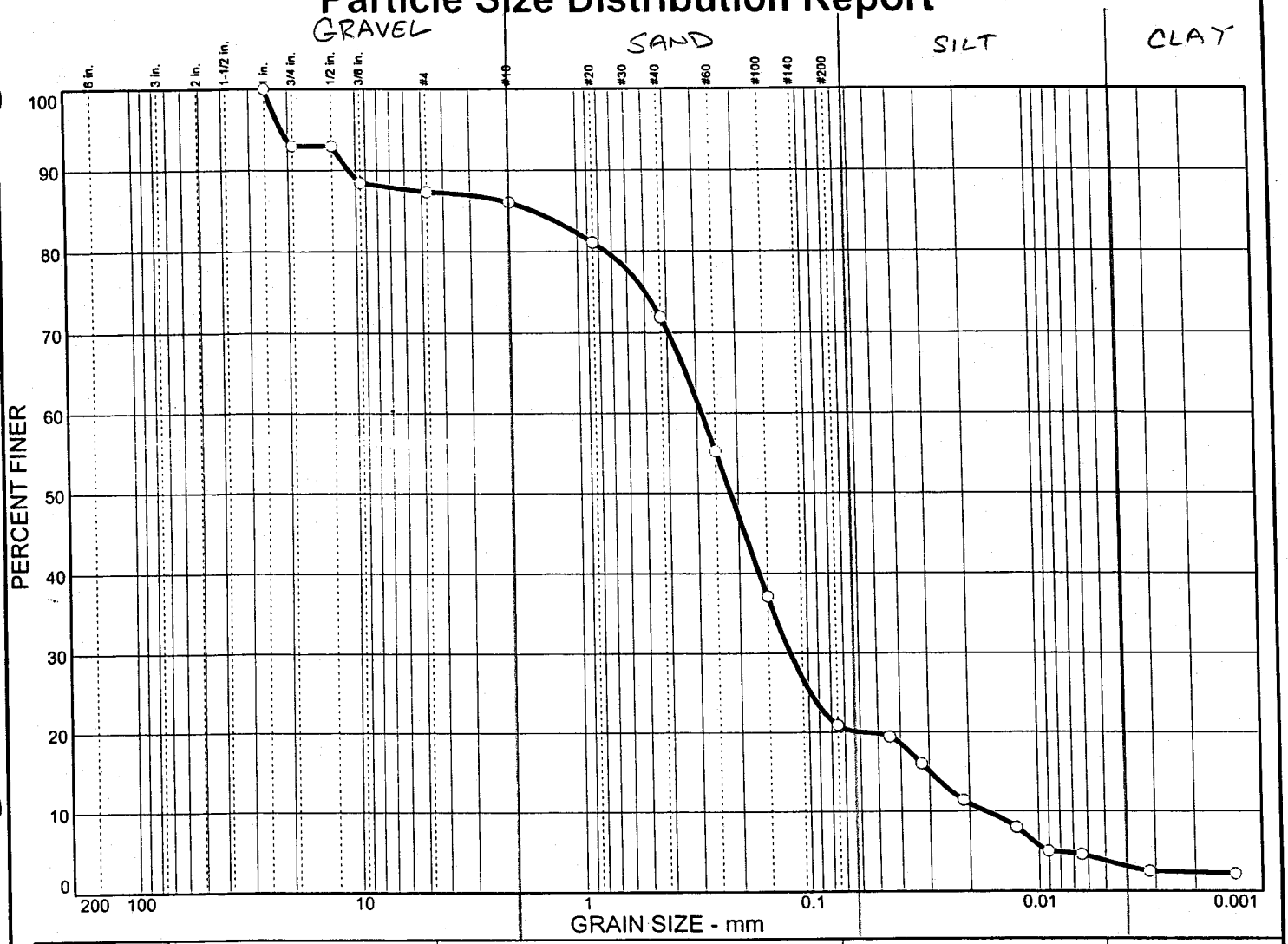
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: B-7 Sample Depth: 48.5 to 60 Specific Yield: 29

Sample Number: S-10 thru 12 Sample Type: Split Spoon **Porosity:** 35

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	12.7	66.4	17.1	3.8
			86 - 20 = 66	20 - 3.5 = 16.5	3.5
			76.7	19.2	4.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	1.57	0.285	0.216	0.119	0.0299	0.0170	2.94	16.81

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY BLACK WHITE SL. CLAYEY SILTY M-F SAND WITH ROCK FRAGMENTS	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** B-7

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE S10-12

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

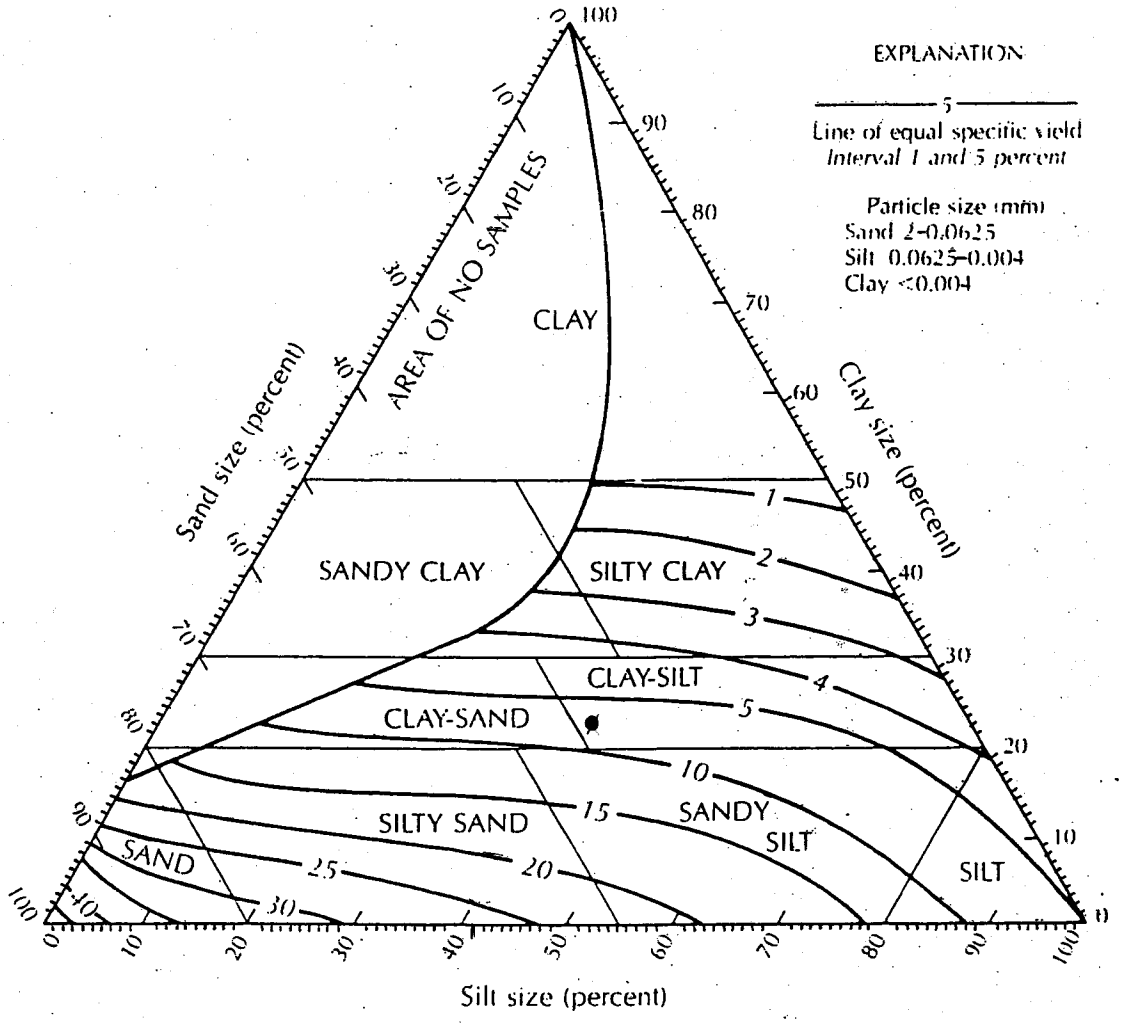


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

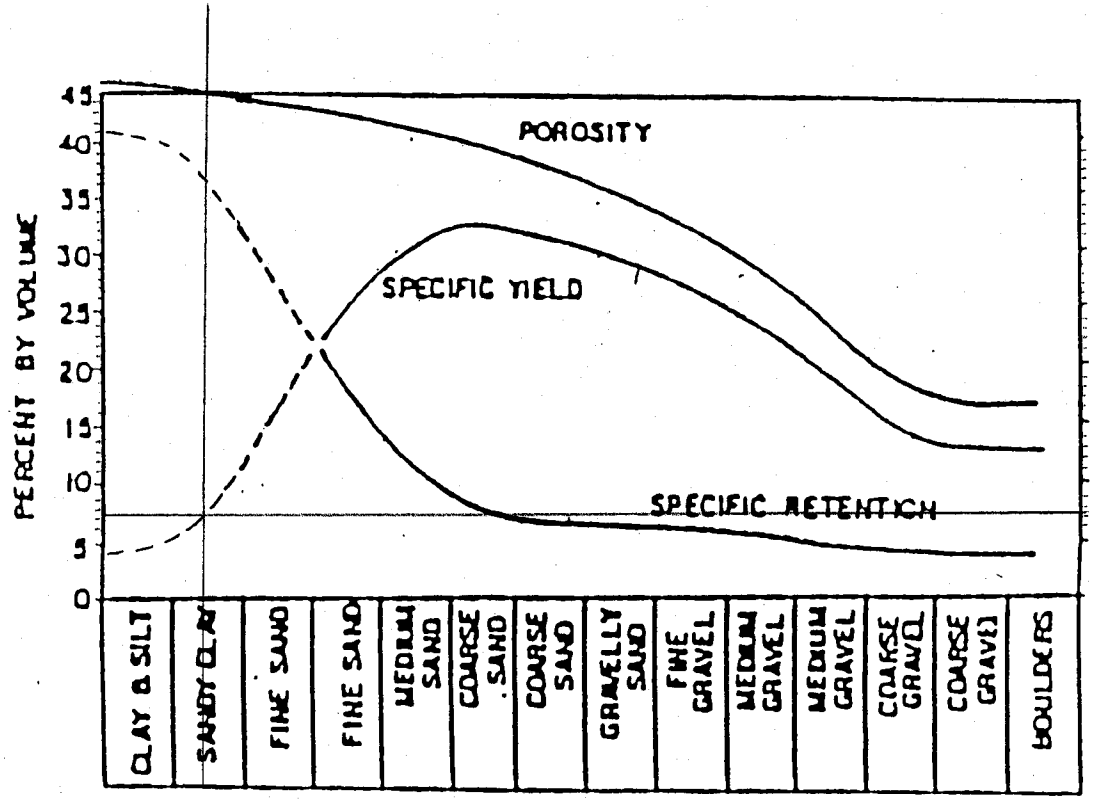
Boring Number: MS-1
Sample Number: NONE
Sample Depth: 20 TO 22
Sample Type: U.D.

Sand Size Percent: 36.4 %
Silt Size Percent: 41.1 %
Clay Size Percent: 22.5 %

Specific Yield: 7.5

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



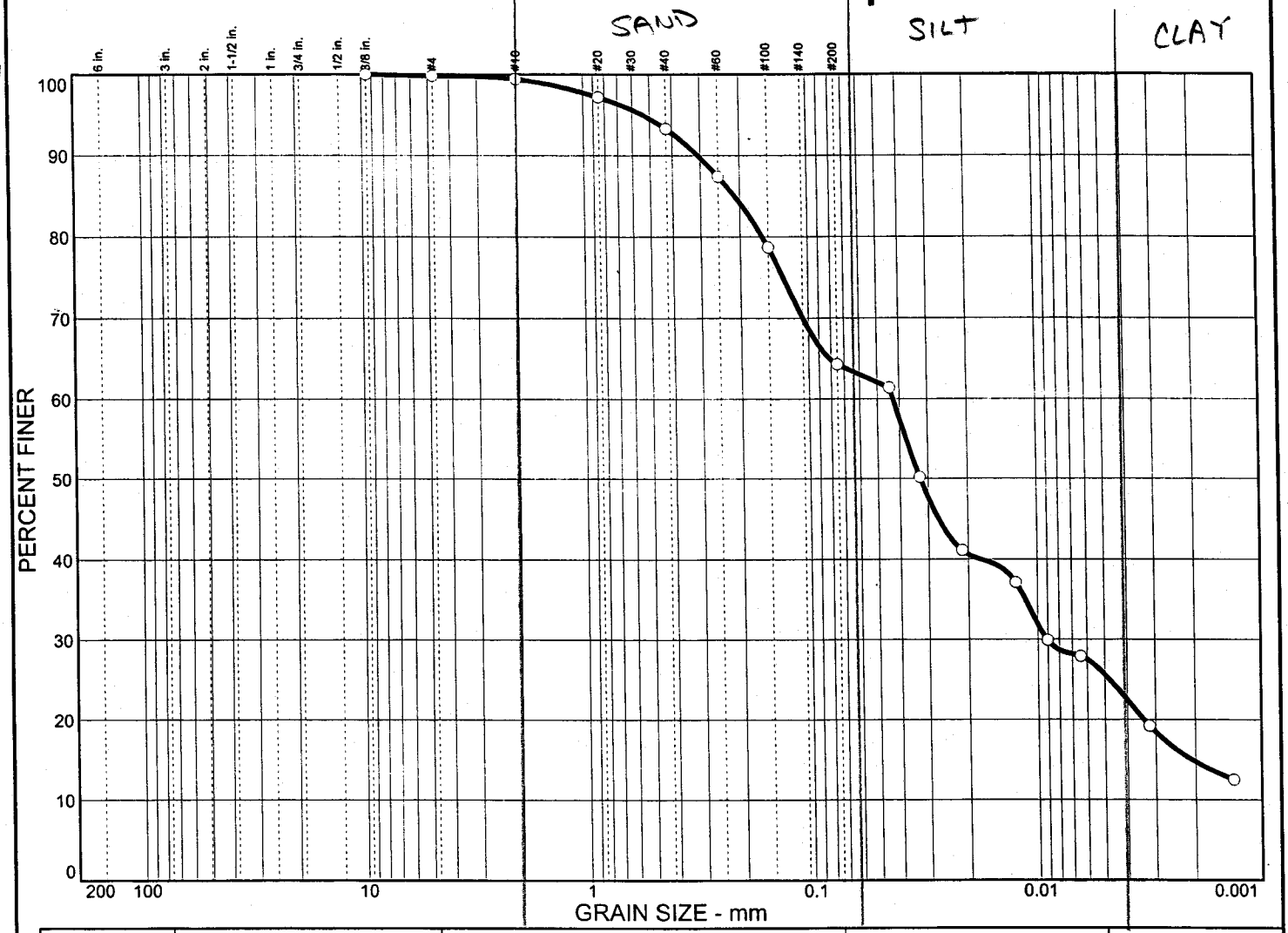
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: MS-1 Sample Depth: 20 to 22 Specific Yield: 7.5

Sample Number: NONE Sample Type: U.D. **Porosity:** 45

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.2	35.5	38.7	25.6
			99.8 - 63.5 = 36.3	63.5 - 22.5 = 41	22.5
			ADS 36.4	41.1	22.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	45	33	0.211	0.0427	0.0324	0.0091	0.0021			

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY WHITE CLAYEY M-F SANDY SILT	ML	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-1

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE U.D.,MS-1

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

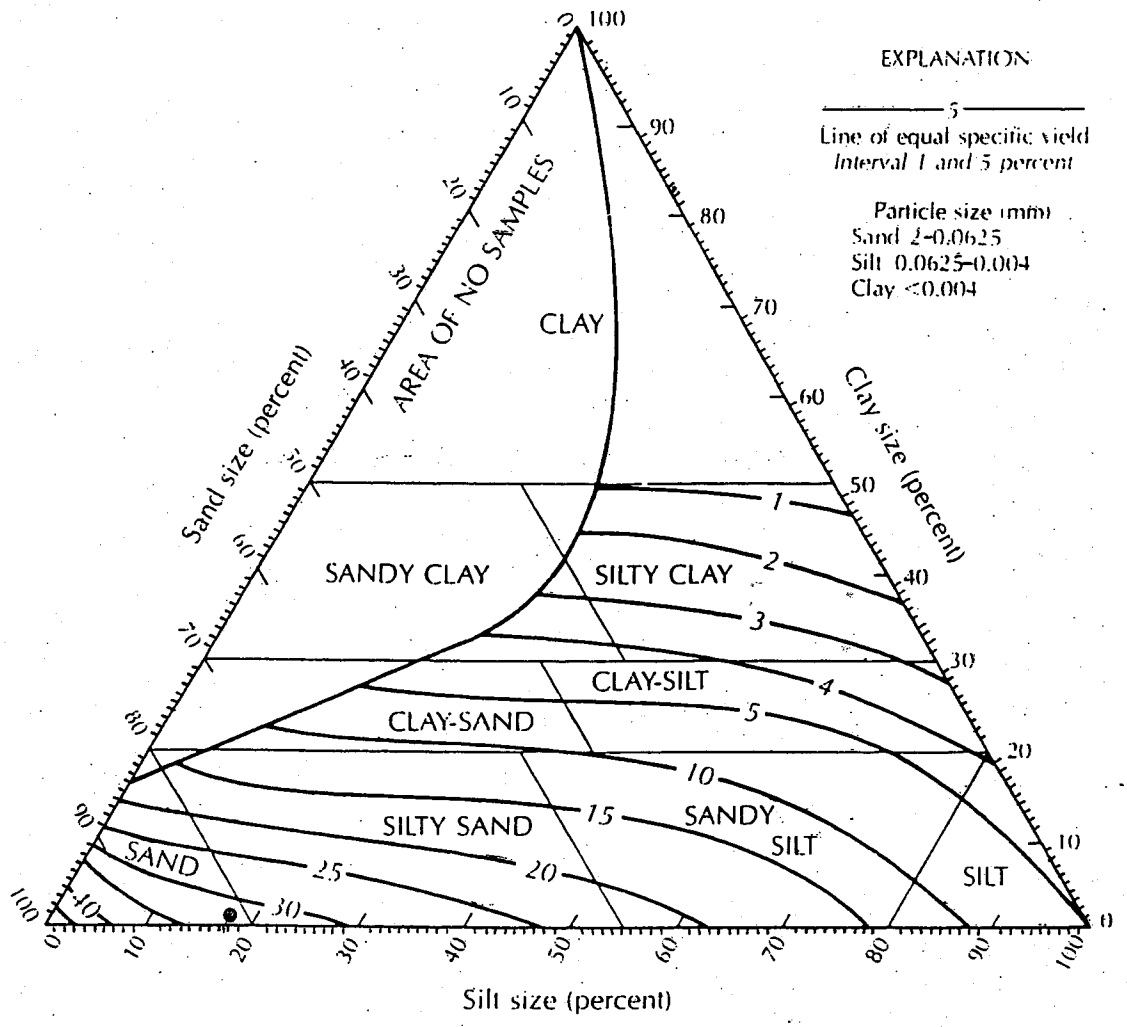


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

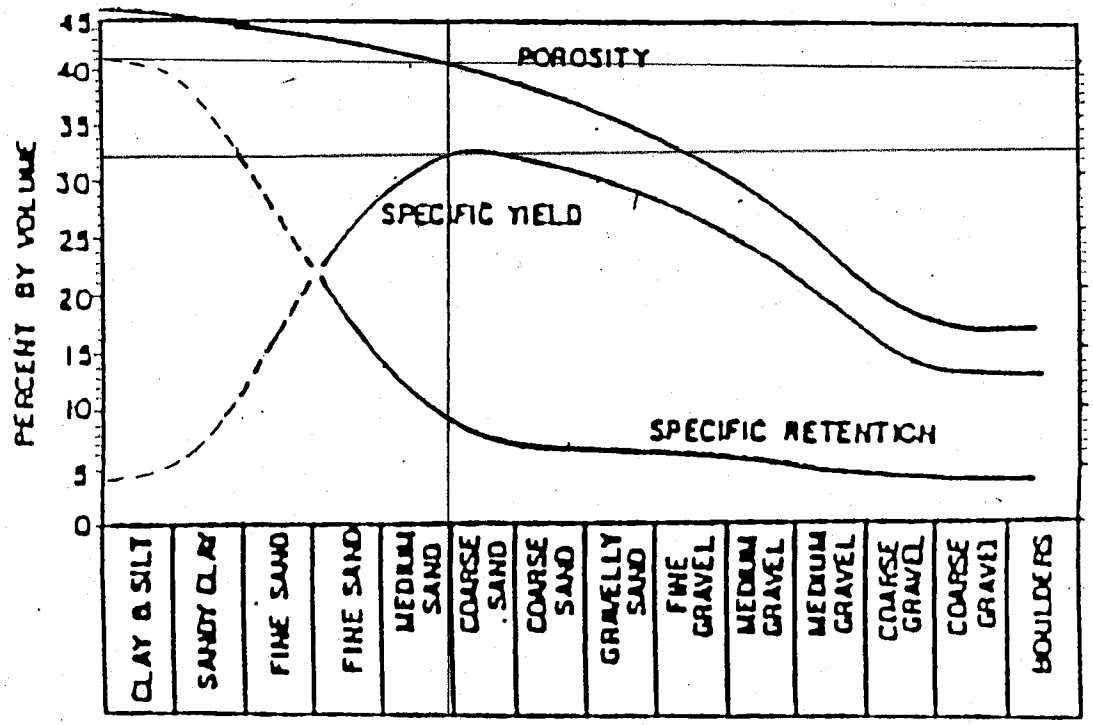
Boring Number: MS-3
Sample Number: NONE
Sample Depth: 15 TO 17
Sample Type: U.D.

Sand Size Percent: 81 %
Silt Size Percent: 17.4 %
Clay Size Percent: 1.6 %

Specific Yield: 32

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



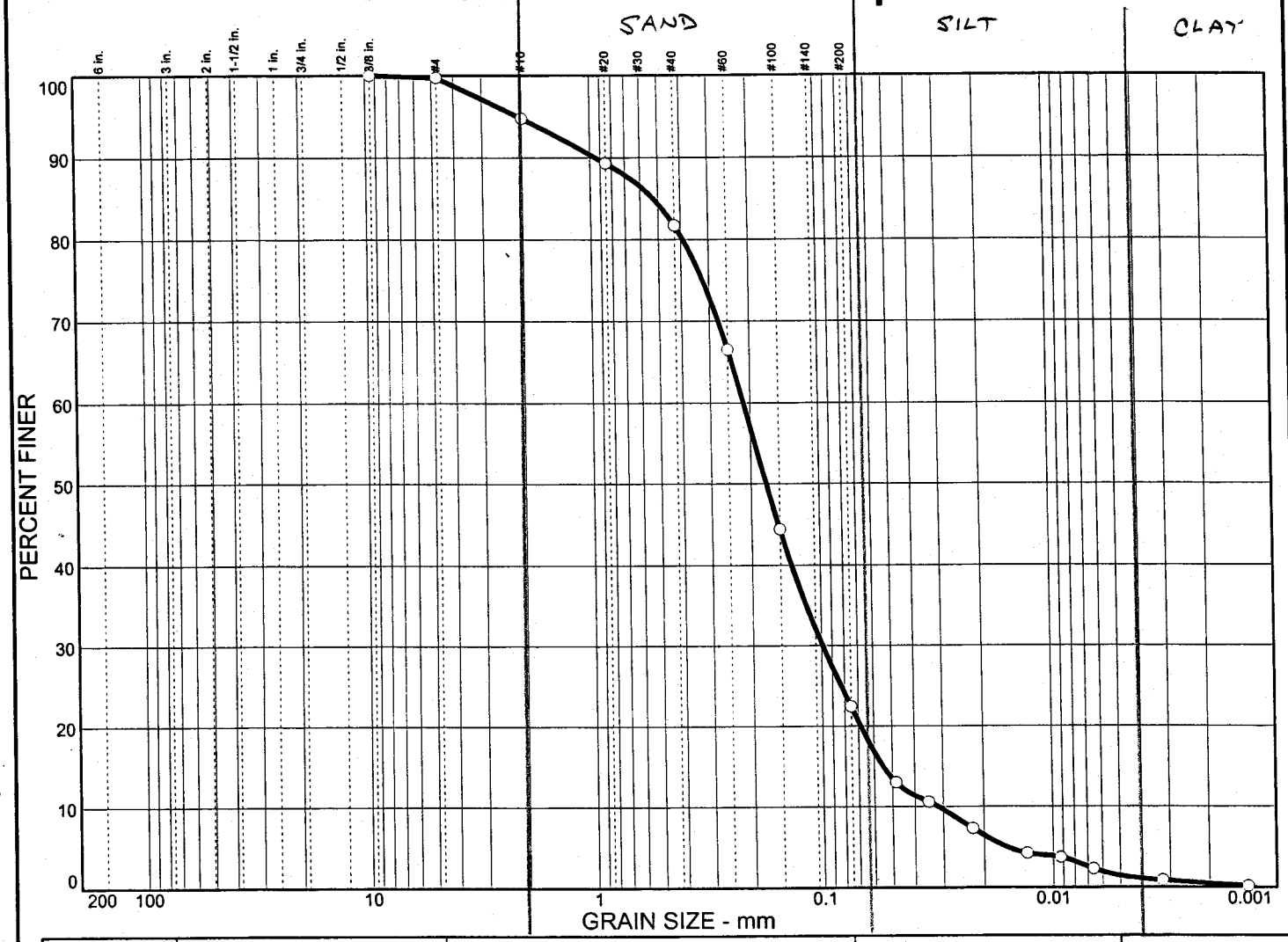
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: MS-3 Sample Depth: 15 TO 17 Specific Yield: 32

Sample Number: NONE Sample Type: U.D. **Porosity:** 41

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.3	77.3	20.9	1.5
			94.8 - 18 = 76.8	18 - 1.5 = 16.5	1.5
			ADJ 81.0	17.4	1.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.524	0.214	0.171	0.0988	0.0547	0.0315	1.45	6.79

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY BROWN WHITE SL.CLAYEY SILTY C-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-3

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE U.D.,MS-3

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

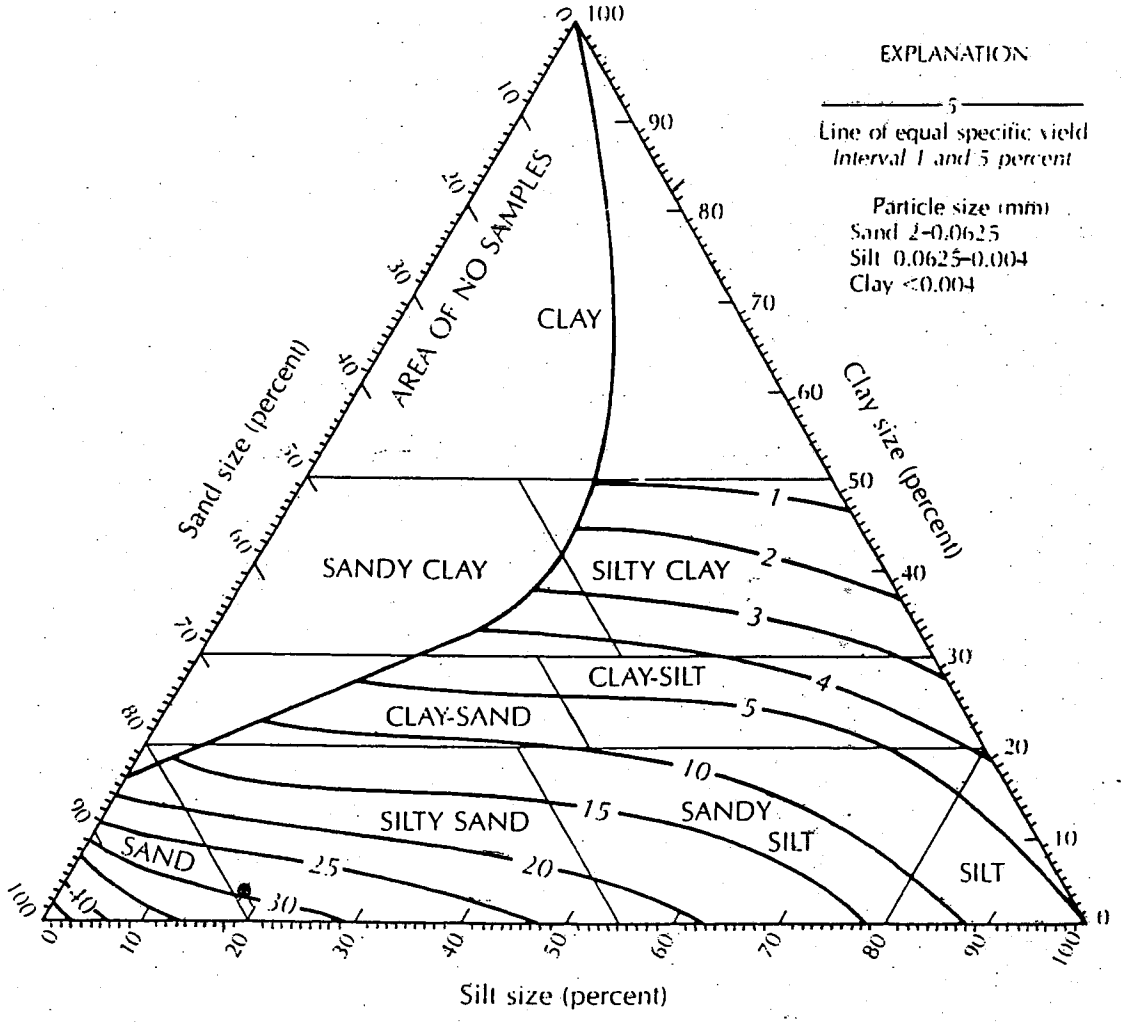


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

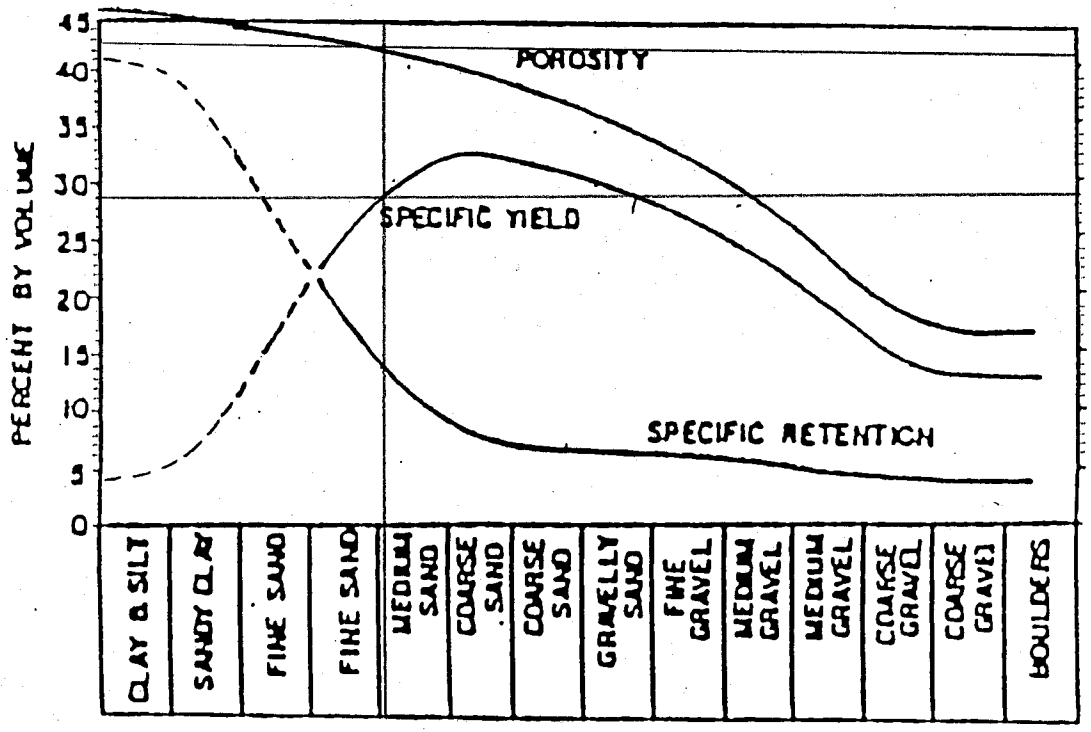
Boring Number: MS-5
Sample Number: NONE
Sample Depth: 32 TO 34
Sample Type: U.D.

Sand Size Percent: 78.7 %
Silt Size Percent: 17.9 %
Clay Size Percent: 3.4 %

Specific Yield: 29

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



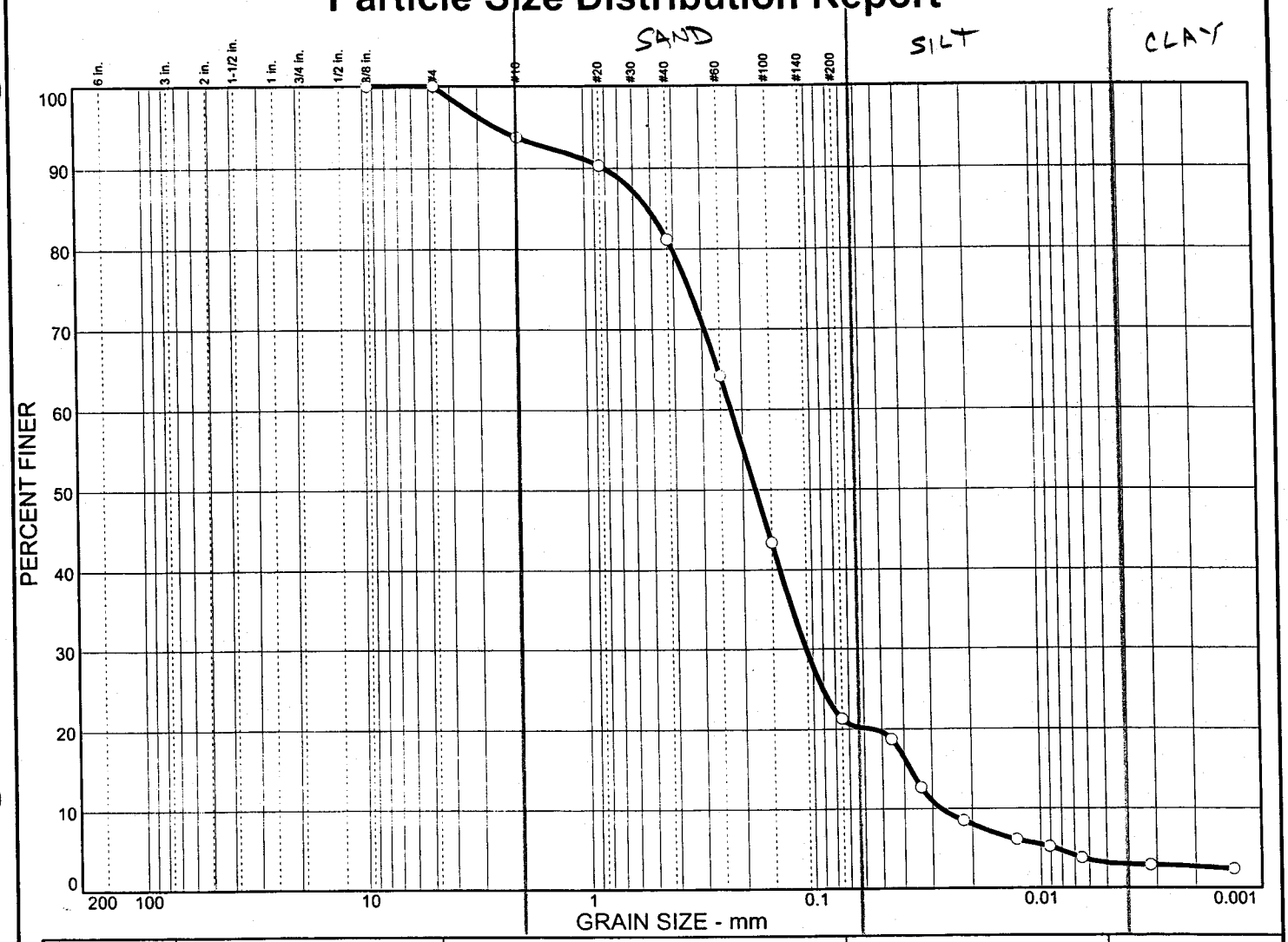
Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: MS-5 Sample Depth: 32 TO 34 Specific Yield: 29

Sample Number: NONE Sample Type: U.D. **Porosity:** 42.5

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	78.7	18.1	3.2
			93.8 - 20 = 73.8	20 - 3.2 = 16.8	3.2
			ADJ 78.7	17.9	3.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.513	0.224	0.176	0.107	0.0375	0.0274	1.86	8.20

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAY TAN BROWN MICACEOUS SL. CLAYEY SILTY C-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-5

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE MS-5,U.D.

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

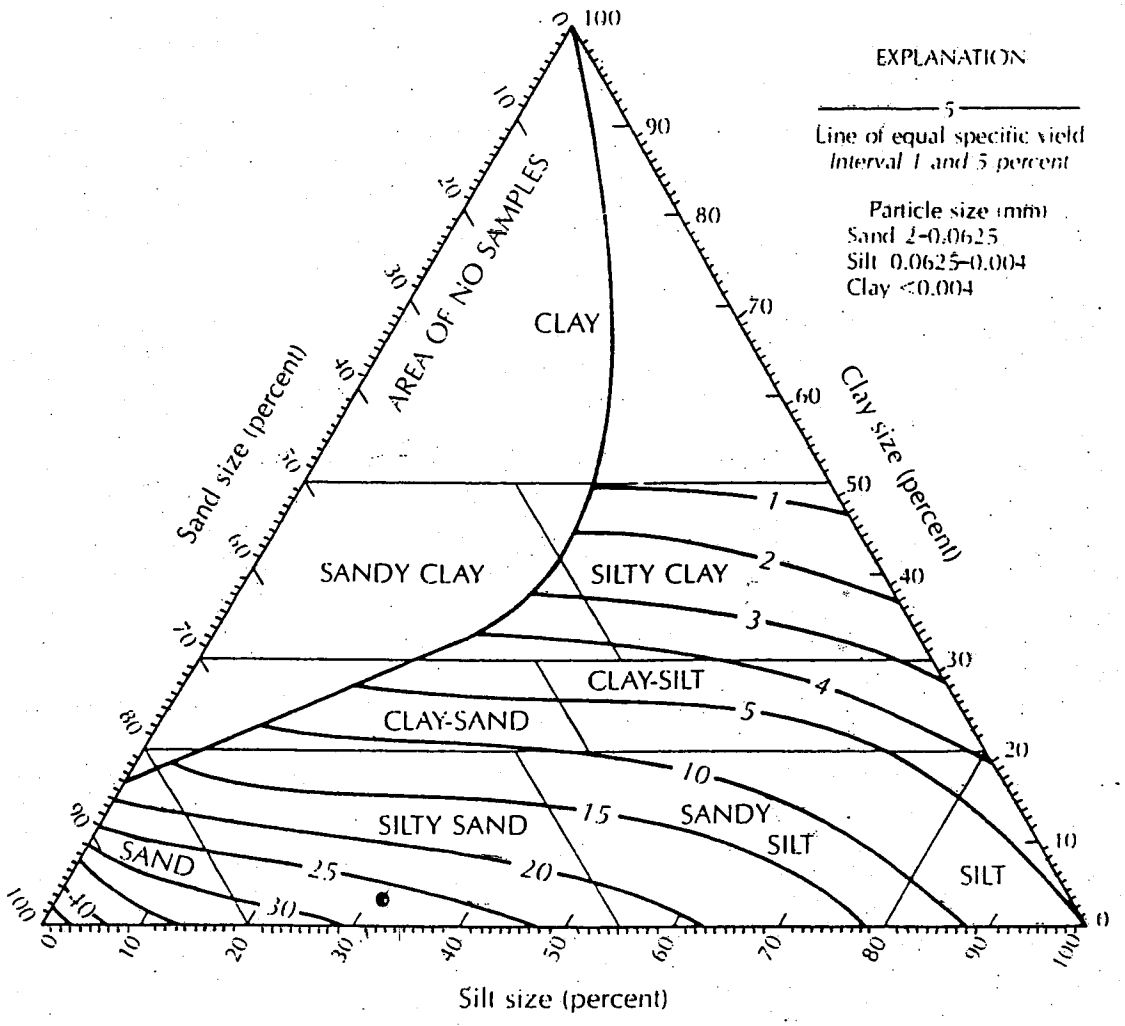


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

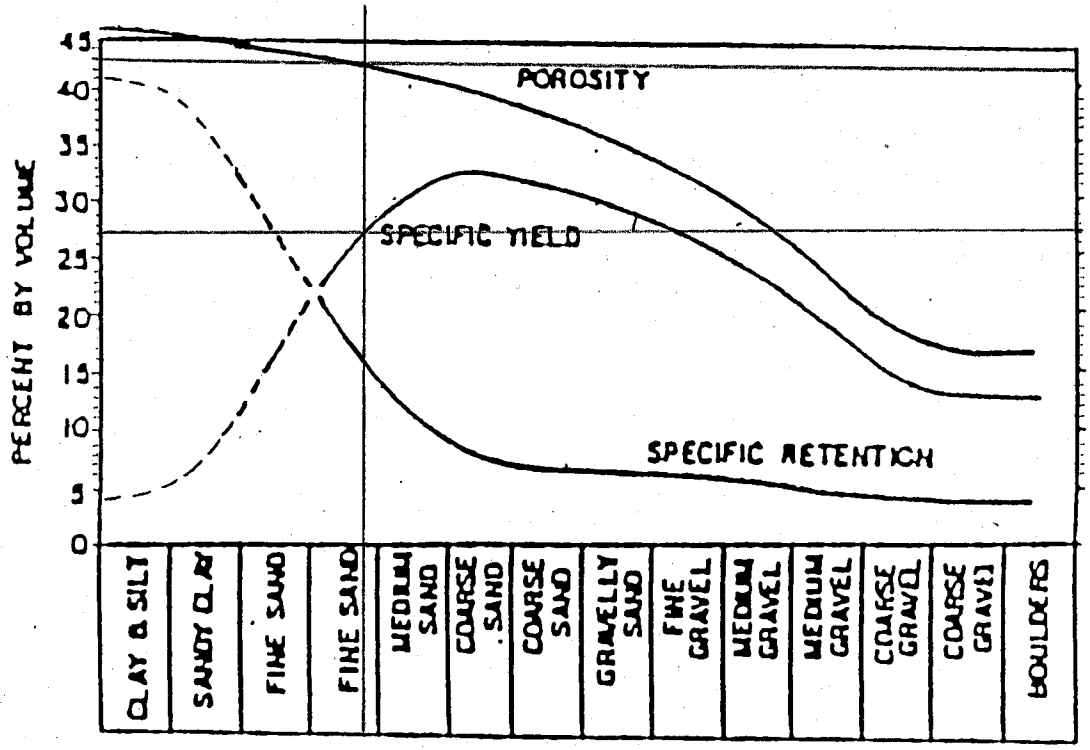
Boring Number: MS-7
Sample Number: S-4
Sample Depth: 18.5 TO 20
Sample Type: Split Spoon

Sand Size Percent: 65.5 %
Silt Size Percent: 31 %
Clay Size Percent: 3.5 %

Specific Yield: 27

Note:
Sand, silt and clay size percent taken from grain size analysis.

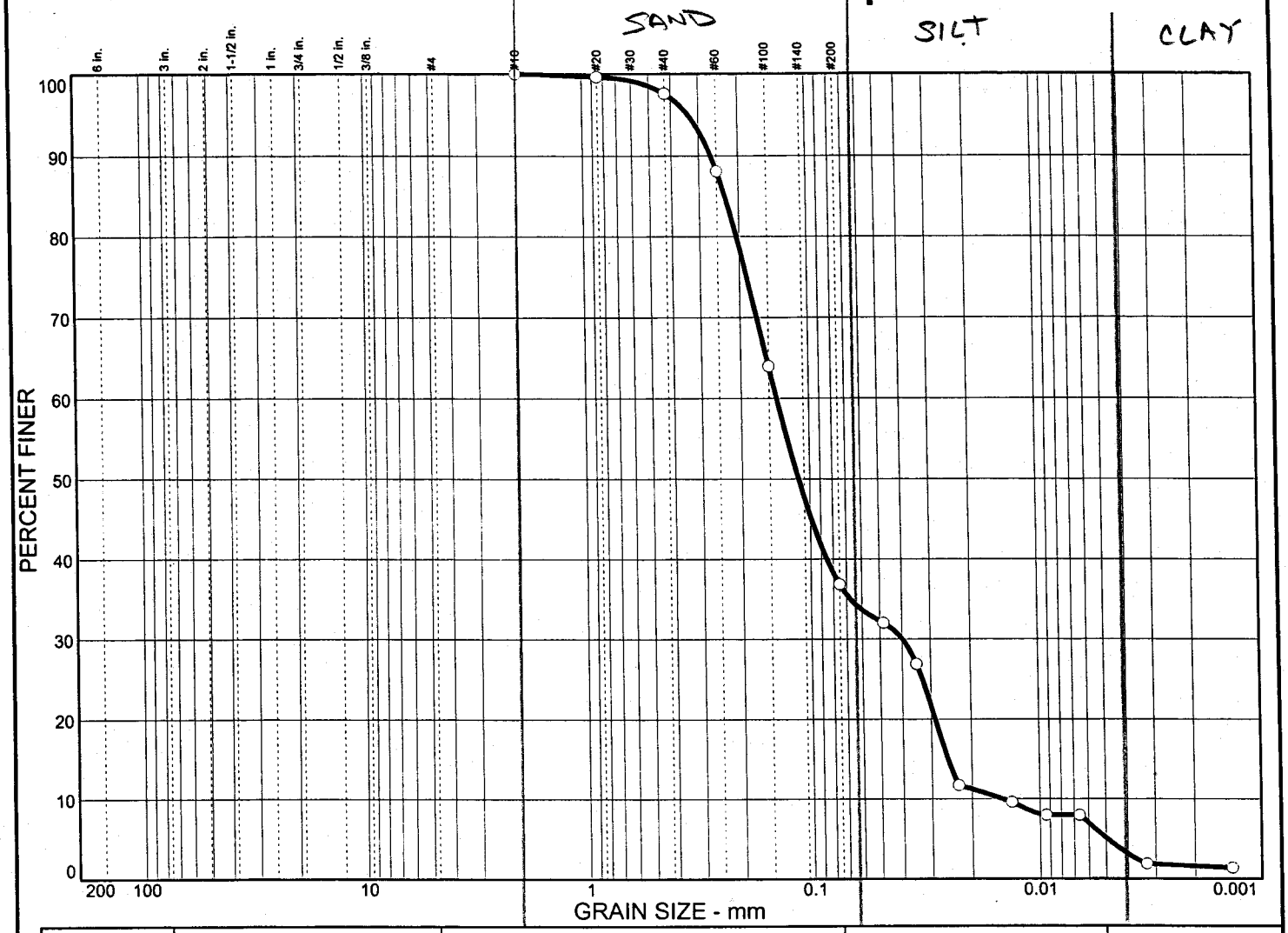
BEAR DIAGRAM



Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: MS-7
Sample Number: S-4
Sample Depth: 18.5 to 20
Sample Type: Split Spoon
Specific Yield: 27
Porosity: 43
Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	63.2	31.7	5.1
			100 - 34.5 = 65.5	34.5 - 3.5 31	3.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.230	0.139	0.112	0.0398	0.0254	0.0146	0.78	9.47

MATERIAL DESCRIPTION	USCS	AASHTO
○ YELLOWISH RED MICACEOUS SL. CLAYEY SILTY M-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-7

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE S-4,MS-7

FETTER DIAGRAM

HYDRAULIC CONDUCTIVITY OF EARTH MATERIALS

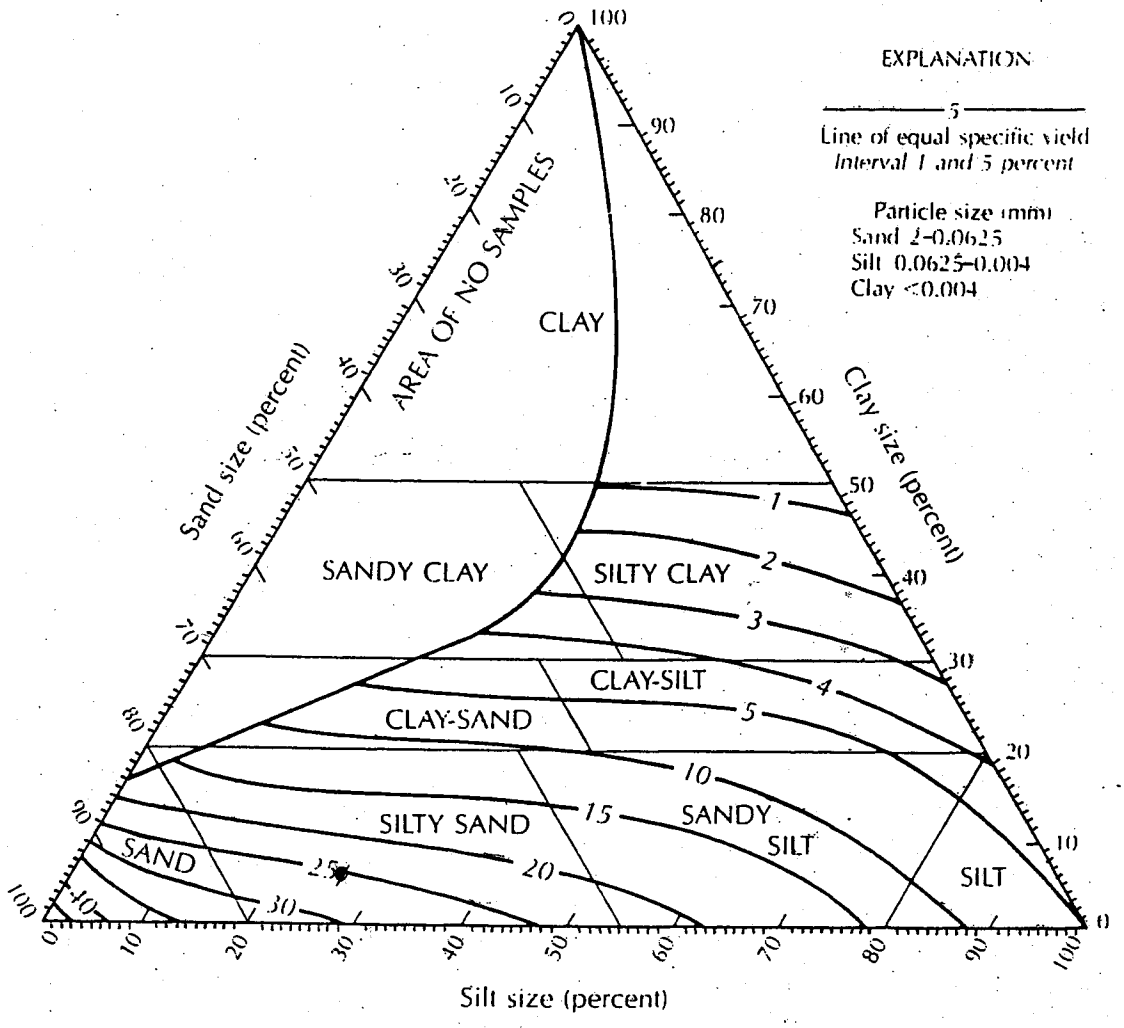


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

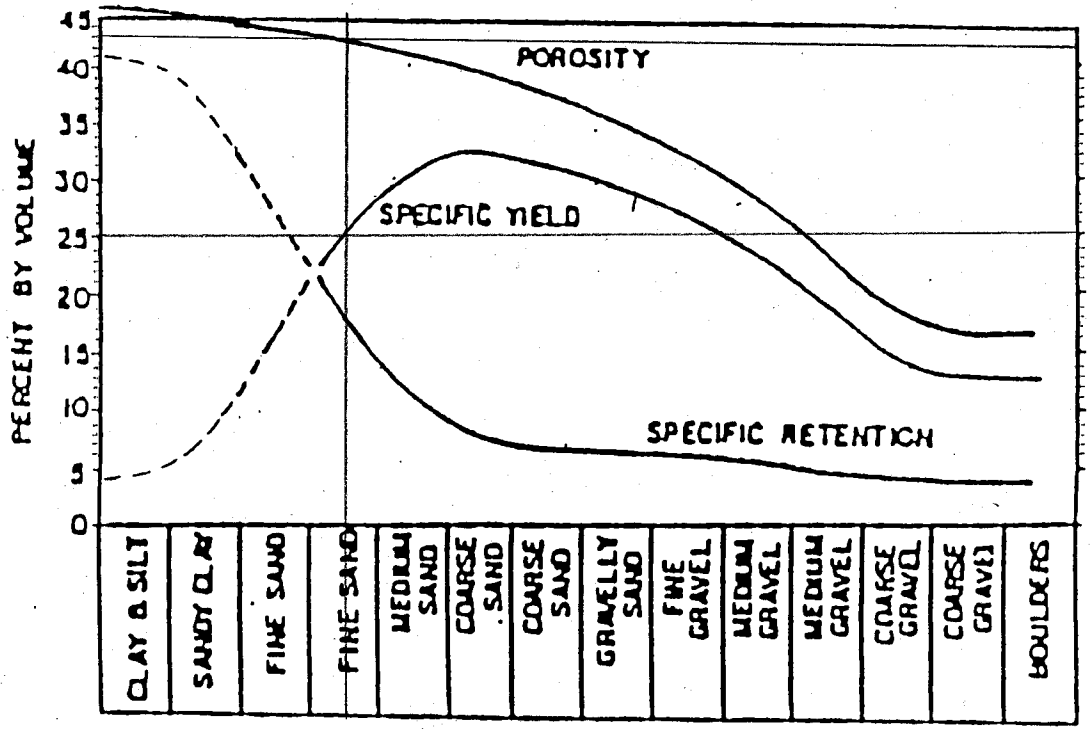
Boring Number: MS - 8
Sample Number: S-5
Sample Depth: 23.5 TO 25
Sample Type: Split Spoon

Sand Size Percent: 68.5 %
Silt Size Percent: 26.3 %
Clay Size Percent: 5.2 %

Specific Yield: 25

Note:
Sand, silt and clay size percent taken from grain size analysis.

BEAR DIAGRAM



Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

Boring Number: MS-8 Sample Depth: 23.5 TO 25 Specific Yield: 25

Sample Number: S-5 Sample Type: Split Spoon **Porosity:** 43

Note: Specific yield taken from Fetter Diagram

Particle Size Distribution Report

	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.1	68.9	25.0	6.0
			95.2 - 30 = 65.2	30 - 5 = 25	5
			ADJ 68.5	26.3	5.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.896	0.223	0.159	0.0551	0.0164	0.0113	1.21	19.81

MATERIAL DESCRIPTION	USCS	AASHTO
○ GRAYISH TAN, PINKISH WHITE MICACEOUS SL. CLAYEY SILTY C-F SAND	SM	

Project No. 1264-02-578 **Client:**

Project: MARSHALL STEAM STATION

○ **Location:** MS-8

Remarks:

○ TESTED BY KMW

Particle Size Distribution Report

S & ME, INC.

SAMPLE S-5,MS-8

4

APPENDIX IV

DRAWINGS

Under Seperate Cover

APPENDIX V

STREAM CHANNEL EVALUATION REPORT

Duke Power®
A Duke Energy Company

FOSSIL AND HYDRO GENERATION

Duke Power
P.O. Box 1006
Charlotte, NC 28201-1006

April 8, 2003

Mr. John Hendrix
U.S. Army Corp of Engineers
Asheville Regulatory Field Office
151 Patton Avenue, Room 208
Asheville, NC 28801-5006

Subject: Marshall Steam Station Gypsum Fill Site, Catawba County, NC

Dear Mr. Hendrix:

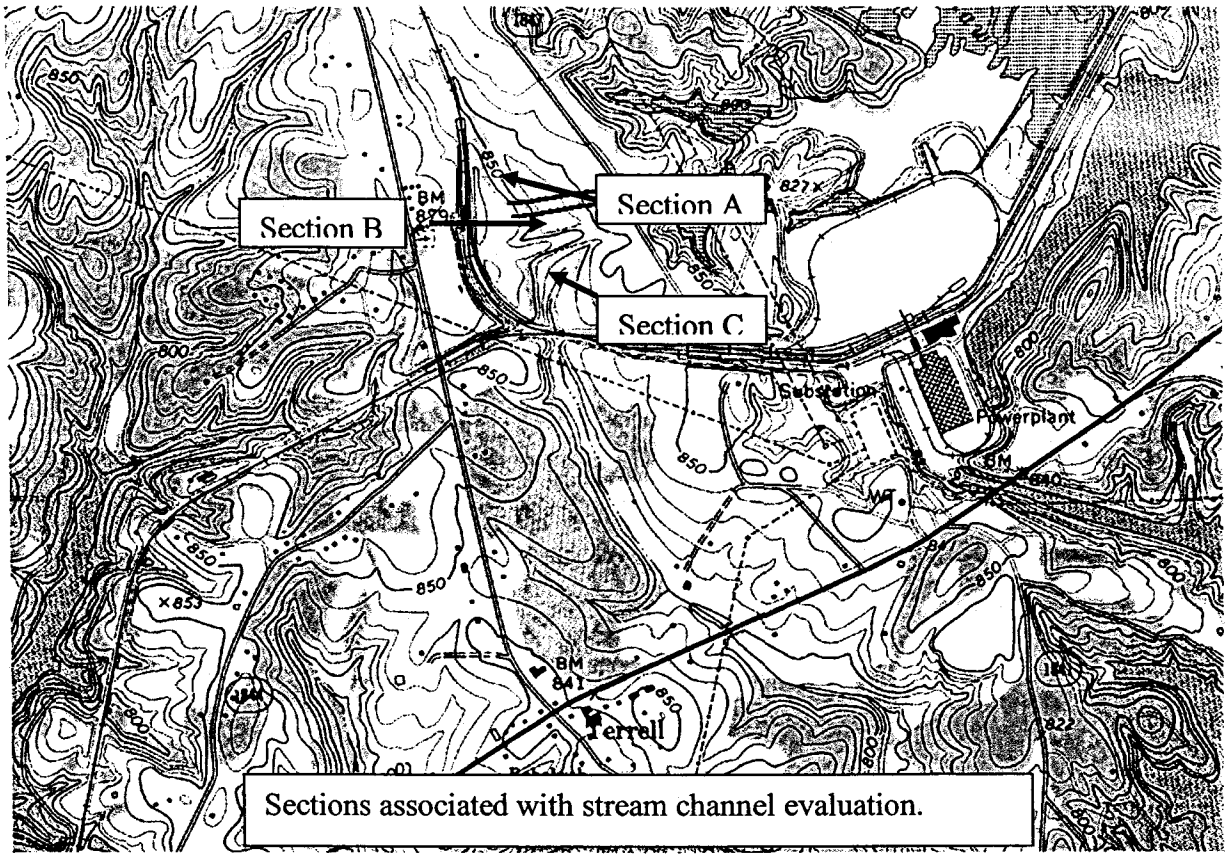
As suggested at our meeting with Mr. Tim Smith and Mr. Steve Chapin of your office at the proposed gypsum fill site on March 13, 2003, we have performed a stream channel evaluation of the proposed site. Attached is the evaluation and supporting information. If you have any questions, please give me a call at (704) 373-5710.

Sincerely,

Ron Lewis

Ron Lewis, Scientist
Environmental, Health and Safety
Fossil-Hydro Generation

Attachments



Sections associated with stream channel evaluation.

INTERMITTENT CHANNEL EVALUATION FORM

ACTION ID Section A . APPLICANT NAME Duke Energy . DATE 3/27/03 .
PROPOSED CHANNEL WORK Gypsum fill site .
WATERBODY/RIVER BASIN Tributary to Lake Norman/Catawba River. COUNTY/CITY Catawba County. RECENT WEATHER CONDITIONS Period of heavy rain followed by 3-4 day period of dry weather .

P	SP	NP	OBSERVATION	COMMENTS OR DESCRIPTION
		X	Fish/Shellfish/Crustaceans Present	None observed
		X	Benthic Macro Invertebrates	None observed
	X		Amphibians Present/Breeding	Chorus frog
		X	Algae and/or Fungus (water quality function)	Iron flocculent
		X	Wildlife Channel Use (i.e. tracks, feces, shell, other)	None observed
		X	Federally Protected Species Present (Discontinue)	None
		X	Riffle/Pool/Structure	None apparent
		X	Stable Streambanks	Banks not apparent
		X	Channel Substrate(i.e. gravel, cobble, rock, coarse sand)	Silt stained leaves
	X		Riparian Canopy Present (SP>/=50% Closure)	None in classical sense
		X	Undercut Banks/Instream Habitat Structure	None
	X		Flow in Channel	Flow during events
	X		Wetlands Adjacent to /Contiguous with Channel (Discontinue)	Potential wetland contiguous with channel.
	X		Persistent Pools/Saturated Bottom (June-September)	Apparently saturated bottom during dry period, inundated during wet period
		?	Seeps/Groundwater Discharge (June-September)	None apparent
	X		Adjacent Floodplain Present	Floodplain resulting from control downstream
	X		Wrack material or Drift Lines	Leaves from recent flooding
	X		Hydrophytic Vegetation in/adjacent to Channel	Greenbrier, Honeysuckle, Privet, Red maple

Important To Domestic Water Supply? Y/N N .
Does Channel Appear On A Quad or Soils Map? Y/N N .
Approx. Drainage Area: Not determined .

Determination:
Perennial Channel ___. Important Channel: _____. Project Manager Initials:___.
Intermittent Channel ___. Unimportant Channel: _X__.
Ephemeral Channel: _X__. (non-jurisdictional)
Ditch Through Upland:___. (non-jurisdictional)
Evaluator's Signature: Robert Siler (704) 483-0972

P=Present SP=Strongly Present NP=Not Present

Section A is located upstream of potential wetland area (see Map). The channel is braided as it enters the potential wetland. A well-defined channel is not apparent; flow is not readily apparent but present on 3/27/03. Substrate is composed of silt-stained leaves (appears depositional) with iron flocculent. Vegetation is primarily greenbrier, honeysuckle, privet and red maple. No aquatic insects were observed in substrate/leaf packs. The absence of a well-defined channel, the alluvial nature of the "channel", strong influence of the culvert downstream, and apparent absence of aquatic life are support for this area being classified as an ephemeral (non-jurisdictional) channel.

Section A, above and contiguous with potential wetland.

Channel at Section A as observed on 12/3/03.

INTERMITTENT CHANNEL EVALUATION FORM

ACTION ID Section B . APPLICANT NAME Duke Energy . DATE 3/27/03 .
PROPOSED CHANNEL WORK Gypsum fill site .
WATERBODY/RIVER BASIN Tributary to Lake Norman/Catawba River. COUNTY/CITY Catawba County. RECENT WEATHER CONDITIONS Period of heavy rain followed by 3-4 day period of dry weather .

P	SP	NP	OBSERVATION	COMMENTS OR DESCRIPTION
		X	Fish/Shellfish/Crustaceans Present	None observed
	X		Benthic Macro Invertebrates	One diptern larvae observed
	X		Amphibians Present/Breeding	Chorus frog
		X	Algae and/or Fungus (water quality function)	Iron flocculent
		X	Wildlife Channel Use (i.e. tracks, feces, shell, other)	None observed
		X	Federally Protected Species Present (Discontinue)	None
	X		Riffle/Pool/Structure	Minor resulting from exposed roots
	X		Stable Streambanks	Defined channel, exposed clay, roots
	X		Channel Substrate(i.e. gravel, cobble, rock, coarse sand)	Silt-stained leaves to roots (fine and coarse) sand, gravel, clay
	X		Riparian Canopy Present (SP>/=50% Closure)	Chinese privet, Christmas fern, mosses
		X	Undercut Banks/Instream Habitat Structure	None
	X		Flow in Channel	Flow during event, tapers as upstream storage reduces.
		X	Wetlands Adjacent to /Contiguous with Channel (Discontinue)	None, but immediately upstream of channel.
	X		Persistent Pools/Saturated Bottom (June-September)	Probably saturated bottom during dry period, inundated during wet period
		?	Seeps/Groundwater Discharge (June-September)	None apparent
	X		Adjacent Floodplain Present	Floodplain resulting from control downstream
	X		Wrack material or Drift Lines	Leaves/sticks from recent flooding to 4 feet
	X		Hydrophytic Vegetation in/adjacent to Channel	Privet, Christmas fern, moss

Important To Domestic Water Supply? Y/N N .
Does Channel Appear On A Quad or Soils Map? Y/N N .
Approx. Drainage Area: Not determined .

Determination:
Perennial Channel ___. Important Channel: _____. Project Manager Initials:___.
Intermittent Channel X . Unimportant Channel: X .
Ephemeral Channel: ____. (non-jurisdictional)
Ditch Through Upland:___. (non-jurisdictional)
Evaluator's Signature: Robert Siler (704) 483-0972 .

P=Present SP=Strongly Present NP=Not Present

Section B is located immediately below the potential wetland area. No channel is apparent in the wetland area and immediately above Section B. A scoured channel that is well defined is present in Section B. Flow at Section B is controlled by rainfall, storage in the potential wetland immediately upstream, and flow through culvert/fill below. The channel here is 33 feet long from wetland to the blocked culvert downstream. The channel varies from 18-inches wide to 70-inches wide and the maximum channel depth varied from 2 to 6.5 inches (on March 27, 2003). Controls in the channel are roots. The substrate is composed of fine roots with iron flocculent and organic matter; areas of sand, gravel and clay are also present. The riparian area is composed of Chinese privet, Christmas fern, and mosses. Privet and an unidentified vascular plant grow in the channel. One diptern larvae was found in the channel and no insects were found in the relatively abundant leaf packs. Wrack lines from recent flooding indicated a water level at the blocked culvert was about 4-foot deep. The channel is incised to about 18 inches deep. The channel has 2 meanders in this section between the potential wetland and the culvert inlet. Discharge was estimated as approximately 0.08 cubic-feet/second on 3/27/03. The channel is evaluated an "unimportant intermittent channel" because the discharge is controlled by a downstream culvert (and potentially dry during summer and fall as indicated by presence of terrestrial vegetation in channel), and it is of little importance in the support of aquatic life.

Beginning of Section B. Here the channel is 70-inches wide and 5-inches deep. Water flows around a red maple.

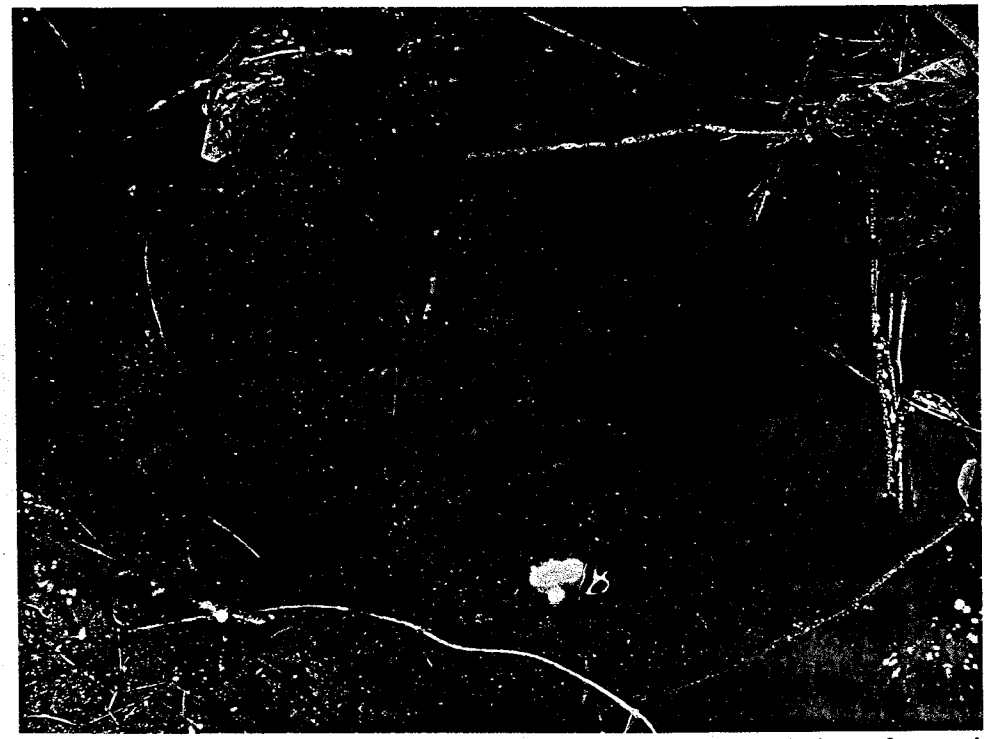
Area immediately upstream of Section B.

Potential wetland area just upstream of Section B.

Potential wetland area above Section B as observed on 12/3/02. Note no evidence of a defined channel draining to Section B.

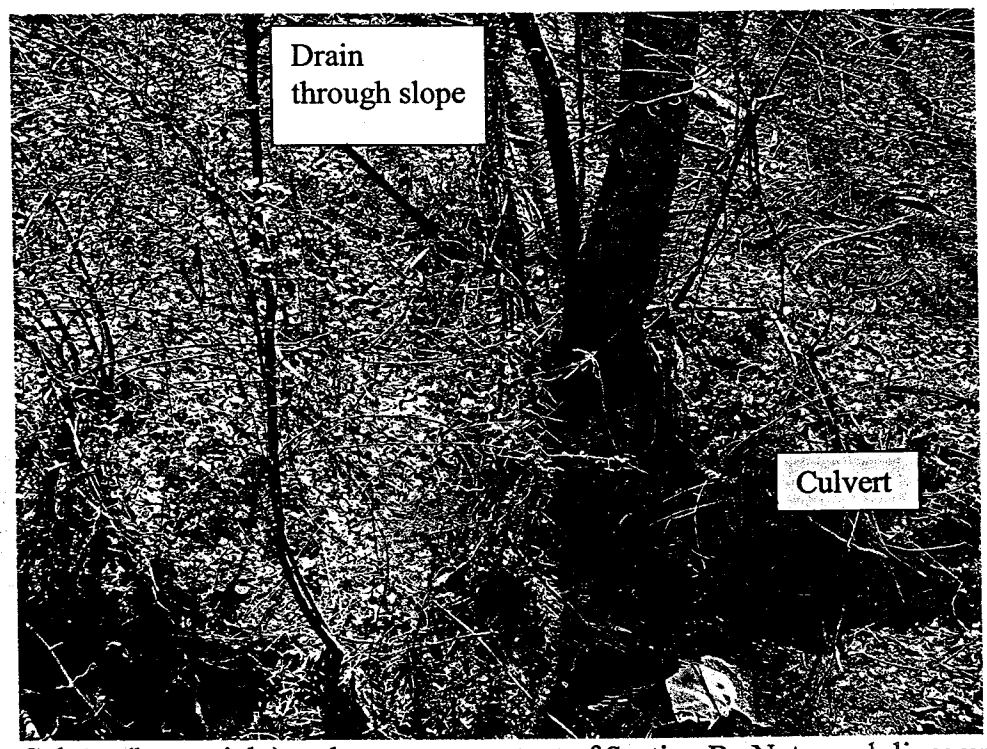
Stream channel in Section B. Note root controls, incised bank, and meander. Depth is 2 inches, width is 18 inches, and the channel is incised about 18 inches.

Riparian community at Section B.



Vegetation growing mid-channel at Section B. Note accumulation of organic material on fine roots and sand/gravel/clay substrate.

Chinese privet growing mid channel in Section B.



Culvert (lower right) at downstream extent of Section B. Not wrack lines upslope and drainage through slope that results in saturated fill.

INTERMITTENT CHANNEL EVALUATION FORM

ACTION ID Section C . APPLICANT NAME Duke Energy . DATE 3/27/03 .
PROPOSED CHANNEL WORK Gypsum fill site .
WATERBODY/RIVER BASIN Tributary to Lake Norman/Catawba River. COUNTY/CITY Catawba County. RECENT WEATHER CONDITIONS Period of heavy rain followed by 3-4 day period of dry weather .

P	SP	NP	OBSERVATION	COMMENTS OR DESCRIPTION
		X	Fish/Shellfish/Crustaceans Present	None observed
		X	Benthic Macro Invertebrates	None observed
	X		Amphibians Present/Breeding	Chorus frog
		X	Algae and/or Fungus (water quality function)	Iron flocculants on fine roots
	X		Wildlife Channel Use (i.e. tracks, feces, shell, other)	Raccoon track
		X	Federally Protected Species Present (Discontinue)	None
	X		Riffle/Pool/Structure	Riffle over coarse gravel
	X		Stable Streambanks	Banks well defined, channel incised; evidence of major erosion/sloughing in past
	X		Channel Substrate(i.e. gravel, cobble, rock, coarse sand)	Gravel, sand, silt; soil deposition adjacent to channel
	X		Riparian Canopy Present (SP>/=50% Closure)	Privet, young tulip tree, American holly, ironwood, black cherry, red maple
		X	Undercut Banks/Instream Habitat Structure	None
	X		Flow in Channel	Estimated at approximately 0.02 cubic-feet/second on 3/27/03
		X	Wetlands Adjacent to /Contiguous with Channel (Discontinue)	None
	X		Persistent Pools/Saturated Bottom (June-September)	Assumed saturated bottom during dry period, inundated during wet period
	?		Seeps/Groundwater Discharge (June-September)	None apparent
		X	Adjacent Floodplain Present	None, deeply incised to 10+ feet
		X	Wrack material or Drift Lines	None, controlled by blocked culvert upstream
	X		Hydrophytic Vegetation in/adjacent to Channel	Christmas fern, red maple, mosses adjacent to channel

Important To Domestic Water Supply? Y/N N (Drains to Lake Norman-water supply).
Does Channel Appear On A Quad or Soils Map? Y/N Y, but downstream of section .
Approx. Drainage Area: Not determined .

Determination:
Perennial Channel ___. Important Channel: _____. Project Manager Initials:___.
Intermittent Channel _X_. Unimportant Channel: _X_.
Ephemeral Channel: _____. (non-jurisdictional)
Ditch Through Upland:___. (non-jurisdictional)
Evaluator's Signature: Robert Siler (704) 483-0972 .

P=Present SP=Strongly Present NP=Not Present

Section C originates in a fill slope where a culvert has failed due to blockage, resulting in erosion and sloughing; the channel was evaluated for 75 feet below the culvert. The stream banks in Section C are well defined and are colonized with young tulip trees, American holly, Christmas fern, privet, and mosses. The substrate is coarse gravel, silt, sand, and fine roots, all cover with an iron flocculent. Deposition of new soil is apparent adjacent to the channel. Evidence of major past erosion and sloughing is apparent from fallen or tilted trees, likely occurring just after the fill and culvert were placed. Meanders are present in the channel. Discharge was coarsely estimated as 0.02 cubic-feet/second. The discharge is likely intermittent during times of little rainfall and flows when water is present in the potential wetland upstream. The banks are deeply incised with the channel being over 10 feet below the banks. The channel varies from 20 to 36 inches wide and is typically 1.5 inches deep. Soft mud bars are located adjacent to the channel in several areas. Section C is evaluated as an "intermittent-unimportant channel" because of the indications that the stream is dry during low rainfall, presence of iron flocculent, lack of aquatic insects, and value for aquatic life and wildlife.

Section C begins just upstream of culvert (no water drains through culvert in photograph). Note erosion upslope of culvert.

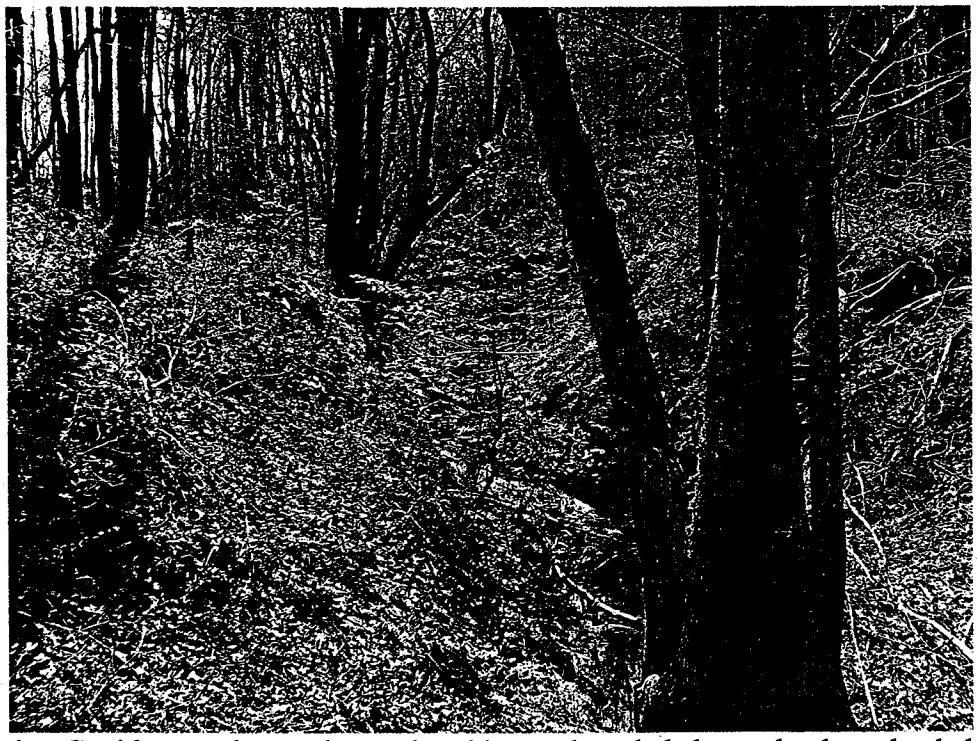
Channel at Section C. Note trees in foreground have tilted from past sloughing and slopes downstream show evidence of past sloughing.

Gravel/silt/sand in channel of Section C. Note iron flocculent in stream.

Channel in Section C. Note red maples growing in channel.

Channel in Section C. Note fine roots with organic matter and iron flocculent in substrate.

Channel in Section C. Note mud accumulation adjacent to channel following storm event, and privet, Christmas fern and mosses colonize adjacent slopes.



Section C with meanders and past sloughing and eroded slopes that have healed with American holly, mosses, Christmas fern, honeysuckle, and greenbrier.