BENEFICIAL REUSE PERMIT APPLICATION

FIELDCREST CANNON ASH HANDLING FACILITY KANNAPOLIS, NORTH CAROLINA

Prepared For:
Fieldcrest Cannon, Inc.
Kannapolis, North Carolina

Prepared By:
S&ME, Inc.
Charlotte, North Carolina

October 1995

S&ME

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Dan Brewer

October 1995

October 5, 1995

North Carolina Department of Environment,
Health, and Natural Resources
Division of Solid Waste Management
585 Waughtown Street
Winston-Salem, North Carolina 27107-2241

Attention: Mrs. Jan McHargue

Reference: **Beneficial Reuse Permit Application**
Fieldcrest Cannon Coal Ash Handling Facility
Kannapolis, North Carolina
S&ME Job No. 1356-95-133

Gentlemen:

On behalf of Fieldcrest Cannon, Inc., S&ME, Inc. presents this Beneficial Reuse Permit Application for the Fieldcrest Cannon coal ash handling facility in Kannapolis, North Carolina. Fieldcrest Cannon would like to expand their current ash handling facility and obtain a Beneficial Reuse Permit to allow for future ash disposal.

Included in this Permit Application is information describing current ash handling operations, geotechnical data from a recent site investigation, and plans for expansion and future operation of the facility. This Permit Application has been prepared in accordance with 15A NCAC 13B .1700 - Requirements for the Beneficial Use of Coal Combustion By-Products of the North Carolina Solid Waste Management Rules dated January 4, 1994.

S&ME, Inc. 9751 Southern Pine Boulevard, Charlotte, North Carolina 28273, (704) 523-4726, Fax (704) 525-3953
Mailing address: P.O. Box 7668, Charlotte, North Carolina 28241-7668

We look forward to your response after you have had an opportunity to review the enclosed information. If you have any questions or require additional information, please contact us.

Sincerely,

S&ME, INC.

P. Greg Garrett, E.I.T.
Staff Professional

Dan E. Brewer, P.E.
Landfill Services Manager

cc: Mr. Evander H. Rowell, P.E. - Fieldcrest Cannon

BENEFICIAL REUSE PERMIT APPLICATION

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1.0 PROJECT INFORMATION

1.1 Site Location

The Fieldcrest Cannon coal ash handling facility is located approximately two miles from the Fieldcrest plant in Kannapolis, North Carolina and is part of the overall wastewater treatment facility. The site location is shown on Figure 1, Site Location Map.

1.2 Background

The facility consists of two settling ponds, two intermediate storage areas and a beneficial fill area. Bottom, medium and fly ash have been sluiced from the plant boilers to the settling ponds since about 1972. Initially, the ash handling facility was permitted under the wastewater treatment plant's NPDES permit.

Fieldcrest is in the initial planning stages to combine the ash handling operations of their plant in Spencer, North Carolina with the Kannapolis ash handling facility. As Fieldcrest is approaching capacity of the existing facility in addition to combining the ash from the Spencer plant, expansion of the existing ash fill area will be required. Permitting of the ash handling facility expansion will fall under the requirements of the State's Division of Solid Waste Management.

1.3 Current Site Operations

Fieldcrest's Kannapolis plant currently produces about 13,600 tons of boiler slag, bottom ash, and fly ash each year (dry basis). These materials are handled by a wet ponding operation. Coal ash from the main plant boilers is sluiced to one of two holding ponds (Pond No. 1 and Pond No. 2) at the ash handling area as shown on Sheet 1, Site Plan in Appendix IV. Ash particles are allowed to settle out in the settling ponds. Once full, the ash is dredged from the active settling pond and transferred to the Upper Storage

Area for further dewatering. Drainage from the ash in the Upper Storage Area is removed by an overflow device and allowed to flow into the Lower Storage Area. Suspended fines are further settled in the Lower Storage Area. Water in the Lower Storage Area is removed and treated in the wastewater treatment plant.

2.0 FACILITY PLAN

2.1 Site Development

Fieldcrest Cannon proposes to expand the ash fill area south and northwest of the existing ash fill area. The Site Plan, Sheet 1, in Appendix IV exhibits the existing and proposed fill limits. The Final Closure Plan, Sheet 4, in Appendix IV includes the proposed final contours of the facility which include horizontal as well as vertical expansion of the existing ash fill operations.

Expansion of the fill area will involve clearing the area south of the existing fill and clearing and grading of Borrow Area I (see Grading Plan, Sheet 2). A soil berm is proposed along the south edge of the proposed fill area to aid in stability and containment of the ash. The berm will be constructed with soil from the on-site borrow areas.

Proposed subgrade elevations of the southern portion of the expansion area will be constructed of suitable ash materials mixed with on-site borrow soils to provide positive drainage to the Lower Storage Area. Selected ash used for the subgrade preparation will reduce the amount of borrow soil needed.

The existing soil berm along the south edge of the ash fill will be left in place. This berm will add stability to the ash fill during future site operations.

To aid in drying of the ash, a network of underdrains with wick drains is included in the design. The wick drains and underdrains will be installed in the existing fill areas prior to expansion. Future operations will require a network of underdrains for each ten foot lift of ash. The underdrains will drain the ash and discharge water into the Lower Storage Area for treatment in the wastewater treatment plant.

2.2 Ash Disposal Rates

Based on Fieldcrest Cannon's records, the Kannapolis plant generates 13,600 tons of ash per year on a dry basis. Fieldcrest's Spencer, North Carolina plant generates approximately 6000 to 8000 tons per year (dry basis). The ash from the Kannapolis plant is sluiced to the settling ponds for dewatering. The ponds are dredged and ash is placed into the Upper Storage Area for further drying. Once the ash is dried into a workable condition, it is dozed into the Beneficial Fill Area. On the order of 14,000 to 16,000 cubic yards of ash is placed yearly in the Beneficial Fill Area. Dry ash from the Spencer plant will be trucked to the Kannapolis ash handling facility on a quarterly basis and placed directly in the ash fill area.

2.3 Ash Characteristics

Ash encountered during the geotechnical investigation of the existing ash fill area (see Section 3.0) generally classifies as a soft, black, silty fine sand and silt. Dry unit weights from undisturbed ash samples taken from the existing beneficial fill area vary from 29.6 to 51.5 pounds per cubic foot. The high variability in the dry unit weights are attributed to differences in material grain size, moisture content during placement, and placement techniques. Based on sampling performed during the geotechnical investigation, a unit weight of 51.5 pounds per cubic foot is representative of most of the in-place ash fill. A summary of laboratory tests performed on the ash is included in Table 2 in Section 3.0. Grain size distribution and moisture-density relationship test sheets are included in Appendix II for reference.

Laboratory hydraulic conductivity testing performed on undisturbed ash samples taken from the existing beneficial fill area indicate permeabilities of approximately 1×10^{-5} to 2×10^{-6} cm/sec. Hydraulic conductivity test results are presented in Table 2 in Section 3.0. Hydraulic conductivity test procedures are presented in Appendix II for reference.

TCLP data of ash samples from the Kannapolis and Spencer plant boilers are presented in Table 1. TCLP lab data sheets are included in Appendix II for reference.

2.4 Beneficial Fill Capacity

The volume of the expanded ash fill area was calculated by comparing the Final Closure Plan to existing topographic conditions. On the order of 360,000 cubic yards of volume is available by the beneficial fill expansion.

Based on laboratory test data and Fieldcrest Cannon's ash fill estimates, on the order of 20 years of capacity will be available.

2.5 Borrow Soil Quantities

As discussed above, expansion of the beneficial fill area will include construction of a perimeter berm along the southern side of the ash fill area. Soil from Borrow Area I and Borrow Area II will be used to construct the berm. Soil remaining in Borrow Area II will be available for maintenance during operations and closure of the ash fill. Soil from Future Borrow Area III will be used to complete construction of the final cover.

Calculations indicate that approximately 52,000 cubic yards of soil will be needed to construct an 18-inch thick final cover for closure of the beneficial fill. An additional 40,000 cubic yards of soil will be required to construct the southern perimeter berm. Borrow Areas I, II, and Future Borrow Area III should supply approximately 100,000 cubic yards of borrow soil. Therefore, the proposed borrow areas should supply enough borrow throughout closure of the facility.

TABLE 1
SUMMARY OF TCLP LABORATORY TESTS OF ASH
FIELDCREST CANNON KANNAPOLIS AND SPENCER PLANTS
S&ME JOB NO. 1356–95–133

PLANT I (KANNAPOLIS, NORTH CAROLINA)
(Sample Date 11/18/92)

1992 Data

PARAMETER	N.C. 15A NCAC 2L GROUNDWATER STANDRD (mg/l)	TCLP TEST RESULTS (mg/l)
Arsenic	0.50	0.019
Barium	10.00	2.86
Cadmium	0.10	<0.005
Chromium	0.50	<0.05
Lead	0.50	<0.05
Mercury	0.02	<0.0002
Selenium	0.10	<0.005
Silver	0.50	<0.01

Note:
Tests for pesticides/herbicides, and semivolatile and volatile organic compounds indicate all parameters below detection limits.

NCF PLANT (SPENCER, NORTH CAROLINA)
(Sample Date 4–7–92)

1992 Data

PARAMETER	N.C. 15A NCAC 2L GROUNDWATER STANDRD (mg/l)	TCLP TEST RESULTS (mg/l)
Arsenic	0.50	0.06
Barium	10.00	1.0
Cadmium	0.10	0.02
Chromium	0.50	ND
Lead	0.50	0.20
Mercury	0.02	ND
Selenium	0.10	0.084
Silver	0.50	ND

Note:
Tests for pesticides/herbicides, and semivolatile and volatile organic compounds indicate all parameters below detection limits.

ND = Not Detected

3.0 GEOTECHNICAL INVESTIGATION

S&ME recently completed an exploration of the Kannapolis ash handling facility to provide detailed site information for developing a plan for expansion of the ash handling area. The information obtained included properties of on-site soils and ash materials, locations of existing ash fill areas, potential future ash fill areas, and on-site soil borrow areas. Groundwater conditions across the site were determined from borings advanced during the investigation.

3.1 Site Reconnaissance

During drilling of the soil test borings a staff professional from our office made several site visits to monitor site activities. A staff professional made site visits during dry and wet weather conditions to observe surface water flow patterns, identify seeping water from embankments and filled areas, and check for unstable slopes or eroded areas.

3.2 Soil Test Borings

To evaluate the characteristics of the materials in the Beneficial Fill Area and on-site soils, 24 soil test borings (B-1 through B-24) were drilled at the locations shown on the Site Plan, Sheet 1 in Appendix IV. The borings were located to identify previous ash disposal areas, potential future disposal areas, and potential sources of borrow soil. The borings were drilled with an all-terrain vehicle mounted drill rig using hollow stem, continuous flight augers.

The borings were drilled to various depths depending on location. In ash disposal areas, the borings were advanced until reaching residual soils (undisturbed soils beneath the ash fill) to determine the depth of ash fill. Two borings, advanced around the perimeter of Pond No.1 (B-15, B-16), were drilled through the Pond No.1 containment dike (soil fill) and terminated upon reaching residual soils. Boring B-17 was advanced through ash fill before reaching residual soils. The remaining borings were drilled to intersect the groundwater surface or until reaching partially weathered rock. A slotted, two-inch diameter PVC standpipe was installed in each boring to allow measurement of groundwater levels in the borings following drilling.

During drilling, standard penetration tests were performed at designated intervals in each soil test boring in accordance with ASTM 1586-84. The standard penetration resistance provides an index for estimating soil strength and relative density. In conjunction with standard penetration testing, split-spoon samples were recovered for classification and laboratory testing.

Split spoon soil samples were examined by a geotechnical staff professional to classify the samples based on distribution of grain sizes, plasticity, organic content, moisture condition, color, and apparent geologic origin. The results of the soil classifications as well as relative density and consistency data, lithologic characteristics, and stabilized depth to groundwater are shown on the boring logs in Appendix I. The strata contact lines represent approximate boundaries between soil types; the actual transition between soil types may be gradual in both the horizontal and vertical directions.

Undisturbed shelby tube samples were obtained with a piston type sampler in Borings B-1, B-3, B-4, and B-24 at designated intervals. The undisturbed ash samples were returned to our laboratory for permeability and consolidation testing.

Field exploration procedures are presented in Appendix I for reference.

3.3 Groundwater Level Measurements

Following drilling and installation of temporary standpipes, water levels were measured in each boring within 24 hours of drilling and again on February 13, 1995. The groundwater level data collected on this date is presented on the attached Groundwater

Surface Map, Figure 2. Future ash placement will be at least two feet above the groundwater levels shown on Figure 2.

3.4 Field Hydraulic Conductivity Testing

In-situ permeability tests were performed in Borings B-1, B-8, and B-24 to estimate hydraulic conductivity of the subsurface materials at these locations. In-situ tests were performed using a falling head technique. The data were analyzed by the Bouwer and Rice method described in Appendix I. Results are presented below.

SUMMARY OF FIELD HYDRAULIC CONDUCTIVITY TESTS

Boring	Hydraulic Conductivity
B-1	2×10^{-4} cm/sec
B-8	6×10^{-5} cm/sec
B-24	1×10^{-5} cm/sec

3.5 Laboratory Testing

S&ME performed laboratory testing on representative samples of the on-site soils obtained during the field exploration. Classification tests included natural moisture content, unit weight, grain size distribution with hydrometers, Atterberg Limits and specific gravity tests. In addition, a standard Proctor compaction test was performed on a representative sample from Boring B-23.

Laboratory tests performed on two undisturbed ash samples obtained from the beneficial fill area included vertical permeability, moisture content, unit weight, and grain size distribution with hydrometers. The unit weight and moisture content tests provided an indication of in-place density of the ash fill.

A consolidation test was performed on an additional undisturbed sample of the ash. The test was performed to determine consolidation characteristics of the existing ash fill.

Results of the laboratory tests performed by S&ME are presented on Table 2, Summary of Laboratory Test Data. Consolidation test results along with the laboratory testing procedures and laboratory test data sheets are included in Appendix II for reference.

S&ME collected two split spoon soil samples just below the ash from Borings B-9 and B-24. The samples were submitted to IEA, Inc. in Cary, North Carolina for TCLP metals analysis. Results of the TCLP tests are summarized in Table 3. Detailed lab results are included in Appendix II. As indicated by the test data it appears that soils at these two locations have not been impacted by constituents in the overlying ash fill.

4.0 ENGINEERING PLAN

4.1 Buffer Requirements

In accordance with the Solid Waste Management Rules, Section .1704 of 15A NCAC 13B, the Beneficial Reuse area is designed so that no ash will be placed: (1) within 50 feet of wetlands, (2) within 50 feet of a perennial stream or other surface water body, (3) within two feet of the seasonal high groundwater table, (4) within 100 feet of any source of drinking water, (5) within the 100-year floodplain, (6) within 25 feet of any property boundary, or (7) within 25 feet of a bedrock outcrop. The proposed beneficial fill limits are shown on the Site Plan, Sheet 1, in Appendix IV. Buffers are shown on the Grading Plan, Sheet 2.

4.2 Ash Placement

As discussed in subsequent sections of this document, the ash will be placed in thin lifts with a dozer and allowed to dry for a few days prior to compaction. The lift of ash will then be compacted prior to placement of the next lift. This process will add stability to the ash as well as provide a suitable foundation for the overlying lifts.

4.3 Slope Stability

Global slope stability analyses were performed for two cross-sections through the ash fill area. The cross-sections are shown on Figures 3 and 4. Soil and groundwater data gathered during our site investigation was used to construct the cross-sections. Conditions representative of the final ash fill elevations with a final soil cover over the ash fill area were modeled. These conditions include loading conditions for final end use modeled by two 30,000 pound point loads near the top of the fill slope (loaded flatbed truck, single rear axle) and a uniformly distributed load of 1000 pounds per square foot over the remaining area at the top of the fill (equipment storage area). Soil and ash strength parameters were conservatively estimated based on laboratory tests and past experience with similar materials.

The STABL/G computer program developed by Purdue University and modified by Geosoft, Inc., was used for the stability analysis. The computer generated analysis was performed by generating circular failure surfaces with safety factors for the ten most critical surfaces calculated by the simplified Bishop method. The minimum safety factor failure surface with total stress strength parameters analyzed are shown on Figures 3 and 4. The minimum slope stability safety factors for sections 1-1 and 2-2 were found to be 2.06 and 1.52, respectively. Computer output for each cross section modeled is included in Appendix III.

The total stress analysis is representative of rapid loading conditions where pore pressure dissipation in materials below the water table has not occurred. The total stress condition is considered conservative since ash is placed in the area approximately once every 8 to 12 months in thin lifts with a total ash height reaching less than five feet thick. This operation should allow excess pore pressures to dissipate prior to placing the next ash lift. In addition, a vertical drain system planned for the existing ash fill area will alleviate pore pressure increases during ash placement.

Based on the slope stability analyses and proposed ash placement, it is our opinion that adequate safety factors will exist for the planned ash fill expansion. We expect that greater safety factors than those listed above will actually be provided due to the installation of a vertical drain system in the existing ash fill and additional horizontal drainage systems for each 10-foot thick ash layer.

4.4 Settlement

Based on past ash fill operations and results of standard penetration resistance testing performed in the borings in the ash fill area, future consolidation of the existing ash fill due to stress increases caused by the vertical expansion is likely. However, based on the results of the laboratory consolidation test on the undisturbed sample obtained from boring B-3, the magnitude of the settlements should not be large.

The ash sample from Boring B-3 was visually classified as a fine, sandy silt. This sample is believed to be representative of most of the existing ash fill; however, softer and finer grained ash materials as well as secondary wastewater treatment plant sludge exist sporadically throughout the fill and at the bottom few feet of the existing ash fill. These materials may be more compressible than the fine, sandy silt materials.

It is expected that total settlement due to consolidation of the existing ash fill may be on the order of one to two feet. Settlements due to localized, very compressible materials within the ash fill may be higher resulting in differential settlements. Settlement of the existing ash layer will probably occur during the placement of consecutive ash lifts. The time between placement of each lift should allow short term consolidation to occur prior to the placement of the next lift. In addition, the proposed vertical drainage system will allow for relief of excess pore pressure and likely increase the rate of consolidation. Following placement of the final soil cover over the ash fill area, consolidation should be nearly completed.

4.5 Underdrain System

Due to the high moisture content and soft nature of the existing ash fill materials, the potential for unstable conditions during future operation of the ash fill exists unless existing pore water pressures are relieved through the installation of a drainage system. Drainage and consolidation of these wet, soft materials will increase long-term stability of the ash fill.

Drainage for the existing ash fill will be accomplished by a system of prefabricated, filter fabric wrapped wick drains and strip drains. The wick drains will be installed in a triangular pattern with approximately 10-foot horizontal spacing between each drain to a depth approximately equal to the depth of the ash fill. Each row of vertical drains will be connected to a horizontal strip drain. Each strip drain will be connected to a common toe drain constructed of a geotextile wrapped gravel trench with perforated pipe. The toe drain will exit the ash fill in the Lower Storage Area. Water collected by the system will be discharged to the Lower Storage Area and subsequently treated in the wastewater treatment plant.

Drainage for future ash lifts will be accomplished by installing horizontal strip drains within each 10 foot thick lift of ash. Horizontal drains will be installed on 20-foot centers across the ash fill area. Horizontal drain installation is discussed further in the Operations Plan, Section 5.0.

4.6 Erosion and Sedimentation Control

Erosion and sedimentation control structures have been designed to accommodate erosion and sedimentation control for construction and operation of the expansion area. These measures include sediment traps, diversion berms, ditches, and grassing. The erosion and sedimentation control devices have been designed in accordance with the "North Carolina Erosion and Sediment Control Planning and Design Manual", 1988. The Erosion and Sedimentation Control Plan with Drawings is presented in Appendix V.

4.7 Groundwater Protection

The grading plan for the expanded ash fill area is designed so that bottom grades of the ash fill will be at least two feet above the groundwater levels shown on the Groundwater Surface Map, Figure 2 (see Section 3.3). Based on our experience in this region of North Carolina, seasonal high groundwater levels typically occur in late winter to early spring.

Therefore, the groundwater levels measured on February 13, 1995 at the site likely represent seasonal high levels.

An underdrain system design is included in the expansion area to provide drainage of the existing ash fill area. This underdrain system will aid in drainage of water within the ash fill as well as surface water that infiltrates through future ash fill areas.

5.0 OPERATIONS PLAN

5.1 Site Development

Prior to ash filling, the existing ash fill surface should be graded to provide positive drainage toward the Lower Storage Area as shown on the Underdrain System Plan, Sheet 3, in Appendix IV. Following regrading activities, the underdrain system which consists of wick drains, strip drains and a toe drain will be installed within the existing fill areas.

Based on anticipated ash generation rates, ash should be placed in the ash fill area in approximately 2.5 acre phases. Each phase will contain two total lifts of approximately 5 feet thick. Each phase should provide approximately 24 to 36 months of disposal volume. The Phasing Diagrams, Figures 5 through 9 indicate the phase development of the ash fill area for each 10-foot thick lift of ash.

Following completion of the expansion earth work and installation of the underdrain system, ash filling should begin in the southern portion of the expansion area (Phase I and II). After placement of the initial 5-foot thick lift in Phase I, a second toe drain should be installed along the center of the phase for subsurface drainage within the ash. The drain should be installed at the location indicated on the Underdrain System Plan, Sheet 3. This toe drain should daylight into the lower storage area for discharge to the wastewater treatment plant.

The ash in each phase should be filled in thin lifts from an up gradient to downgradient manner to maintain positive drainage to the Lower Storage Area. Each phase will consist of two 5-foot thick lifts of ash (approximately 24 to 36 months of operation). Following completion of adjacent phases (each 10-foot thick lift of ash), strip drains should be placed at 20 feet on-center spacing in a north-south direction with the ends daylighting at their intersection with the 5H:1V final side slope. The strip drains should be placed prior to placement of ash in the next overlying series of phases.

Borrow area II should be utilized as needed for maintenance and initial closure of the site. An erosion control permit for Borrow area III should be obtained prior to beginning closure operations. Borrow Areas II and III should be used to construct the final soil cap.

5.2 Ash Placement

Ash will be excavated from the Upper Storage Area (and hauled from the Spencer Plant) and end-dumped by dump trucks into the active phase of the ash fill area. The ash will be dozed into place in lifts of approximately one foot thick within a specific phase. After a few days of drying, the ash lifts will be moderately compacted into place to within 92 percent of the standard Proctor maximum dry density. It is anticipated that compaction of the ash can be achieved with conventional tracked equipment. However, compaction equipment such as shallow sheepsfoot or smooth drum rollers (non-vibratory) may be required. Density testing should be performed during operations for at least every five foot lift within a phase. Once a phase has reached a total height of five feet, ash filling shall proceed to the subsequent phase. The active face of each phase shall be no steeper than 3 horizontal to 1 vertical (5 horizontal to 1 vertical for final elevations).

As discussed previously, once the ash reaches a thickness of 10 feet (at elevations 730, 740, 750, and 760), a network of strip drains shall be installed at 20 foot spacing oriented in a north-south direction. In Phase II of operation the strip drains should daylight into the Lower Storage Area. In Phase III the strip drains should be placed in an east-west direction overlapping the first strip drain encountered in Phase IV (Phase IV and V strip drains will have already been installed). In later phases, the strip drains should be installed so that the ends daylight out along the southern ash slope.

During initial ash placement on a subsurface drainage layer (strip drains), care should be taken to avoid damaging the strip drains. Equipment should never be operated directly on the strip drains. Strip drains should be covered with a minimum one-foot thick ash lift by pushing the ash out ahead of a low ground pressure, tracked dozer. Equipment should avoid sharp turns until a minimum of two feet of ash is placed and compacted over the strip drains.

This filling process will continue until final grades are achieved as discussed in the Closure Plan, Section 6.0.

5.3 Reporting Requirements

In accordance with the Solid Waste Management Rules (Sections .1703(a)(4), .1705(c), and .1710 of 15A NCAC 13B), operational documentation shall be performed for the Beneficial Reuse area. Documentation requirements will include annual TCLP test data on the ash from each source (Kannapolis and Spencer Plant), density testing of the ash fill; and ash volumes produced, disposed, and filled.

The ash volumes shall include: (1) volume of coal combustion ash produced, (2) volume of ash disposed, (3) volume of ash used in structural fill, and (4) volume of ash used for other uses as described in Section .1708 of the Solid Waste Management Rules (15A NCAC 13B). These volumes shall be reported to the Division of Solid Waste Management on an annual basis by October 1 of each year for the previous operating period from July 1 through June 31.

5.4 Erosion and Sedimentation Control

Site development and operation shall comply with the Erosion and Sedimentation Control Plan in Appendix V as required by the North Carolina Sedimentation Pollution Control Act of 1973.

The erosion and sedimentation control devices for expansion and operation of the facility include rock dams, sediment traps, ditches and grassing. The locations of erosion and sedimentation control devices and construction details are shown on Sheets 5 and 6 in the Erosion and Sedimentation Control Plan presented in Appendix V. Sediment shall be removed from the rock dam basins and sediment traps when sediment accumulates to one half of the design depth. The rock dams, sediment traps, ditches and outlets shall be inspected for damage after each runoff event. Necessary repairs shall be made immediately.

Embankment slopes shall be periodically inspected for erosion. The embankment slopes shall be mowed at least once a year and should be refertilized in the second year unless vegetation growth is fully adequate. Reseed, fertilize and mulch damaged areas immediately. Seeding, fertilizing, and mulching shall be in accordance with the seeding specifications presented in the Erosion and Sedimentation Control Plan.

Ash fill areas exposed for more than six months shall be seeded in accordance with the seeding specifications in the Erosion and Sedimentation Control Plan.

5.5 Stormwater Management

Stormwater run-on will be diverted around the ash fill area by perimeter ditches. The ash fill areas will be graded to provide positive drainage to allow surface water run-off to drain to the Lower Storage Area for discharge to the wastewater treatment plant.

A stormwater discharge permit will be required for construction activities prior to ash placement. A stormwater discharge permit during operations will not likely be required since the stormwater runoff from the ash fill area will be collected for treatment in the wastewater treatment plant.

5.6 Dust Control

Dust is not considered to be a problem due to the high moisture contents of the ash from the Kannapolis wet handling operation. Ash will be transported from the Spencer Plant in covered dump trucks and may cause dust problems. If dust problems occur during ash transportation, placement and/or compaction, dust will be controlled as necessary by the application of water by truck or other approved method.

Periodic watering of gravel access roads may be necessary if dust becomes a problem on other areas of the site. Also, final cover will be placed and vegetated as soon as practical to reduce the blowing of dust on the beneficial fill areas.

6.0 CLOSURE PLAN

6.1 Final Cover

Placement of the final cover will commence once the final proposed elevations are achieved. Final cover proposed grades are shown on the Final Closure Plan, Sheet 4, in Appendix IV. Phasing of the beneficial fill is designed so that final cover can be established in a phased approach.

The proposed final cover will consist of a 12-inch thick compacted soil layer and a 6-inch thick vegetative soil layer. The perimeter side slopes for the beneficial fill area will be 5 horizontal to 1 vertical. The top of the beneficial fill will be sloped at five percent to provide positive drainage. The cover soils will be excavated from Borrow Areas II and III. A mixture of fertilizer, grass seed, and mulch will be applied to the final surface to rapidly establish a dense cover of grass. Some portions along the top of the beneficial fill will be surfaced with gravel for plant machinery storage as discussed below.

6.2 Erosion and Sedimentation Control

Erosion of the final cover will be controlled by establishing a suitable grass cover. Run-on diversion ditches constructed for operations will remain in-place after closure to reduce potential erosion along the perimeter of the ash fill.

Prior to closure operations, the Erosion and Sedimentation Control Plan will be modified for final closure. The plan will include Borrow Area III and provisions to control erosion that takes place on the final cover before a suitable stand of grass can be established.

6.3 Stormwater Management

The final cover will be sloped so that stormwater run-off from the beneficial fill area will be collected in ditches and routed to downgradient areas. As mentioned above, run-on control ditches will remain in-place following closure. In conjunction with the modification of the Erosion and Sedimentation Control Plan for closure activities, a stormwater discharge permit will be required for construction activities for final closure.

6.4 Final Use Plan

The top of the ash fill area is to be used by Fieldcrest Cannon as an equipment storage area. This area will be used to store scrap equipment as well as large parts for the plant machinery. The final contours will be graded along the top of the fill area to a minimum of five percent so that equipment staging as well as stormwater runoff can be accommodated.

6.5 Post-Closure Maintenance

The final cover will be inspected quarterly for signs of excessive settlement, erosion, vector damage, or bare spots. Additional inspections will be warranted after large storm events. Depressions in the cover that pond water will be filled and/or regraded. Areas subject to regrading will be revegetated according to the seeding specifications in the Erosion and Sedimentation Control Plan. Erosion and vector damage will be repaired, and the source of the damage will be corrected if possible.

The final cover grass should be mowed at least once per year. Bare spots should be revegetated as soon as possible.

6.6 Recording Requirements

In accordance with the Solid Waste Management Rules (Section .1707 of 15A NCAC 13B) following closure activities, Fieldcrest Cannon (owner) shall file a statement (in accordance with G.S. 47-38 through 47-43) of the volume and location of the beneficial fill with the Register of Deeds with Rowan County. Recordation shall be done within 90 days of final closure of the beneficial fill.

If the property is sold, leased, conveyed, or transferred, the deed or instrument of transfer shall contain a description or statement that coal combustion by-products have been used as fill material on the property.

APPENDIX I

FIELD TESTING PROCEDURES AND RESULTS

FIELD EXPLORATION PROCEDURES

FIELD EXPLORATION PROCEDURES

Soil Test Boring: 24 soil test borings were drilled at the locations shown on the Boring Location Plan. 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 each location 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 examined by an engineer to verify the driller's and/or engineer's field classifications. Test Boring Records are attached showing the soil descriptions and Standard Penetration Resistances.

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.

Field Permeability Testing: Falling head permeability (slug) tests were performed in three of the borings. The tests consisted of initially obtaining the established groundwater level measurement. A slug of water was introduced into the well causing a rise in the water level. The fall 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.

TEST BORING RECORDS

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPES

(Shown in Graphic Log)

- FLY ASH FILL
- Topsoil
- Gravel
- Sand
- Silt
- Clay
- Organic
- Sandy
- Silty
- Clayey
- Silty Sand
- Clayey Sand
- Sandy Silt
- Clayey Silt
- Sandy Clay
- Silty Clay
- Partially Weathered Rock
- Cored Rock

WATER LEVELS

(Shown in Water Level Column)

- ▽ = Water Level At Termination Of Boring
- ▼ = Water Level On 2/13/95
- ◄ = Loss Of Drilling Water
- HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Soft	0 to 2
Soft	3 to 4
Firm	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	31 to 50
Very Hard	Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	Over 50

SAMPLER TYPES

(Shown in Samples Column)

- ■ Shelby Tube
- ⊠ Split Spoon
- I Rock Core
- ▯ No Recovery

TERMS

Standard Penetration Resistance – The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D-1586

REC – Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD – Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks exluded) Divided by the Total Length of the Core Run Times 100%.

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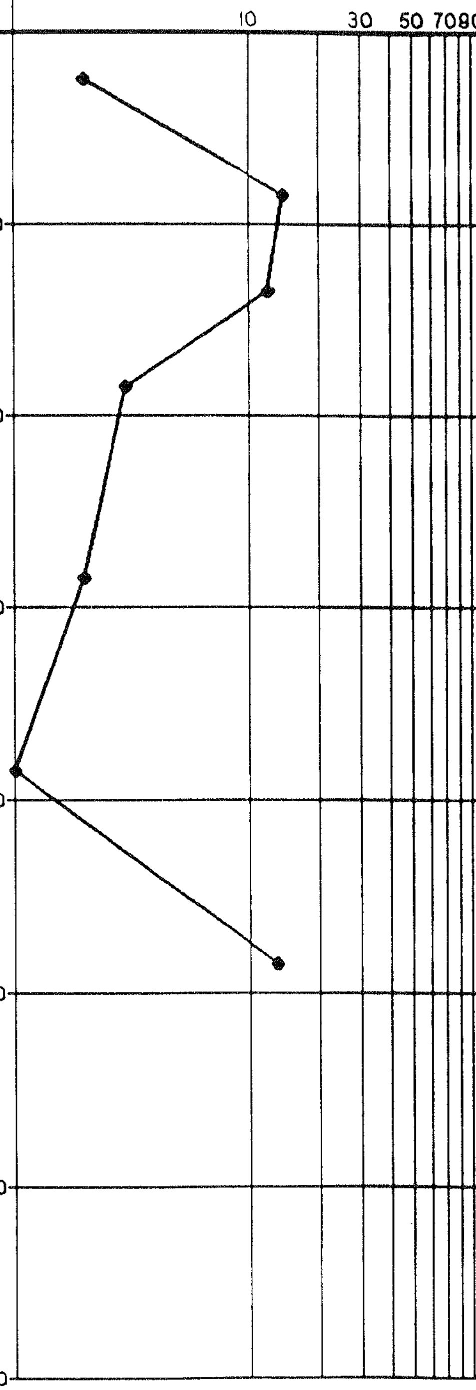
PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-1

PROJECT NO.:	1356-95-133	ELEVATION:	739.0 (Approximate)
LOGGED BY:	PGG	BORING DEPTH:	25.0 FEET
DATE DRILLED:	2-7-95	WATER LEVEL:	23.13 feet, 2/13/95
DRILLING METHOD:	4-1/4" HSA	DRILL RIG:	Mobile B-57

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	GRAPHIC LOG	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.	Standard Penetration Test Data (Blows/ft)	BPF
		Fill: **FLY ASH**, sampled as Very Soft, Black to Dark Grey Silt						2
		Stiff, Greenish Grey and Tan, Slightly Micaceous, Slightly Sandy, **SILT**						14
5						734.0		
		Stiff **FLY ASH**, mixed with Greenish Grey and Tan, Slightly Micaceous, Sandy Silt						12
		Moist, Very Soft to Soft **FLY ASH**						3
10						729.0		
15						724.0		2
								WH
20						719.0		
		Residuum: Stiff, Tan, Orange, Black and Grey, Micaceous, Fine Sandy **SILT**		▼				13
25						714.0		
		Boring terminated at 25.0 feet. Temporary, slotted standpipe installed for water level monitoring.						
30						709.0		
35						704.0		



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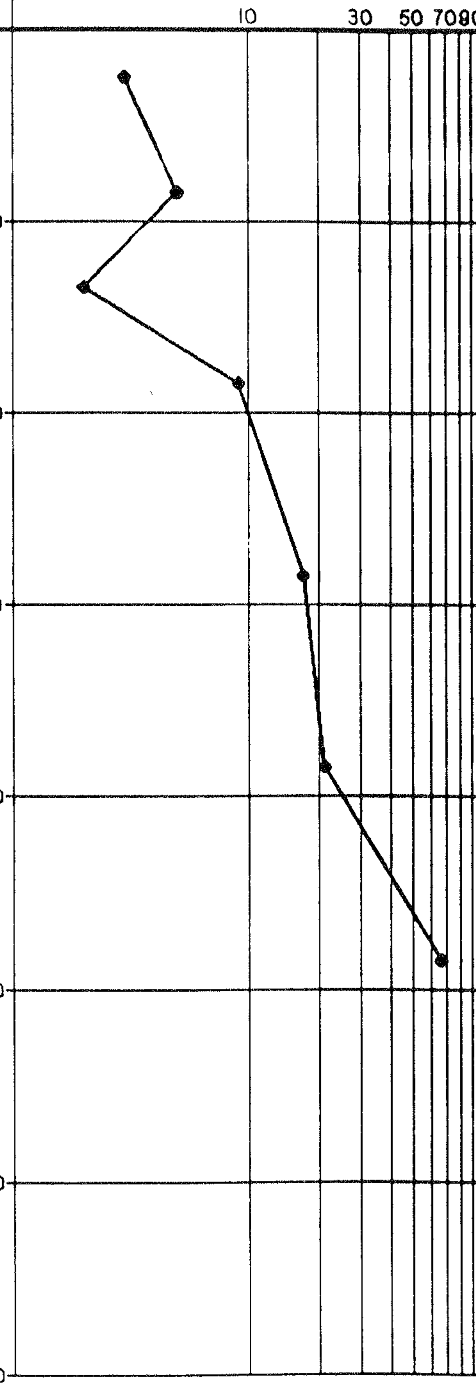
PROJECT:	**Fieldcrest Cannon – Ash Disposal** **Kannapolis, North Carolina**	TEST BORING RECORD	B-2

PROJECT NO.:	*1356-95-133*	ELEVATION:	*736.0 (Approximate)*
LOGGED BY:	*PGG*	BORING DEPTH:	*25.0 FEET*
DATE DRILLED:	*2-7-95*	WATER LEVEL:	*14.70 feet, 2/13/95*
DRILLING METHOD:	*4-1/4" HSA*	DRILL RIG:	*Mobile B-57*

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.	BPF
0–5.5	Fill: **FLY ASH**, sampled as Very Soft to Soft, Black to Dark Grey, Silt					3
5					731.0	5
5.5–8.5	Wet, **FLY ASH**					2
8.5–25	Residuum: Loose to Very Dense, Grey and Brown to Orange, Micaceous, Fine to Coarse Sandy **SILT** with Rock Fragments					9
10					726.0	
			▼			
15					721.0	17
20					716.0	21
25					711.0	88
25	*Boring terminated at 25.0 feet. Temporary, slotted standpipe installed for water level monitoring.*					
30					706.0	
35					701.0	

Standard Penetration Test Data (Blows/ft)



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PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-3

PROJECT NO.:	1356-95-133	ELEVATION:	737.0 (Approximate)	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY:	PGG	BORING DEPTH:	23.4 FEET	
DATE DRILLED:	2-8-95	WATER LEVEL:	17.60 feet, 2/13/95	
DRILLING METHOD:	4-1/4" HSA	DRILL RIG:	Mobile B-57	

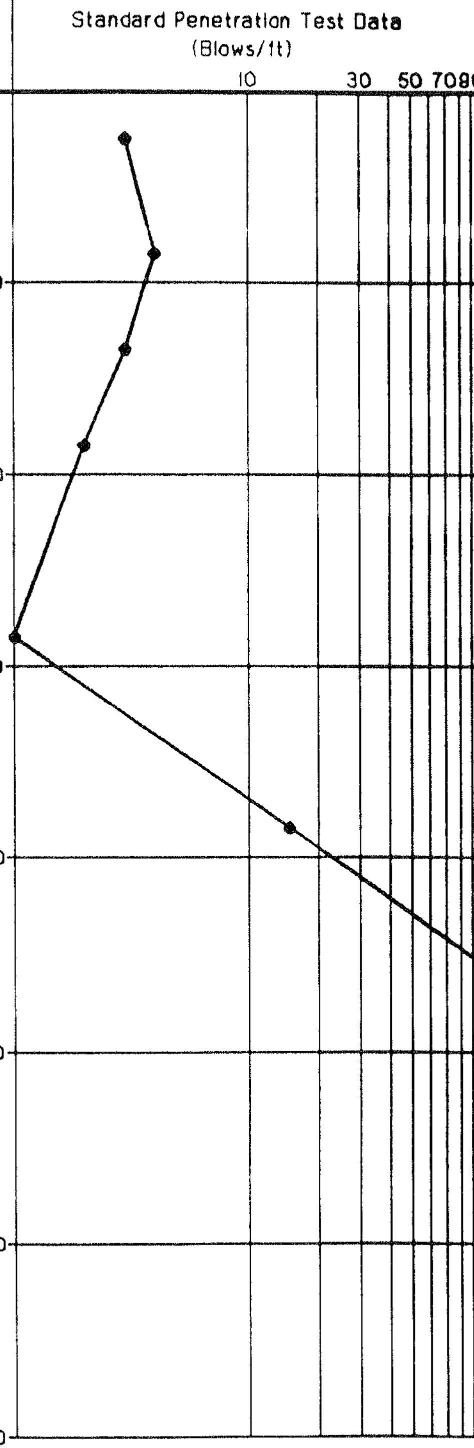
DEPTH (ft)	Soil Description	ELEV.	BPF
0 – 8.5	Fill: **FLY ASH**, sampled as Soft, Black to Dark Grey Silt to Silty Fine Sand		3, 4, 3
8.5 – 17	Wet, **FLY ASH**		2, WH
17 – 23	Residuum: Medium Dense, Grey, Tan, White, Black, Slightly Sandy **SILT** with Rock Fragments		15
23 – 23.4	Partially Weathered Rock, sampled as Tan to Orange, Grey, White, and Black Sandy Silt with Rock Fragments		50/5"

Depth scale: 5, 10, 15, 20, 25, 30, 35

Elevation scale: 732.0, 727.0, 722.0, 717.0, 712.0, 707.0, 702.0

Columns: OVM (ppm), WATER LEVEL, SAMPLE

Boring terminated at 23.4 feet.
Temporary slotted standpipe installed for water level monitoring.



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PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD B-4

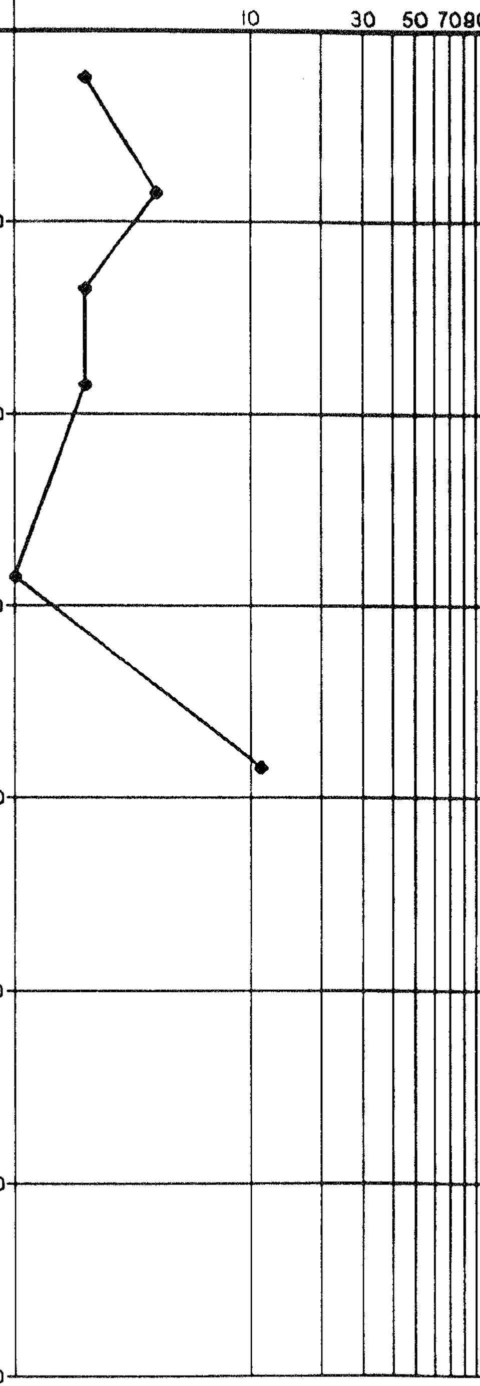
				NOTES:
PROJECT NO.:	*1358-95-133*	ELEVATION:	*737.0 (Approximate)*	Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY:	*PGG*	BORING DEPTH:	*20.0 FEET*	
DATE DRILLED:	*2-795*	WATER LEVEL:	*9.90 feet, 2/13/95*	
DRILLING METHOD:	*4-1/4" HSA*	DRILL RIG:	*Mobile B-57*	

DEPTH (ft)	Soil Description	ELEV.	BPF
0–16	Fill: **FLY ASH**, sampled as Very Soft to Soft, Black to Dark Grey Slightly Sandy Silt		2, 4, 2, 2, WH
16–20	Residuum: Medium Dense, Grey and Tan, Micaceous, Medium to Coarse Sandy **SILT** with Rock Fragments		11
20	*Boring terminated at 20.0 feet. Temporary slotted standpipe installed for water level monitoring.*		

Depth scale: 5, 10, 15, 20, 25, 30, 35 ft; Elevation scale: 732.0, 727.0, 722.0, 717.0, 712.0, 707.0, 702.0

Columns: OVM (ppm), WATER LEVEL, SAMPLE

Standard Penetration Test Data (Blows/ft)



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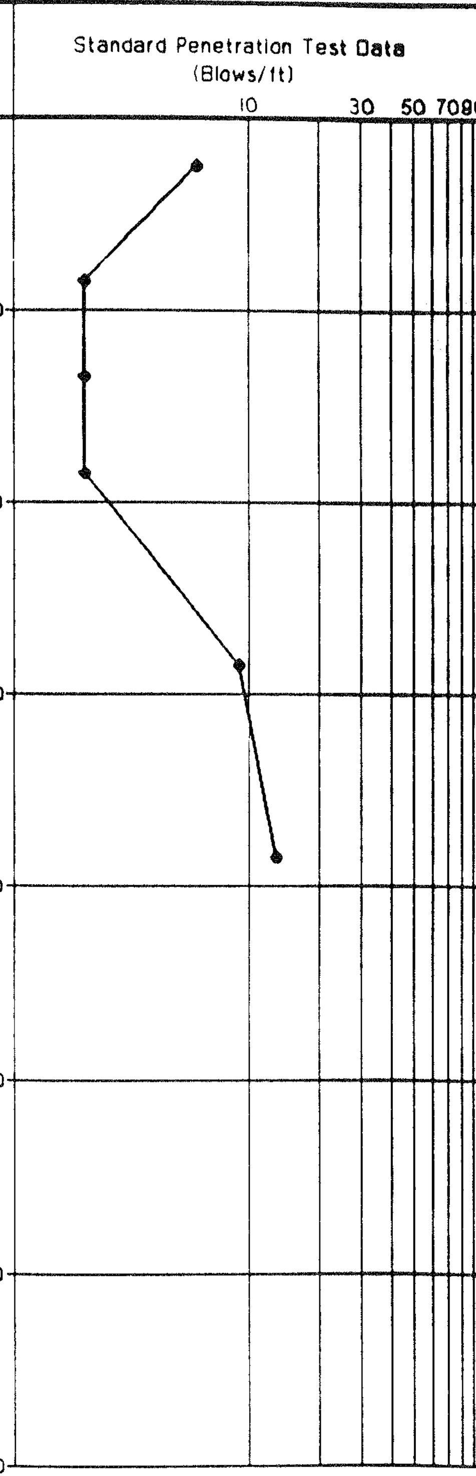
PROJECT: Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina		TEST BORING RECORD B-5
PROJECT NO.: 1356-95-133	ELEVATION: 732.0 (Approximate)	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY: PGG	BORING DEPTH: 20.0 FEET	
DATE DRILLED: 1-27-95	WATER LEVEL: 15.50 feet, 2/13/95	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: CME-45	

DEPTH (ft)	Soil Description	ELEV.	BPF
0–3	Fill: **FLY ASH**, sampled as Firm, Black to Dark Grey Silt		8
3–5	Very Soft, Grey and Tan, Slightly Clayey, Sandy **SILT**		2
5–17.5	**FLY ASH**, sampled as Very Soft to Firm, Black to Dark Grey, Fine Sandy Silt	727.0 (5), 722.0 (10), 717.0 (15)	2, 2, 9
17.5–20	Residuum: Medium Dense, Dark Grey to White, Very Micaceous, Sandy **SILT** with rock fragments	712.0 (20)	13
20	*Boring terminated at 20.0 feet. Temporary slotted standpipe installed for water level monitoring.*		

Column headings: DEPTH (ft) | GRAPHIC LOG | Soil Description | OVM (ppm) | WATER LEVEL | SAMPLE | ELEV. | Standard Penetration Test Data (Blows/ft) | BPF



Depth scale: 5, 10, 15, 20, 25, 30, 35. Elevation scale: 727.0, 722.0, 717.0, 712.0, 707.0, 702.0, 697.0.

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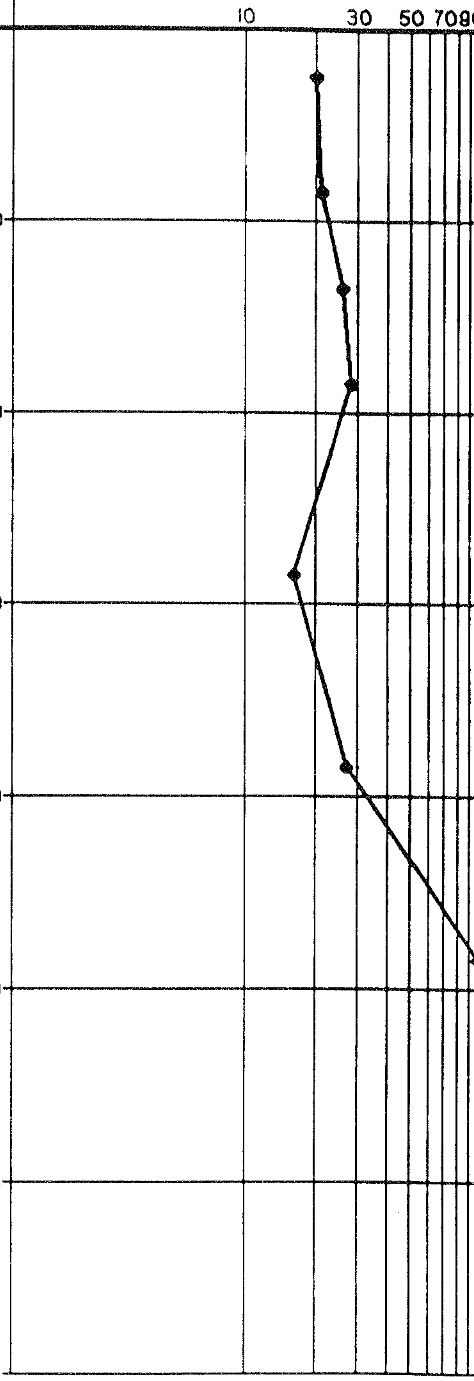
PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD B-6

PROJECT NO.: *1358-95-133*	ELEVATION: *709.0 (Approximate)*	NOTES:
LOGGED BY: *PGG*	BORING DEPTH: *22.9 FEET*	Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
DATE DRILLED: *1-27-95*	WATER LEVEL: *19.95 feet, 2/13/95*	
DRILLING METHOD: *4-1/4" HSA*	DRILL RIG: *CME-45*	

DEPTH (ft)	Soil Description	ELEV.
0 – ~1.9	Fill: Very Stiff, Tan to Light Brown, Slightly Sandy, Clayey, **SILT**	
~1.9 – 5.5	Residuum: Very Stiff, Reddish Brown and Dark Gray, Slightly Micaceous, Slightly Sandy, Clayey **SILT**	704.0 (at 5)
5.5 – 12.5	Medium Dense, Light Tan, Grey, and White, Slightly Micaceous, Fine to Medium Sandy **SILT**, with small Quartz fragments.	699.0 (at 10)
12.5 – 22	Medium Dense, Tan to Orange, Silty, Fine to Medium **SAND** with small rock fragments.	694.0 (at 15), 689.0 (at 20)
22 – 22.9	Partially Weathered Rock, sampled as Light Grey and White, Silty, Fine to Medium Sand	
	Boring terminated at 22.9 feet. Temporary slotted standpipe installed for water level monitoring.	684.0 (at 25), 679.0 (at 30), 674.0 (at 35)

Standard Penetration Test Data (Blows/ft)



Approx. Depth (ft)	BPF
2.5	20
5	21
7.5	26
10	28
15	16
20	27
24	50/5"

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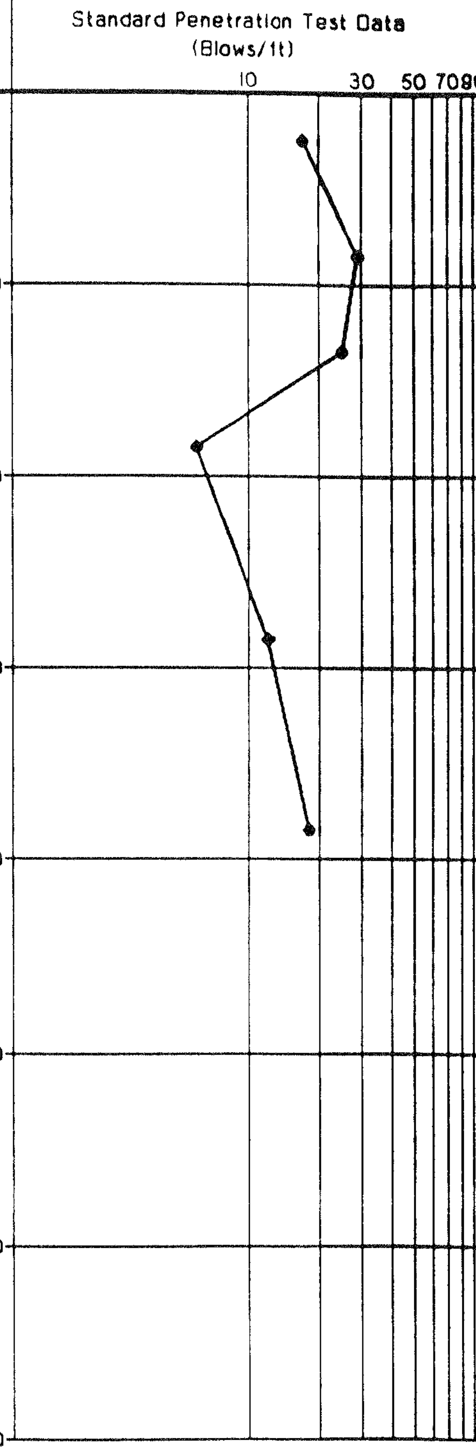
PROJECT: Fieldcrest Cannon – Ash Disposal, Kannapolis, North Carolina	TEST BORING RECORD B-7

PROJECT NO.: 1356-95-133	ELEVATION: 715.0 (Approximate)	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to the nearest 0.5 feet.
LOGGED BY: PGG	BORING DEPTH: 20.0 FEET	
DATE DRILLED: 1-30-95	WATER LEVEL: 5.50 feet, 2/13/95	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: Mobile B-57	

DEPTH (ft)	Soil Description	ELEV.	BPF
0–0.5	Topsoil		
	Residuum: Very Stiff, Light Tan to Orange-Red, Slightly Sandy, Slightly Clayey **SILT** with Rock Fragments		17
5	Very Stiff, Light Tan to Orange and Grey, Fine to Medium Sandy, Silty **CLAY**	710.0	29
			25
10	Wet, Loose, Reddish Brown, Slightly Micaceous, Slightly Silty, Slightly Clayey, Fine to Medium **SAND**	705.0	8
15	Moist, Stiff to Very Stiff, Dark Grey to White, Very Micaceous, Sandy **SILT**	700.0	12
20		695.0	18
	Boring terminated at 20.0 feet. Temporary slotted standpipe installed for water level monitoring.		
25		690.0	
30		685.0	
35		680.0	

Columns: DEPTH (ft) | GRAPHIC LOG | Soil Description | OVM (ppm) | WATER LEVEL | SAMPLE | ELEV. | Standard Penetration Test Data (Blows/ft) | BPF



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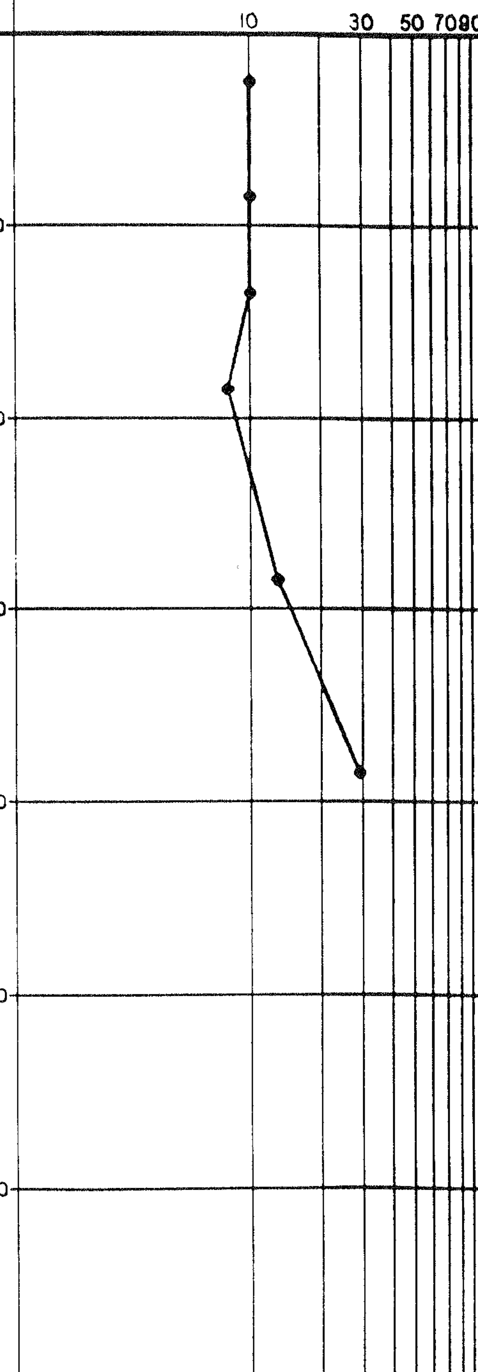
PROJECT:	Fieldcrest Cannon - Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-8

PROJECT NO.: 1358-95-133	ELEVATION: 705.0 (Approximate)	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to the nearest 0.5 foot.
LOGGED BY: PGG	BORING DEPTH: 20.0 FEET	
DATE DRILLED: 1-30-95	WATER LEVEL: 13.95 feet, 2/13/95	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: Mobile B-57	

DEPTH (ft)	Soil Description	ELEV.	BPF
0–12	Residuum: Loose, Light Brown to Orange, Slightly Clayey, Silty, Fine to Medium **SAND** with Rock Fragments		10, 10, 10, 8
12–20	Medium Dense, Light Grey to White and Tan, Micaceous, Silty, Fine to Medium **SAND**, with Rock Fragments.		13, 29
20	*Boring terminated at 20.0 feet. Temporary slotted standpipe installed for waterlevel monitoring.*		

Depth scale: 5, 10, 15, 20, 25, 30, 35. Elevation scale: 700.0, 695.0, 690.0, 685.0, 680.0, 675.0, 670.0. Columns: OVM (ppm), WATER LEVEL, SAMPLE.

Standard Penetration Test Data (Blows/ft)



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PROJECT:	**Fieldcrest Cannon – Ash Disposal** **Kannapolis, North Carolina**

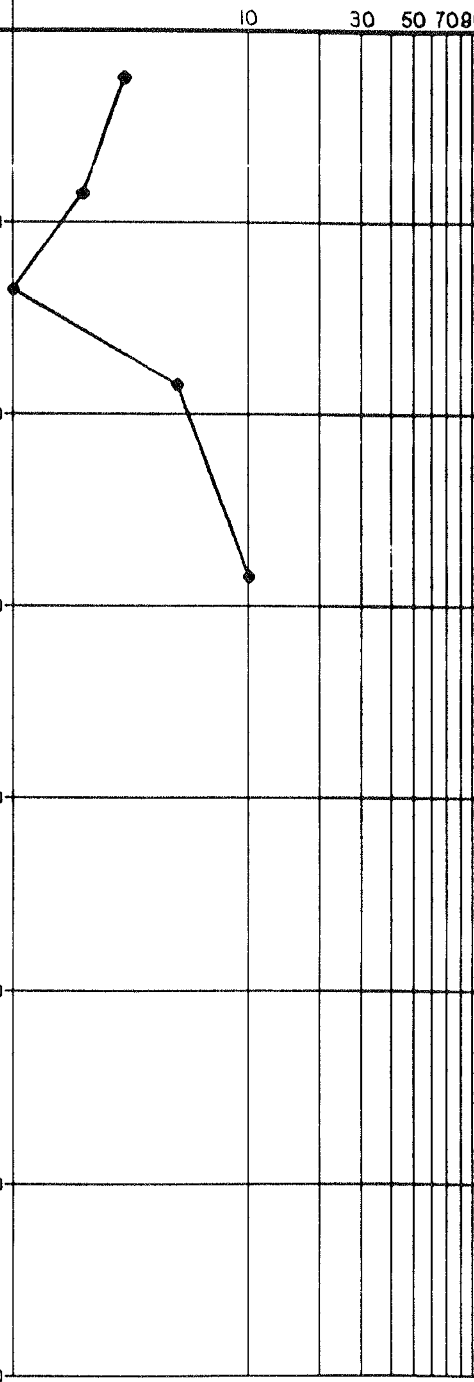
TEST BORING RECORD B-9

PROJECT NO.:	*1358-95-133*	ELEVATION:	*715.0 (Approximate)*
LOGGED BY:	*PGG*	BORING DEPTH:	*15.0 FEET*
DATE DRILLED:	*2-3-95*	WATER LEVEL:	*10.05 feet, 2/13/95*
DRILLING METHOD:	*4-1/4" HSA*	DRILL RIG:	*Mobile B-57*

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to the nearest 0.5 foot.

DEPTH (ft)	GRAPHIC LOG	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.	BPF
0–6		Fill: **FLY ASH**, sampled as Very Soft to Soft, Black to Dark Grey Slightly Sandy Silt					3
5						710.0	2
6–9.5		Moist **FLY ASH**		▼			WH
							5
10						705.0	
9.5–15		Residuum: Firm to Stiff, Greenish Grey and Tan, Slightly Micaceous, Slightly Sandy, Clayey **SILT**					10
15		*Boring terminated at 15.0 feet. Temporary slotted standpipe installed for water level monitoring.*				700.0	
20						695.0	
25						690.0	
30						685.0	
35						680.0	

Standard Penetration Test Data (Blows/ft)



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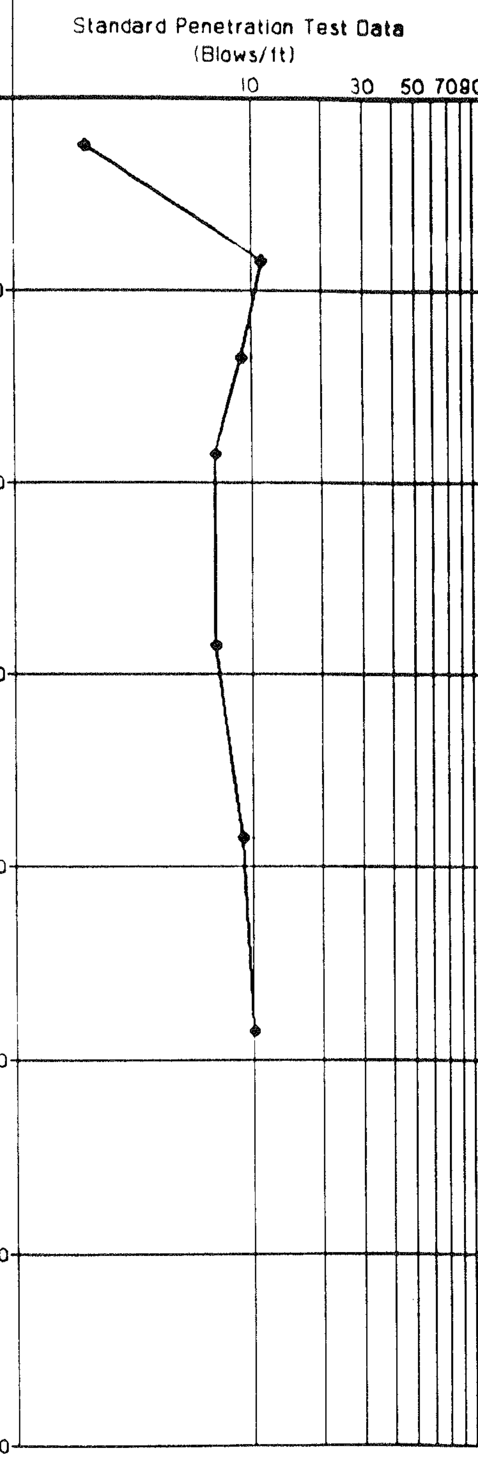
PROJECT:	Fieldcrest Cannon - Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-10

PROJECT NO.:	1356-95-133	ELEVATION:	719.0 (Approximate)
LOGGED BY:	PGG	BORING DEPTH:	25.0 FEET
DATE DRILLED:	2-3-95	WATER LEVEL:	14.30 feet, 2/13/95
DRILLING METHOD:	4-1/4" HSA	DRILL RIG:	Mobile B-57

NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to the nearest 0.5 foot.

DEPTH (ft)	Soil Description	ELEV.	BPF
0–2.7	Fill: **FLY ASH**, sampled as Very Soft, Black to Dark Grey Silt		2
2.7–12.5	Residuum: Firm to Stiff, Reddish Brown, Micaceous, Fine to Medium Sandy, Silty **CLAY**, with Rock Fragments.	714.0 (5), 709.0 (10)	11, 9, 7
12.5–22	Firm to Stiff, Grey and Tan, Very Micaceous, Fine to Medium Sandy **SILT** (water level ▼ at ~13 ft)	704.0 (15), 699.0 (20)	7, 9
22–25	Loose, White to Tan and Grey, Silty, Fine to Medium **SAND**, with Rock Fragments	694.0 (25)	10
25	*Boring terminated at 25.0 feet. Temporary slotted standpipe installed for water level monitoring.*	689.0 (30), 684.0 (35)	

Columns: DEPTH (ft) | GRAPHIC LOG | Soil Description | OVM (ppm) | WATER LEVEL | SAMPLE | ELEV. | Standard Penetration Test Data (Blows/ft) | BPF



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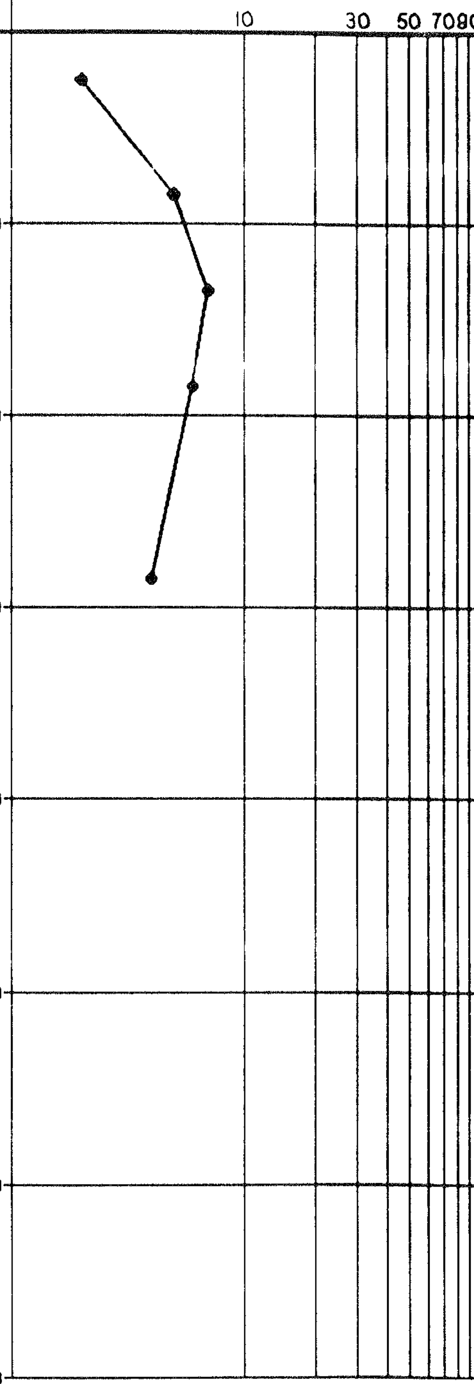
PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD B-11

PROJECT NO.:	*1356-95-133*	ELEVATION:	*718.0 (Approximate)*	NOTES:
LOGGED BY:	*PGG*	BORING DEPTH:	*15.0 FEET*	Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
DATE DRILLED:	*2-3-95*	WATER LEVEL:	*7.00 feet, 2/13/95*	
DRILLING METHOD:	*4-1/4" HSA*	DRILL RIG:	*Mobile B-57*	

DEPTH (ft)	GRAPHIC LOG	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.	BPF
0–3.5		Fill: **FLY ASH**, sampled as Very Soft, Black to Dark Grey Silty, Fine Sand					2
3.5–5.5		Residuum: Firm, Reddish Brown and Tan, Micaceous, Clayey, Sandy **SILT**		▼		713.0 (5 ft)	5
5.5–12		Firm, Reddish Brown, Micaceous, Fine to Medium Sandy, Silty, **CLAY**, with Rock Fragments.				708.0 (10 ft)	7 8
12–15		Soft, Grey and Tan, Very Micaceous, Fine to Medium Sandy, **SLIT**				703.0 (15 ft)	4
15		*Boring terminated at 15.0 feet. Temporary, slotted standpipe installed for water level monitoring.*					
20						698.0	
25						693.0	
30						688.0	
35						683.0	

Standard Penetration Test Data (Blows/ft)



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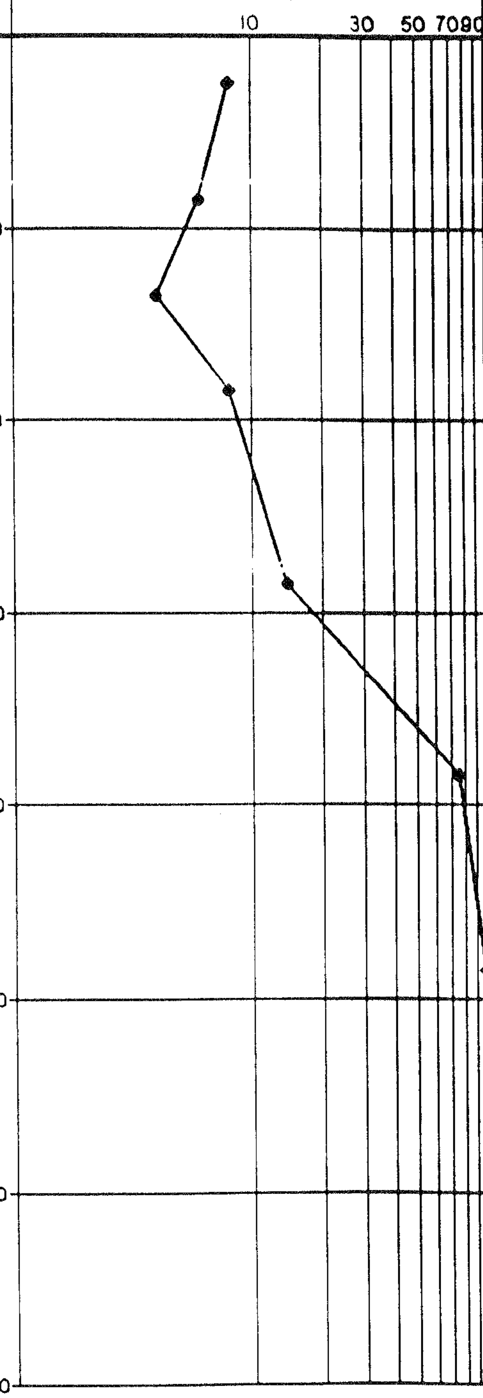
PROJECT: Fieldcrest Cannon – Ash Disposal, Kannapolis, North Carolina	TEST BORING RECORD B-12

PROJECT NO.: 1358-95-133	ELEVATION: 732.0 (Approximate)	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY: PGG	BORING DEPTH: 24.5 FEET	
DATE DRILLED: 1-30-95	WATER LEVEL: 12.10 feet, 2/13/95	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: Mobile B-57	

DEPTH (ft)	Soil Description	ELEV.	BPF
0	Topsoil		
	Residuum: Loose, Reddish Brown, Slightly Micaceous, Slightly Clayey, Silty SAND		8
	Soft to Firm, Reddish Brown and Tan, Micaceous, Slightly Sandy SILT		8
5		727.0	
			4
			8
10		722.0	
15		717.0	14
20	Partialy Weathered Rock, sampled as Tan, Black, White, and Grey, Silty, Fine to Medium Sand	712.0	75
			50/3"
25	*Boring terminated at 24.5 feet. Temporary, slotted standpipe installed for water level monitoring.*	707.0	
30		702.0	
35		697.0	

Columns: OVM (ppm) | WATER LEVEL | SAMPLE

Standard Penetration Test Data (Blows/ft)



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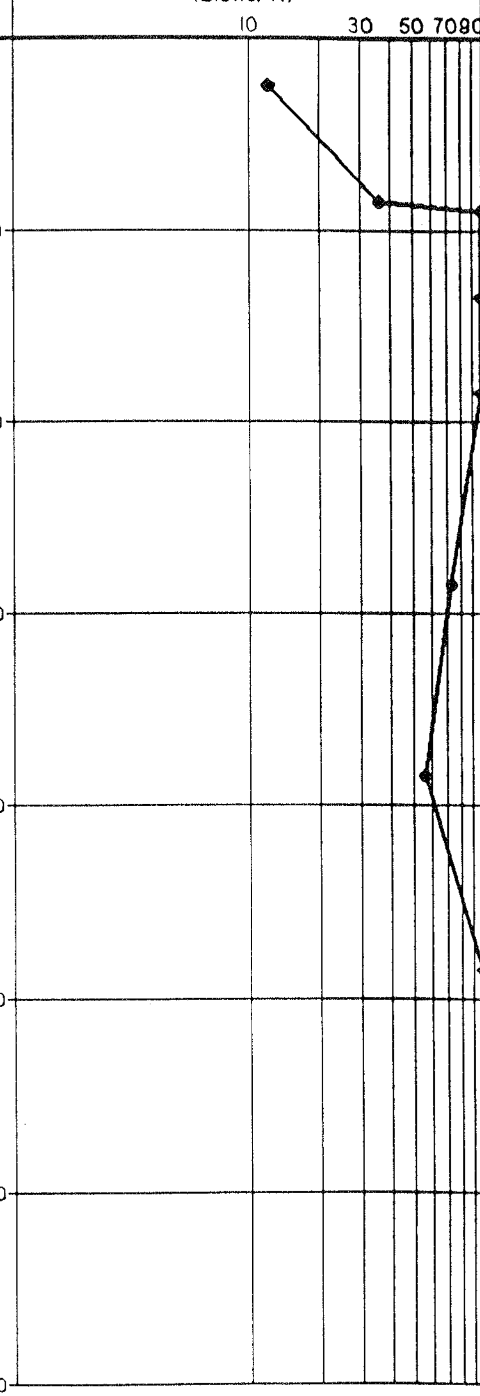
PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-13

PROJECT NO.:	1356-95-133	ELEVATION:	749.0 (Approximate)
LOGGED BY:	PGG	BORING DEPTH:	24.25 FEET
DATE DRILLED:	1-31-95	WATER LEVEL:	16.05 feet, 2/13/95
DRILLING METHOD:	4-1/4" HSA	DRILL RIG:	Mobile B-57

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	GRAPHIC LOG	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.
		Topsoil				
		Residuum: Stiff, Greenish Tan, Slightly Micaceous, Slightly Sandy, Clayey **SILT**				
		Hard, Light Tan to White and Grey, Micaceous, Fine Sandy **SILT**				
5		Partially Weathered Rock, sampled as Tan, Black, White, and Grey, Micaceous, Fine Sandy Silt				744.0
10						739.0
		Very Dense, Grey and Brown, Micaceous, Silty, Fine to Coarse **SAND**		▼		
15						734.0
		Very Hard, Tan, Orange, Black and Grey, Fine to Medium Sandy **SILT**				
20						729.0
		Partially Weathered Rock, sampled as Tan, Orange, Black and Grey, Fine to Medium Sandy Silt				
25						724.0
		Boring terminated at 24.25 feet. Temporary slotted standpipe installed for water level monitoring.				
30						719.0
35						714.0

Standard Penetration Test Data (Blows/ft)



BPF: 12, 38, 50/4", 50/6", 50/3", 73, 56, 50/3"

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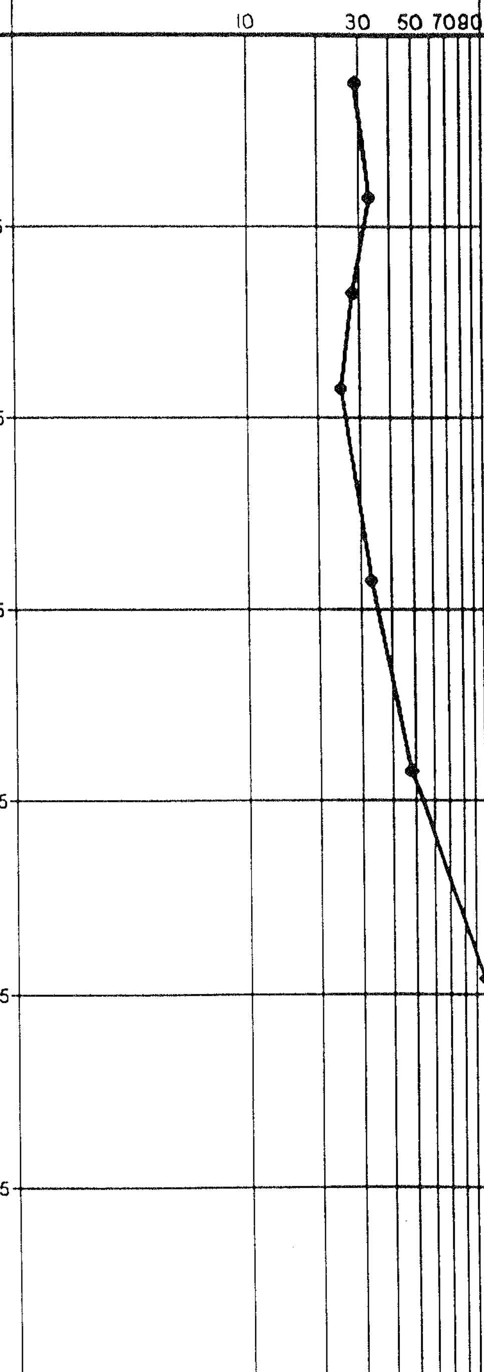
PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-14

PROJECT NO.:	1356-95-133	ELEVATION:	750.5 (Approximate)
LOGGED BY:	PGG	BORING DEPTH:	24.75 FEET
DATE DRILLED:	1-31-95	WATER LEVEL:	10.25 feet, 2/13/95
DRILLING METHOD:	4-1/4" HSA	DRILL RIG:	Mobile B-57

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	Soil Description	ELEV.	BPF
0	Topsoil		
	Residuum: Very Stiff to Hard, Tan to Orange, Black, White and Grey, Slightly Micaceous, Fine to Medium Sandy **SILT**, with Rock Fragments		29
			33
5		745.5	
			28
	(Water level ▽)		25
10		740.5	
	Hard, Brownish Orange to White, Medium to Coarse, Sandy **SILT** with Rock Fragments		
			33
15		735.5	
			48
20		730.5	
			50/3"
25	Partialy Weathered Rock, sampled as Tan, Grey and White, Silty Sand with Rock Fragments	725.5	
	Boring terminated at 24.75 feet. Temporary slotted standpipe installed for water level monitoring.		
30		720.5	
35		715.5	

Columns: DEPTH (ft) | GRAPHIC LOG | Soil Description | OVM (ppm) | WATER LEVEL | SAMPLE | ELEV. | Standard Penetration Test Data (Blows/ft) | BPF



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PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-15

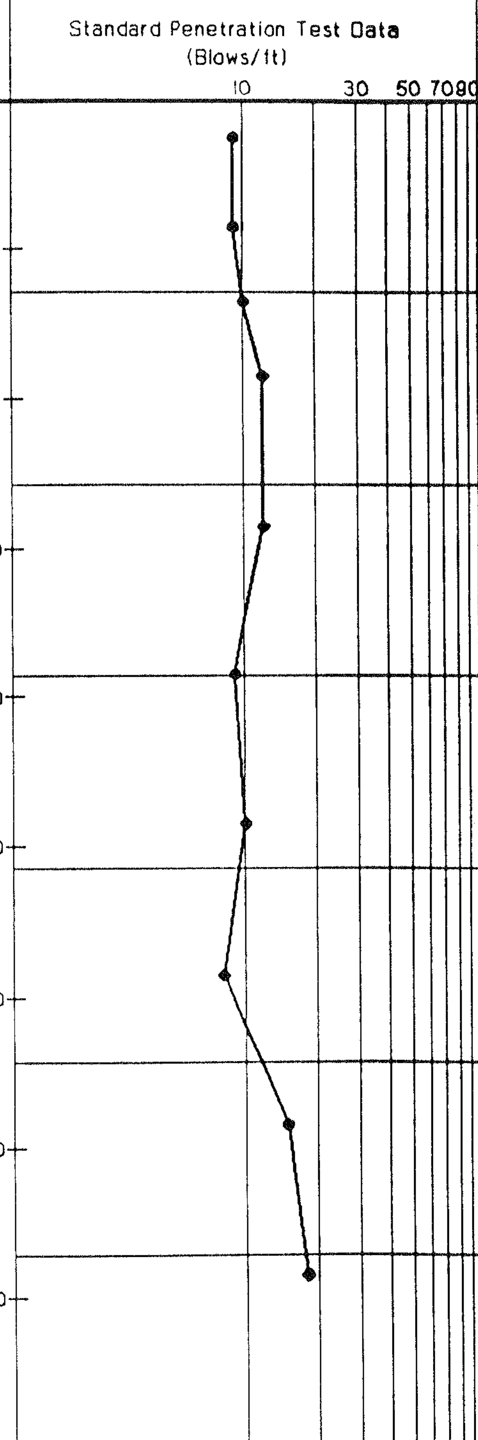
PROJECT NO.: 1356-95-133	ELEVATION: 749.0 (Approximate)	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY: PGG	BORING DEPTH: 40.0 FEET	
DATE DRILLED: 2-2-95	WATER LEVEL: 24.65 feet, 2/13/95	
DRILLING METHOD: 4-1/4" HSA	DRILL RIG: Mobile B-57	

DEPTH (ft)	Soil Description	ELEV.	BPF
0–8	Fill: Stiff, Brown to Tan, Fine to Medium Sandy, Clayey **SILT** with Rock Fragments	744.0 (at 5 ft)	9, 9, 10
8–31	Firm to Stiff, Greenish Grey and Tan, Fine Sandy, Clayey **SILT**	739.0, 734.0, 729.0, 724.0, 719.0	12, 12, 9, 10, 8
31–37.5	Residuum: Stiff to Very Stiff, Grey, Fine to Medium Sandy, Silty, **CLAY** with Fine Roots	714.0	15
37.5–40	Stiff, Greenish Grey to Tan, Slightly Micaceous, Slightly Clayey, Fine to Medium Sandy **SILT** with Rock Fragments	709.0	18

Boring terminated at 40.0 feet. Temporary slotted standpipe installed for water level monitoring.

Columns: DEPTH (ft) | GRAPHIC LOG | Soil Description | OVM (ppm) | WATER LEVEL | SAMPLE | ELEV. | Standard Penetration Test Data (Blows/ft) | BPF

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45. Elevation scale: 744.0, 739.0, 734.0, 729.0, 724.0, 719.0, 714.0, 709.0, 704.0



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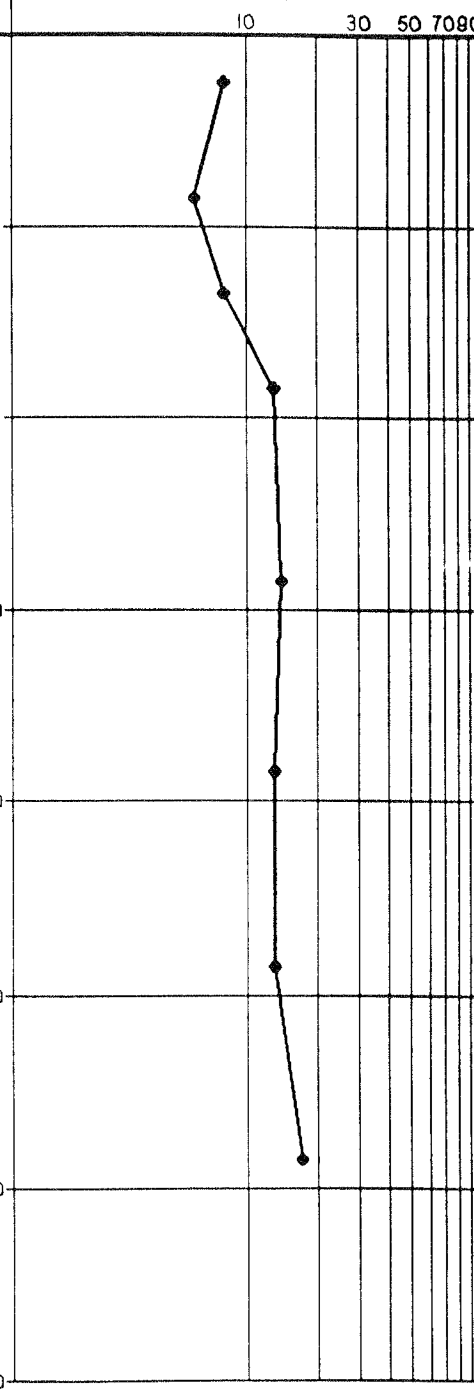
PROJECT: Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD B-16

PROJECT NO.: *1356-95-133*	ELEVATION: *749.0 (Approximate)*	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY: *PGG*	BORING DEPTH: *30.0 FEET*	
DATE DRILLED: *2-8-95*	WATER LEVEL: *24.65 feet, 2/13/95*	
DRILLING METHOD: *4-1/4" HSA*	DRILL RIG: *Mobile B-57*	

DEPTH (ft)	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.	BPF
0–1	Fill: **FLY ASH** sampled as Firm, Black to Dark Grey Silt					8
1–28.5	Fill: Firm to Stiff, Tan, Brown and Orange, Very Micaceous, Slightly Sandy, Slightly Clayey, **SILT**					6
5					744.0	8
10					739.0	13
15					734.0	14
20					729.0	13
21.5			▼			
25					724.0	13
28.5–30	Residuum: Very Stiff, Dark Grey to White, Micaceous, Fine Sandy, **SILT**					17
30					719.0	
30	*Boring terminated at 30.0 feet. Temporary slotted standpipe installed for water level monitoring.*					
35					714.0	

Standard Penetration Test Data (Blows/ft)



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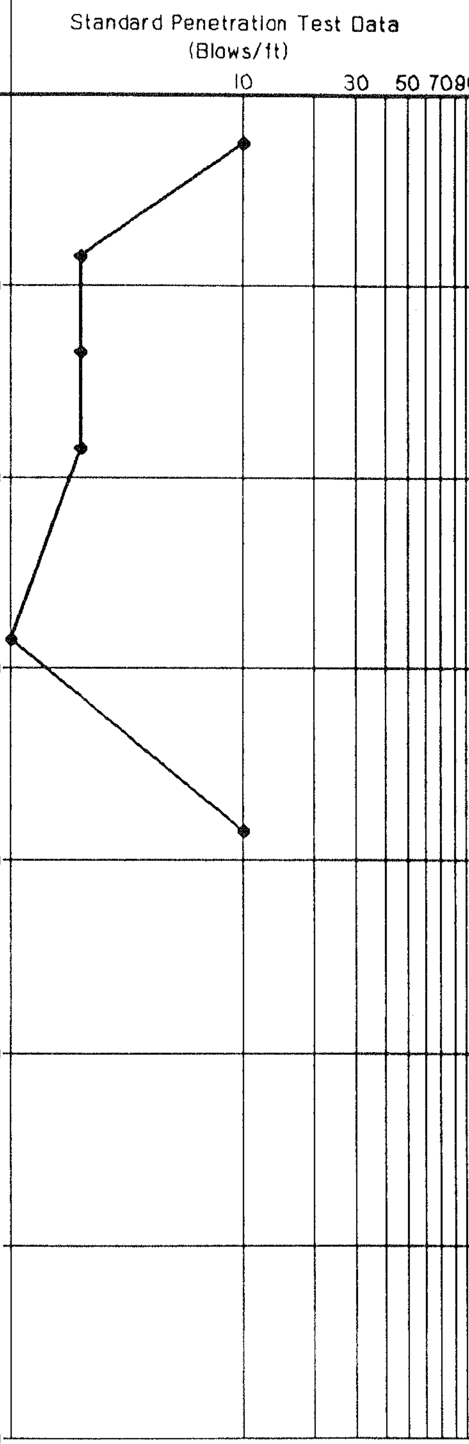
PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-17

PROJECT NO.: *1356-95-133*	ELEVATION: *750.0 (Approximate)*	NOTES:
LOGGED BY: *PGG*	BORING DEPTH: *20.0 FEET*	Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
DATE DRILLED: *2-2-95*	WATER LEVEL: *19.35 feet, 2/13/95*	
DRILLING METHOD: *4-1/4" HSA*	DRILL RIG: *Mobile B-57*	

DEPTH (ft)	Soil Description	ELEV.
0–1.5	Fill: Stiff, Brown to Tan, Slightly Sandy, Silty **CLAY**	
1.5–15	**FLY ASH**, sampled as Very Soft to Soft, Black to Dark Grey Silty, Fine Sand	745.0 (at 5), 740.0 (at 10)
15–20	Residuum: Stiff, Greenish Grey to Brown, Tan and Red, Micaceous, **SILT**	735.0 (at 15)
20	*Boring terminated at 20.0 feet. Temporary slotted standpipe installed for water level monitoring.*	730.0 (at 20)
25		725.0
30		720.0
35		715.0

Column headings: DEPTH (ft) | GRAPHIC LOG | Soil Description | OVM (ppm) | WATER LEVEL | SAMPLE | ELEV. | Standard Penetration Test Data (Blows/ft) | BPF



BPF
10
2
2
2
WH
10

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TEST BORING RECORD B-18

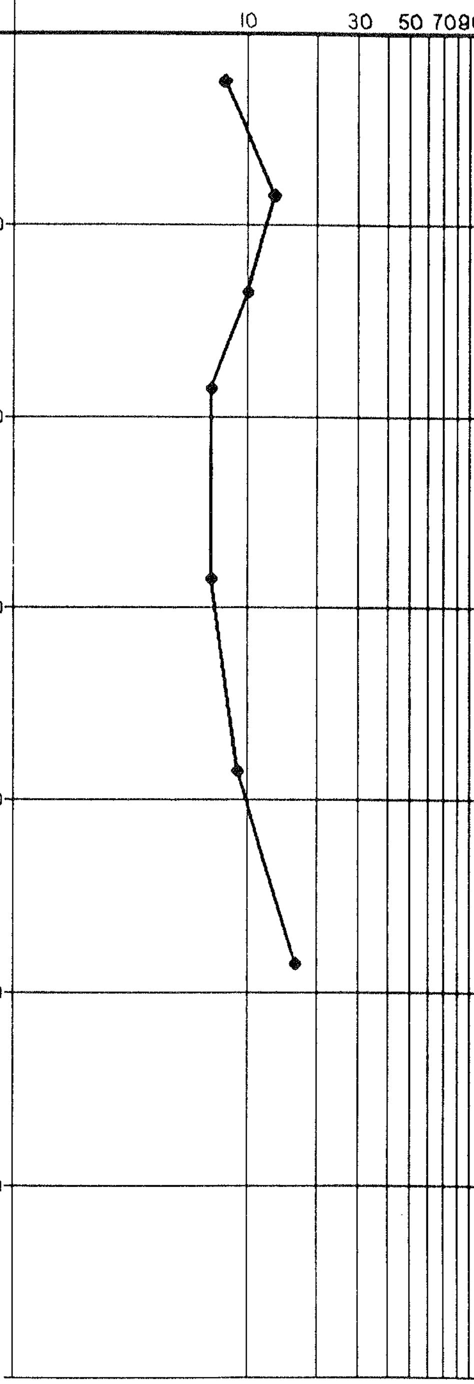
PROJECT: Fieldcrest Cannon – Ash Disposal
Kannapolis, North Carolina

PROJECT NO.:	*1356-95-133*	**ELEVATION:**	*757.0 (Approximate)*
LOGGED BY:	*PGG*	**BORING DEPTH:**	*25.0 FEET*
DATE DRILLED:	*2-3-95*	**WATER LEVEL:**	*14.70 feet, 2/13/95*
DRILLING METHOD:	*4-1/4" HSA*	**DRILL RIG:**	*Mobile B-57*

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	Soil Description	ELEV.
0	Topsoil	757.0
	Residuum: Firm, Reddish Brown, Slightly Micaceous, Slightly Sandy, Clayey **SILT**	
5		752.0
10		747.0
	Firm to Stiff, Grey-Green, Black and Grey, Micaceous **SILT** with Rock Fragments	
15		742.0
20		737.0
25	*Boring terminated at 25.0 feet. Temporary slotted standpipe installed for water level monitoring.*	732.0
30		727.0
35		722.0

Standard Penetration Test Data (Blows/ft)



BPF
8
13
10
7
7
9
16

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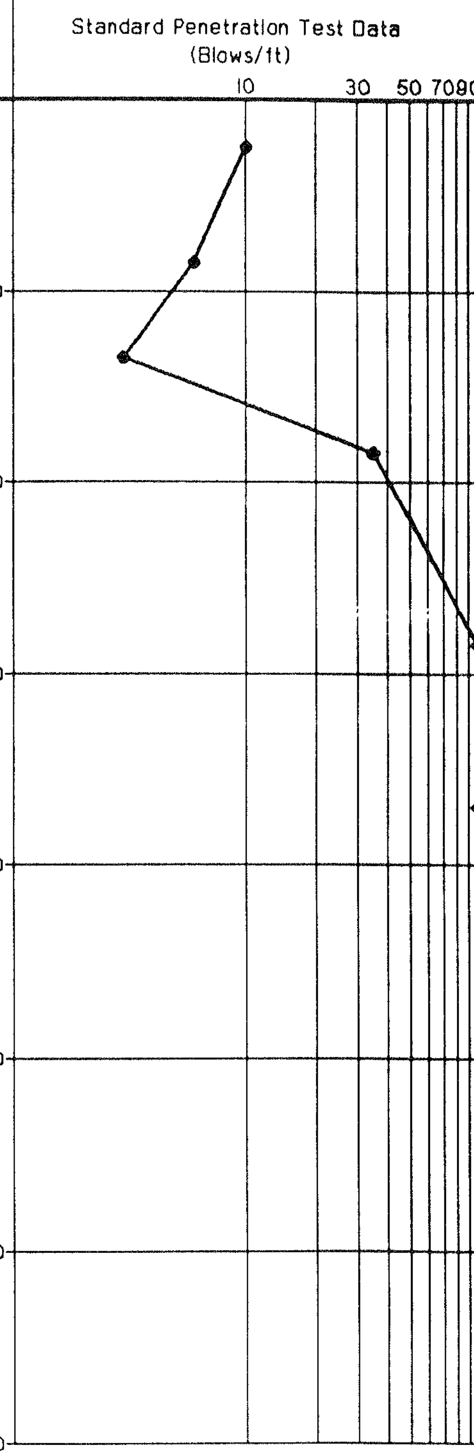
PROJECT:	Fieldcrest Cannon - Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-19

PROJECT NO.: *1356-95-133*	ELEVATION: *718.0 (Approximate)*	NOTES:
LOGGED BY: *PGG*	BORING DEPTH: *18.7 FEET*	Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
DATE DRILLED: *2-6-95*	WATER LEVEL: *8.20 feet, 2/13/95*	
DRILLING METHOD: *4-1/4" HSA*	DRILL RIG: *Mobile B-57*	

DEPTH (ft)	Soil Description	ELEV.	BPF
0–8	Residuum: Stiff Reddish Brown to Grey, Micaceous, Slightly Sandy, Slightly Clayey **SILT**	713.0 (at 5 ft)	8, 6, 4
8–15	Grey Green to Tan, Micaceous, Sandy **SILT**, with Quartz fragments	708.0 (at 10 ft)	8, 50/3"
15–18.7	Partially Weathered Rock, sampled as Grey Green to Tan, Micaceous, Sandy **SILT**, with Quartz fragments	703.0 (at 15 ft)	50/2"
18.7	*Boring terminated at 18.7 feet. Temporary slotted standpipe installed for water level monitoring.*	698.0 (at 20 ft)	

Elevation scale: 713.0, 708.0, 703.0, 698.0, 693.0, 688.0, 683.0 (depths 5–35 ft). Columns: OVM (ppm), WATER LEVEL, SAMPLE, GRAPHIC LOG.



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PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-20

PROJECT NO.:	*1356-95-133*	ELEVATION:	*722.5 (Approximate)*
LOGGED BY:	*PGG*	BORING DEPTH:	*13.7 FEET*
DATE DRILLED:	*2-6-95*	WATER LEVEL:	*9.40 feet, 2/13/95*
DRILLING METHOD:	*4-1/4" HSA*	DRILL RIG:	*Mobile B-57*

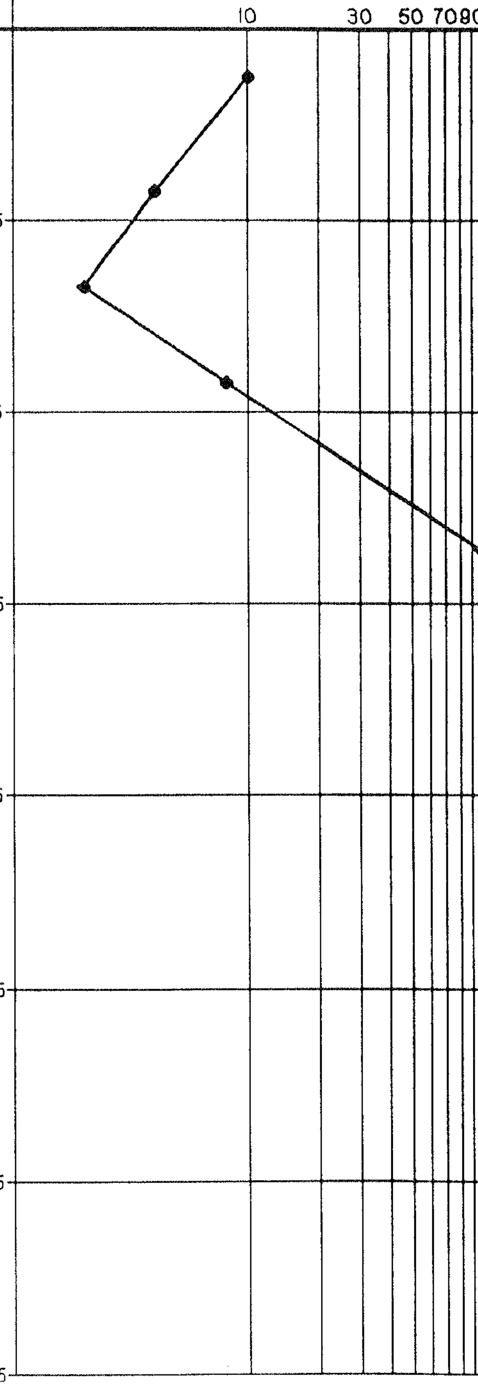
NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	Soil Description	ELEV.	BPF
0 – 8	Residuum: Stiff Reddish Brown to Grey, Micaceous, Slightly Sandy, Slightly Clayey **SILT**		8, 6, 4
8 – 13	Grey Green to Tan, Micaceous, Sandy **SILT**, with Quartz fragments		8
13 – 13.7	Partially Weathered Rock, sampled as Grey Green to Tan, Micaceous, Sandy **SILT**, with Quartz fragments		50/2"

Boring terminated at 13.7 feet.
Temporary slotted standpipe installed for water level monitoring.

Depth scale (ft): 5, 10, 15, 20, 25, 30, 35
Elevation scale: 717.5, 712.5, 707.5, 702.5, 697.5, 692.5, 687.5

Standard Penetration Test Data (Blows/ft)



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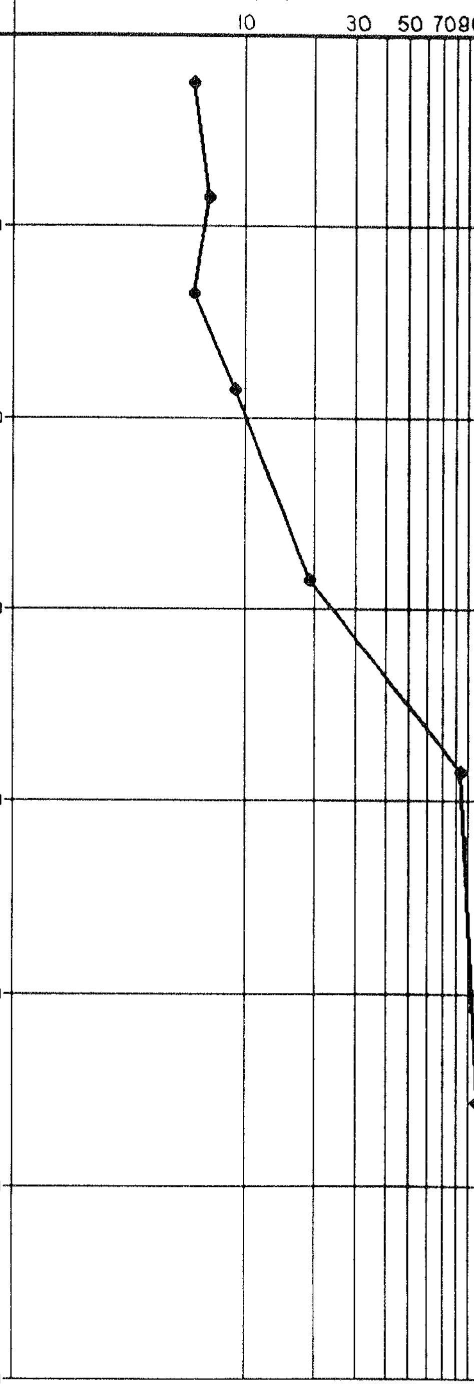
PROJECT:	Fieldcrest Cannon - Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-21

PROJECT NO.:	1356-95-133	ELEVATION:	743.0 (Approximate)
LOGGED BY:	PGG	BORING DEPTH:	23.9 FEET
DATE DRILLED:	2-3-95	WATER LEVEL:	19.50 feet, 2/13/95
DRILLING METHOD:	4-1/4" HSA	DRILL RIG:	Mobile B-57

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	GRAPHIC LOG	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.
0–12		Residuum: Firm, Light Brown to Tan, Micaceous, Slightly Fine Sandy **SILT**				
12–19.4		Medium Dense, White, Black and Grey to Tan, Slightly Micaceous, Silty, Fine to Medium **SAND**		▼		
19.4–23.9		Partially Weathered Rock, sampled as White, Black, Grey and Tan, Slightly Micaceous, Slightly Silty, Fine to Coarse **SAND** with Quartz fragments				
		Boring terminated at 23.9 feet. Temporary slotted standpipe installed for water level monitoring.				

Depth scale: 5, 10, 15, 20, 25, 30, 35
Elevation scale: 738.0, 733.0, 728.0, 723.0, 718.0, 713.0, 708.0



BPF
8
7
8
9
19
84
50/5"

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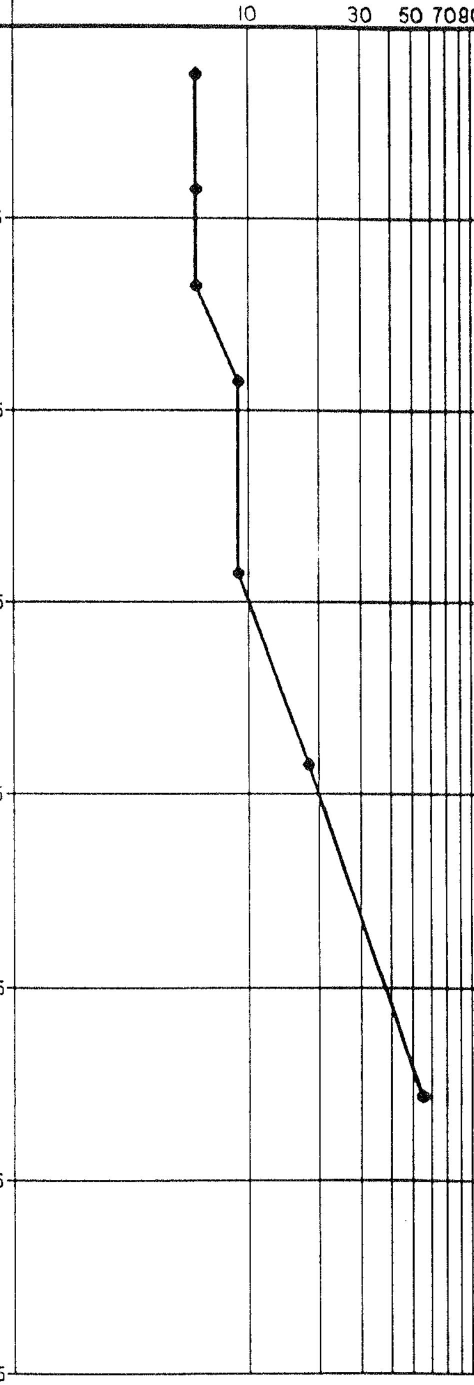
PROJECT:	Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD	B-22

PROJECT NO.:	*1356-95-133*	ELEVATION:	*742.5 (Approximate)*
LOGGED BY:	*PGG*	BORING DEPTH:	*25.0 FEET*
DATE DRILLED:	*2-3-95*	WATER LEVEL:	*16.57 feet, 2/13/95*
DRILLING METHOD:	*4-1/4" HSA*	DRILL RIG:	*Mobile B-57*

NOTES:
Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.

DEPTH (ft)	GRAPHIC LOG	Soil Description	OVM (ppm)	WATER LEVEL	SAMPLE	ELEV.	Standard Penetration Test Data (Blows/ft)	BPF
0–25		Residuum: Firm to Very Stiff, Tan to Brownish Orange, Micaceous, Slightly Sandy **SILT**, with small rock fragments		▼ (at about 15 ft)				6, 6, 6, 9, 9, 18, 55
25		*Boring terminated at 25.0 feet. Temporary slotted standpipe installed for water level monitoring.*				717.5		

Depth scale: 5, 10, 15, 20, 25, 30, 35
Elevation scale: 737.5, 732.5, 727.5, 722.5, 717.5, 712.5, 707.5



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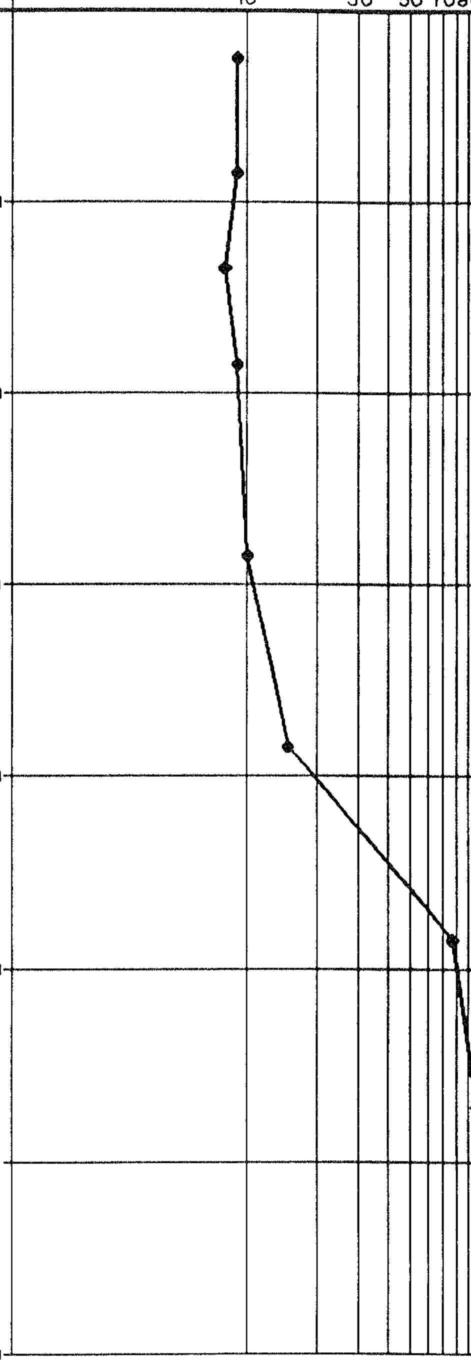
PROJECT: Fieldcrest Cannon – Ash Disposal, Kannapolis, North Carolina	TEST BORING RECORD B-23

PROJECT NO.: 1358-95-133	**ELEVATION:** 751.0 (Approximate)	**NOTES:** Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY: PGG	**BORING DEPTH:** 28.8 FEET	
DATE DRILLED: 2-6-95	**WATER LEVEL:** 23.20 feet, 2/13/95	
DRILLING METHOD: 4-1/4" HSA	**DRILL RIG:** Mobile B-57	

DEPTH (ft)	Soil Description	ELEV.
	Topsoil	
	Residuum: Stiff, Reddish Brown, Slightly Micaceous, Slightly Sandy, Clayey **SILT**	
5		746.0
	Firm to Stiff, Reddish Brown to Tan, Slightly Micaceous, Slightly Clayey, Sandy **SILT**, with rock fragments	
10		741.0
15		736.0
20		731.0
	Stiff to Very Hard, White, Black, and Grey, Slightly Micaceous, Fine to Medium Sandy **SILT** with rock fragments	
25		726.0
	Partially Weathered Rock, sampled as Wet, Dark Grey, Tan and Black, Micaceous, Fine Sandy Silt	
30		721.0
	Boring terminated at 28.8 feet *Temporary slotted standpipe installed for water level monitoring.*	
35		716.0

Standard Penetration Test Data (Blows/ft)



BPF: 9, 9, 8, 9, 10, 15, 77, 50/4"

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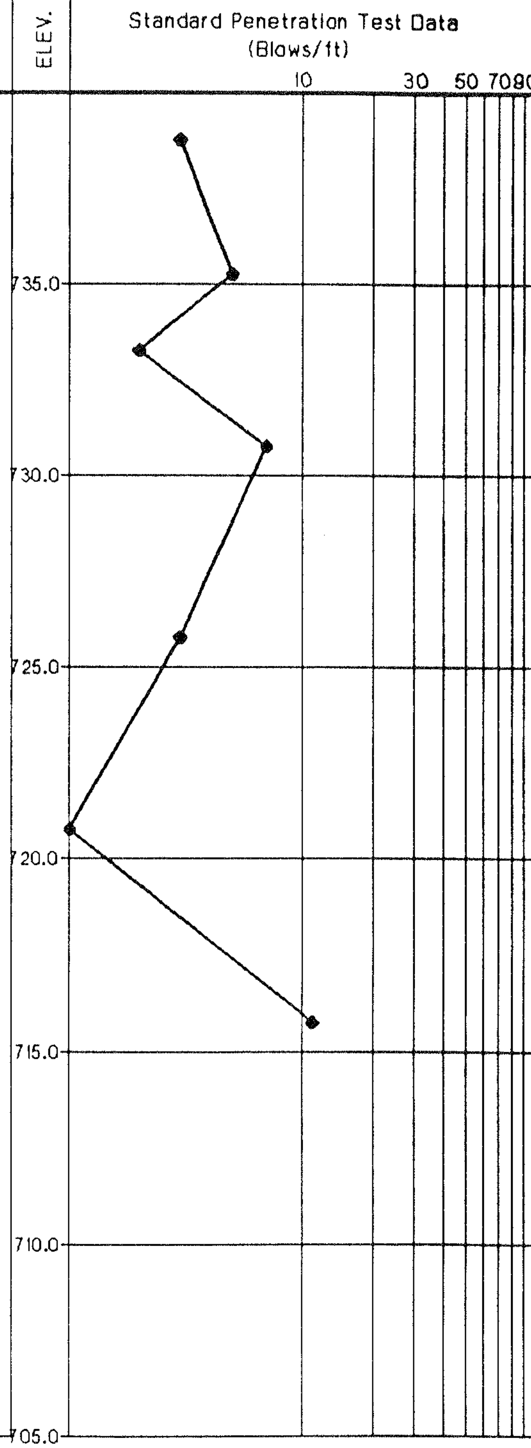
PROJECT: Fieldcrest Cannon – Ash Disposal Kannapolis, North Carolina	TEST BORING RECORD B-24

PROJECT NO.: *1358-95-133*	ELEVATION: *740.0 (Approximate)*	NOTES: Water level on 2/13/95 measured from top of standpipe. Groundsurface elevation estimated to nearest 0.5 foot.
LOGGED BY: *PGG*	BORING DEPTH: *25.0 FEET*	
DATE DRILLED: *2-8-95*	WATER LEVEL: *16.40 feet, 2/13/95*	
DRILLING METHOD: *4-1/4" HSA*	DRILL RIG: *Mobile B-57*	

DEPTH (ft)	Soil Description	ELEV.	BPF
0–8.5	Fill: **FLY ASH**, sampled as Soft, Black to Dark Grey Silt		3, 5, 2
8.5–11	Firm, Brown to Tan and Orange, Micaceous, Fine Sandy **SILT**	730.0 (at 10 ft)	7
11–15	**FLY ASH**, sampled as Moist, Black to Dark Grey, Very Silty, Fine Sand	725.0 (at 15 ft)	3
15–22	Wet, **FLY ASH**	720.0 (at 20 ft)	WH
22–25	Residuum: Wet, Greenish Grey and White, Micaceous, Fine to Medium Sandy **SILT**	715.0 (at 25 ft)	11
25	*Boring terminated at 25.0 feet. Temporary slotted standpipe installed for water level monitoring.*		



S&ME Environmental Services Engineering * Testing

FIELD PERMEABILITY
TEST DATA SHEETS

PROJECT NAME:	FIELDCREST CANNON ASH DISPOSAL FACILITY	WELL ID:	B-1
PROJECT NUMBER:	1356-94-133	TEST DATE:	2-22-95

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER	=	26.00	FT
DEPTH TO WATER	=	19.63	FT
DEPTH TO TOP OF SAND	=	14.38	FT
DEPTH TO BASE OF SCREEN	=	24.38	FT
CASING DIAMETER	=	2.00	IN
BOREHOLE DIAMETER	=	3.25	IN
SAND PACK POROSITY	=	0.40	

HYDRAULIC CONDUCTIVITY

FT/MIN =	3.58E-04
FT/DAY =	5.15E-01
GPD/FT2 =	3.85E+00
CM/SEC =	1.82E-04

rW =	0.135	FT	L/rW =	73.85
H =	4.75	FT	A =	3.72
D =	6.37	FT	B =	0.60
L =	10.00	FT	C =	3.50
rC =	0.107	FT		
rC =	0.107	FT	ln(D-H/rW) =	2.48
Yo =	2.386	FT	ln(Re/rW) =	2.63
t =	2.000	MIN		
Yt =	1.488	FT		

SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG(Yt) (FT)
0.08	17.30	2.33	0.37
0.25	17.34	2.29	0.36
0.50	17.49	2.14	0.33
0.75	17.62	2.01	0.30
1.00	17.74	1.89	0.28
1.25	17.87	1.76	0.25
1.50	17.95	1.68	0.23
1.75	18.06	1.57	0.20
2.00	18.16	1.47	0.17
2.25	18.24	1.39	0.14
2.50	18.31	1.32	0.12
2.75	18.38	1.25	0.10
3.00	18.45	1.18	0.07
3.50	18.58	1.05	0.02
4.00	18.70	0.93	-0.03
4.50	18.81	0.82	-0.09
5.00	18.90	0.73	-0.14
6.00	19.07	0.56	-0.25
7.00	19.20	0.43	-0.37
8.00	19.30	0.33	-0.48
9.00	19.39	0.24	-0.62
10.50	19.50	0.13	-0.89

RANGE FOR REGRESSION

INITIAL TIME	=	0.5	min
FINAL TIME	=	4	min

Regression Output:

Constant		0.378
Std Err of Y Est		0.003
R Squared		0.999
No. of Observations		13
Degrees of Freedom		11
X Coefficient(s)	-0.1026	
Std Err of Coef.	0.0008	

METHOD:

BOUWER & RICE

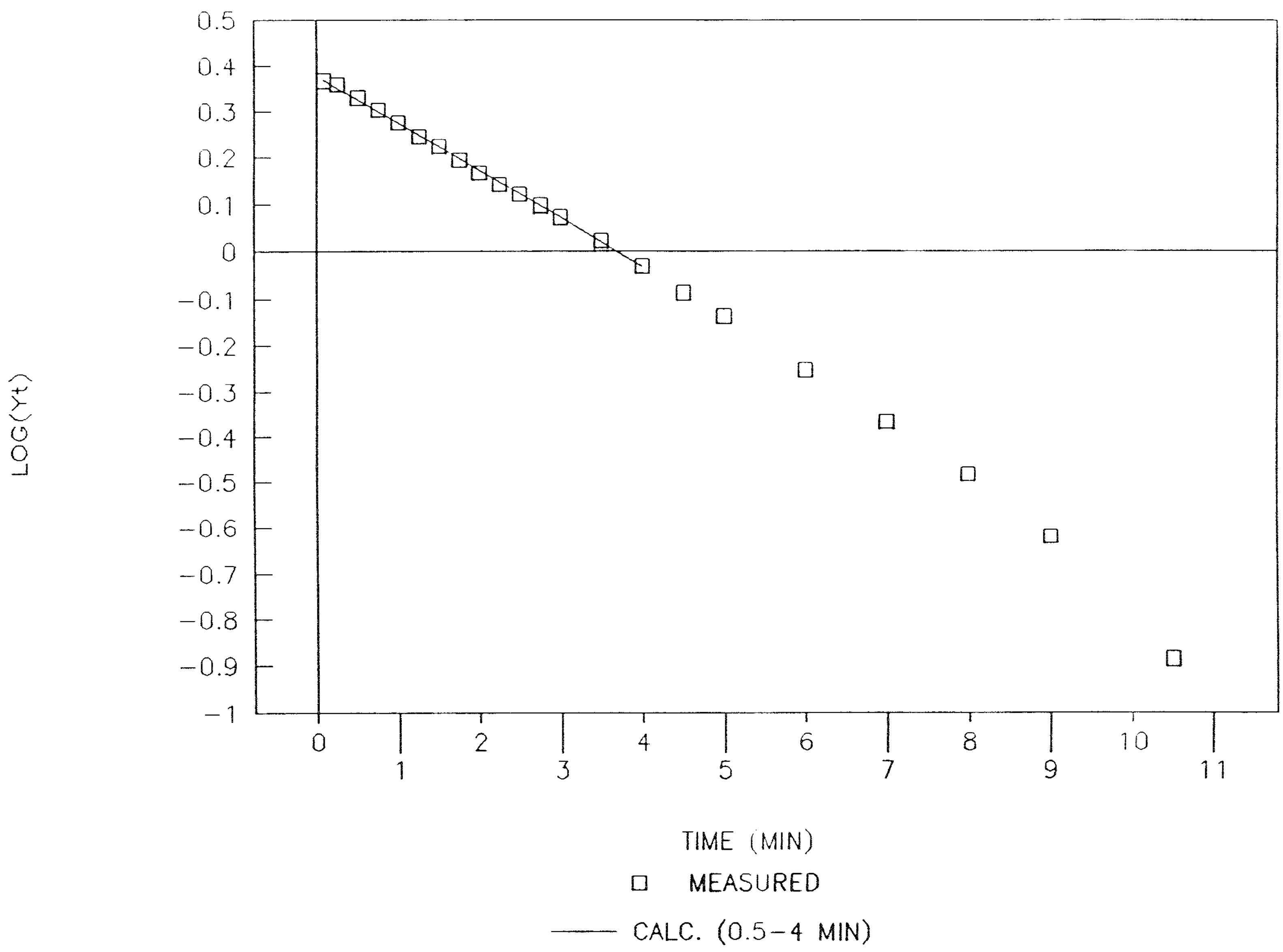
"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989

FIELDCREST CANNON

B-1



PROJECT NAME: FIELDCREST CANNON ASH DISPOSAL FACILITY
PROJECT NUMBER: 1356−94−133

WELL ID: B−8
TEST DATE: 2−22−95

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER	=	21.80	FT
DEPTH TO WATER	=	13.11	FT
DEPTH TO TOP OF SAND	=	9.85	FT
DEPTH TO BASE OF SCREEN	=	19.85	FT
CASING DIAMETER	=	2.00	IN
BOREHOLE DIAMETER	=	3.25	IN
SAND PACK POROSITY	=	0.40	

HYDRAULIC CONDUCTIVITY

FT/MIN =	1.20E−04
FT/DAY =	1.72E−01
GPD/FT2 =	1.29E+00
CM/SEC =	6.08E−05

rW =	0.135	FT	L/rW =	73.85
H =	6.74	FT	A =	3.72
D =	8.69	FT	B =	0.60
L =	10.00	FT	C =	3.50
rC =	0.107	FT		
rC =	0.107	FT	ln(D−H/rW) =	2.67
Yo =	1.166	FT	ln(Re/rW) =	2.83
t =	2.000	MIN		
Yt =	1.007	FT		

SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG(Yt) (FT)
0.13	11.92	1.19	0.08
0.28	11.96	1.15	0.06
0.50	11.98	1.13	0.05
0.75	12.01	1.10	0.04
1.00	12.03	1.08	0.03
1.50	12.07	1.04	0.02
2.00	12.11	1.00	0.00
3.00	12.19	0.92	−0.04
3.50	12.21	0.90	−0.05
4.00	12.24	0.87	−0.06
4.50	12.28	0.83	−0.08
5.00	12.31	0.80	−0.10
6.00	12.38	0.73	−0.14
7.00	12.41	0.70	−0.15
8.00	12.45	0.66	−0.18
9.00	12.50	0.61	−0.21
10.00	12.52	0.59	−0.23
12.00	12.59	0.52	−0.28
14.00	12.65	0.46	−0.34
16.00	12.71	0.40	−0.40
18.00	12.75	0.36	−0.44
20.00	12.78	0.33	−0.48
22.00	12.81	0.30	−0.52
24.00	12.83	0.28	−0.55

RANGE FOR REGRESSION

INITIAL TIME	=	0.13	min
FINAL TIME	=	9	min

Regression Output:

Constant	0.067
Std Err of Y Est	0.006
R Squared	0.996
No. of Observations	16
Degrees of Freedom	14
X Coefficient(s)	−0.0320
Std Err of Coef.	0.0006

METHOD:

BOUWER & RICE

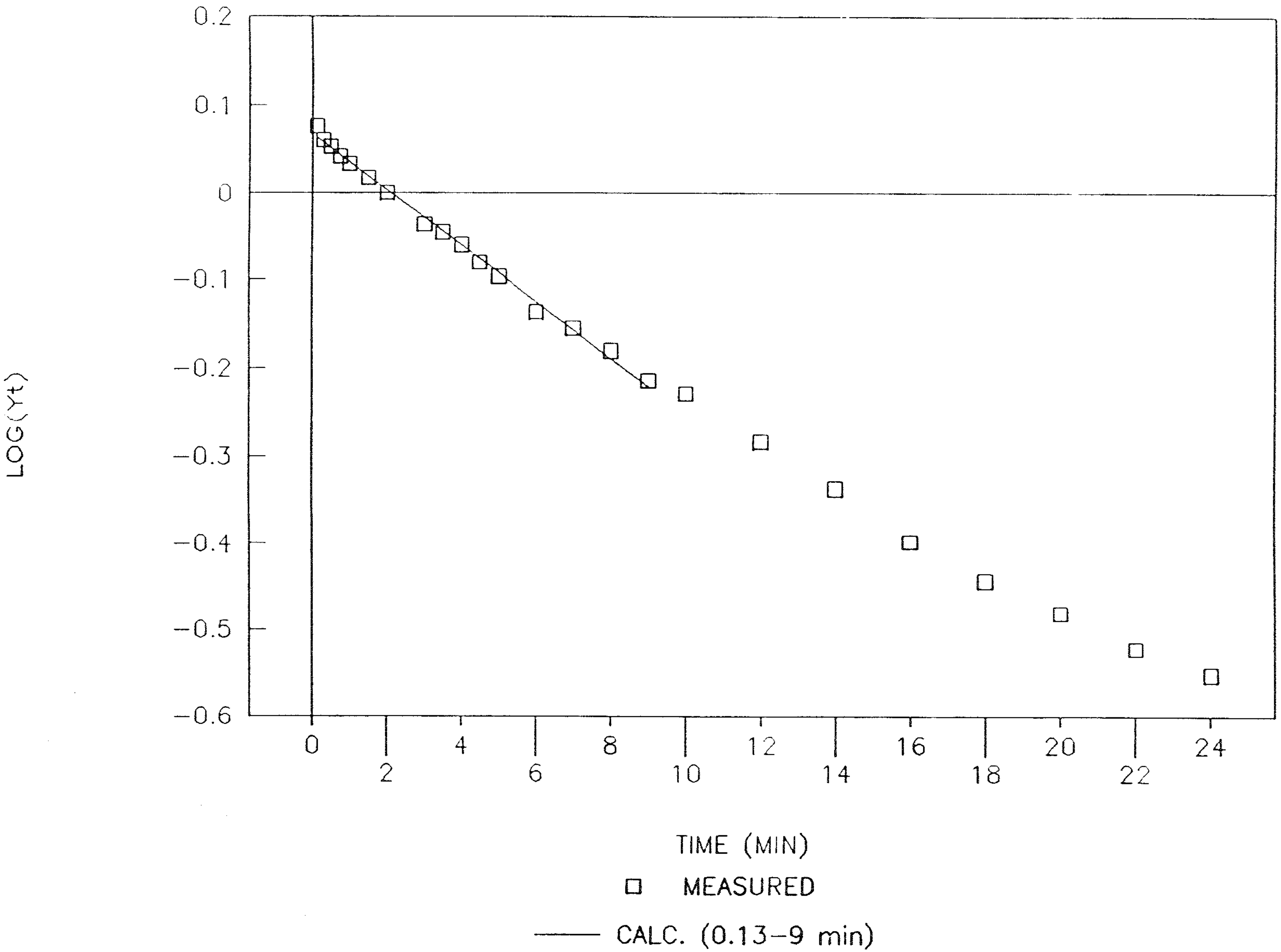
"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST – AND UPDATE", 1989

FIELDCREST CANNON

B-8



PROJECT NAME: FIELDCREST CANNON ASH DISPOSAL FACILITY
PROJECT NUMBER: 1356-94-133

WELL ID: B-24
TEST DATE: 2-22-95

LEVELS MEASURED RELATIVE TO TOP OF CASING OR MEASURING POINT

DEPTH TO BASE OF AQUIFER	=	30.00	FT
DEPTH TO WATER	=	22.57	FT
DEPTH TO TOP OF SAND	=	18.95	FT
DEPTH TO BASE OF SCREEN	=	28.95	FT
CASING DIAMETER	=	2.00	IN
BOREHOLE DIAMETER	=	3.25	IN
SAND PACK POROSITY	=	0.40	

HYDRAULIC CONDUCTIVITY

FT/MIN =	**1.96E-03**
FT/DAY =	**2.82E+00**
GPD/FT2 =	**2.11E+01**
CM/SEC =	**9.95E-04**

rW =	0.135	FT	L/rW =	73.85
H =	6.38	FT	A =	3.72
D =	7.43	FT	B =	0.60
L =	10.00	FT	C =	3.50
rC =	0.107	FT		
rC =	0.107	FT	ln(D-H/rW) =	2.05
Yo =	1.575	FT	ln(Re/rW) =	2.84
t =	2.000	MIN		
Yt =	0.143	FT		

SLUG TEST DATA

TIME (MIN)	DTW (FT)	Yt (FT)	LOG(Yt) (FT)
0.12	20.65	1.92	0.28
0.20	21.30	1.27	0.10
0.33	21.55	1.02	0.01
0.50	21.68	0.89	-0.05
0.67	21.85	0.72	-0.14
0.83	22.00	0.57	-0.24
1.00	22.11	0.46	-0.34
1.25	22.22	0.35	-0.46
1.50	22.32	0.25	-0.60
1.83	22.40	0.17	-0.77
2.00	22.42	0.15	-0.82
2.25	22.46	0.11	-0.96
2.50	22.49	0.08	-1.10
2.75	22.51	0.06	-1.22
3.00	22.53	0.04	-1.40
3.25	22.53	0.04	-1.40
3.50	22.54	0.03	-1.52
4.00	22.56	0.01	-2.00

RANGE FOR REGRESSION

INITIAL TIME	=	0.2	min
FINAL TIME	=	3	min

Regression Output:

Constant		0.197
Std Err of Y Est		0.017
R Squared		0.999
No. of Observations		14
Degrees of Freedom		12
X Coefficient(s)	-0.5216	
Std Err of Coef.	0.0050	

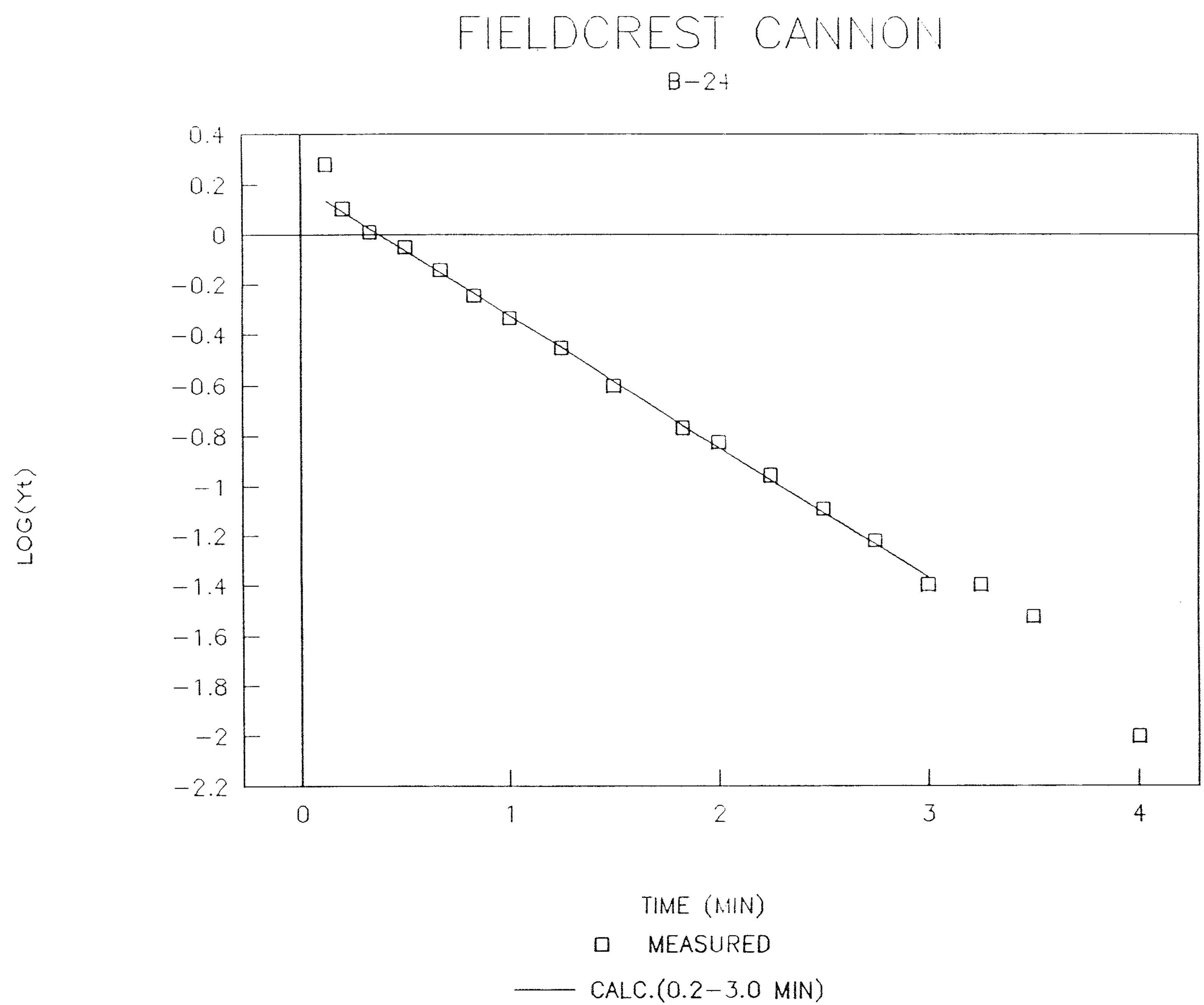
METHOD:

BOUWER & RICE

"A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFER WITH COMPLETELY OR PARTIALLY PENETRATING WELLS", 1976

AND

"THE BOUWER AND RICE SLUG TEST - AND UPDATE", 1989


FIELDCREST CANNON
B-24
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
LOG(Yt)
0
1
2
3
4
TIME (MIN)
MEASURED
CALC.(0.2-3.0 MIN)

APPENDIX II

LABORATORY TESTING PROCEDURES AND RESULTS

LABORATORY TESTING PROCEDURES

LABORATORY PROCEDURES

Moisture Content: The moisture content of selected samples was determined. 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. The test results are presented on the Summary of Laboratory Test Data sheets.

Grain Size Test: 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. The results are presented on the attached Grain Size Distribution sheets.

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. The data obtained is presented on the Summary of Laboratory Test Data sheets and Grain Size Distribution sheets.

Specific Gravity: The specific 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. The results of the test are presented on the Summary of Laboratory Test Data sheets.

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.

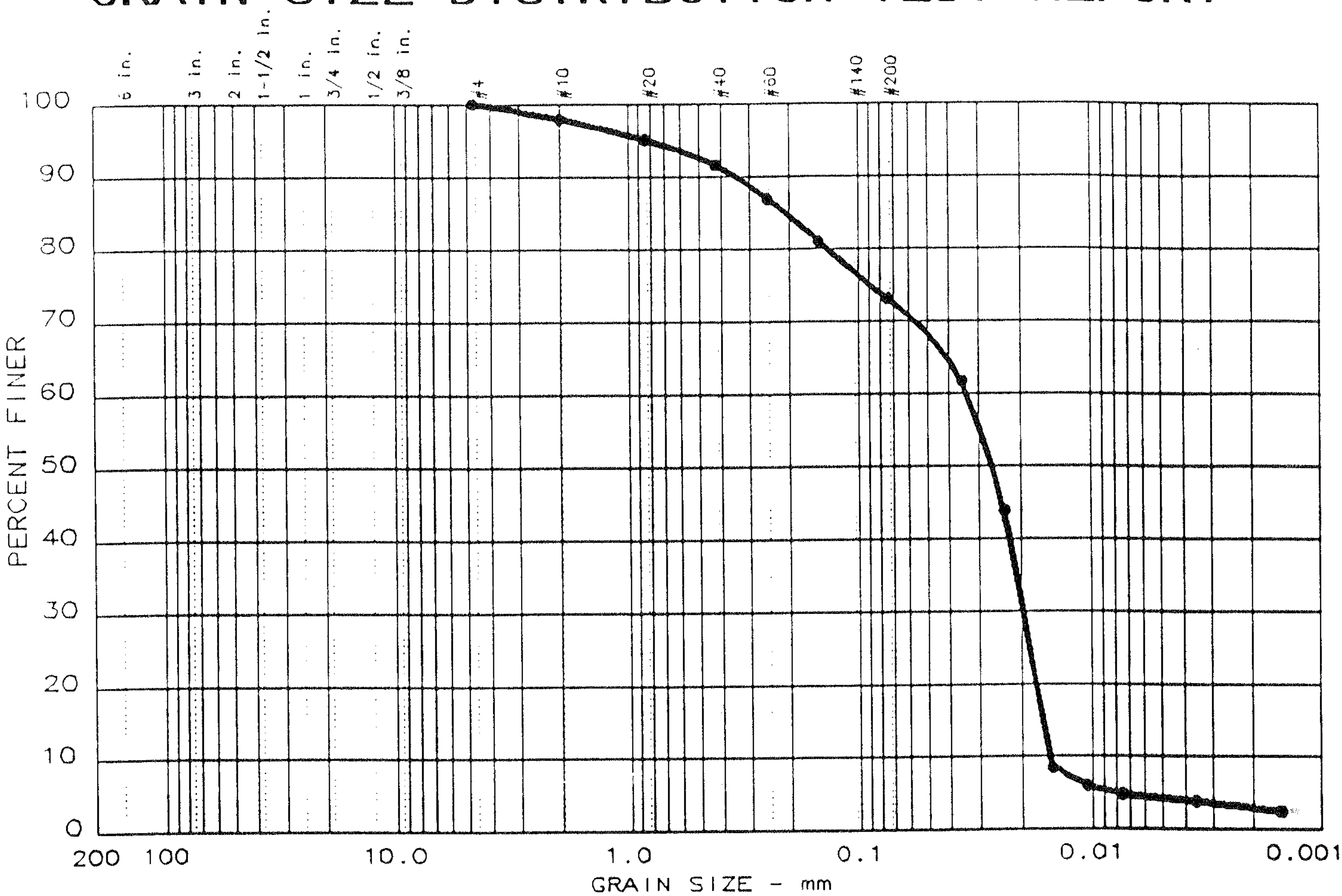
Permeability Test: The coefficient of permeability, k, of selected samples was estimated in the laboratory by testing the samples in a constant head permeameter. The sample and apparatus dimensions were carefully measured and the sample saturated prior to initiating the test. A head was then applied 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.

Standard Proctor Compaction Test: Representative samples of the on-site and borrow soils were obtained from auger cuttings to determine their suitability as 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.

Consolidation Test: A single section of the undisturbed sample from boring B-3 was extruded from the sampling tube for consolidation testing. The section was trimmed into a disk 2.5 inches in diameter and one inch thick. The disc was confined in a stainless steel ring and sandwiched between porous stones. The sample was then subjected to incrementally increasing vertical loads and the resulting deformations measured with a micrometer dial gauge. The results are presented in the form of a pressure versus percent strain curve on the accompanying Consolidation Test sheet.

LABORATORY TEST DATA SHEETS

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	27.0	68.8	4.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.21		0.03	0.020	0.0162	0.0152	0.75	2.2

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK SL. CLAYEY MEDIUM TO FINE SANDY SILT	ML	

Project No.: 1356-95-133
Project: FIELDCREST CANNON
● Location: B-24; 2-4'; UD

Date: 3/24/95

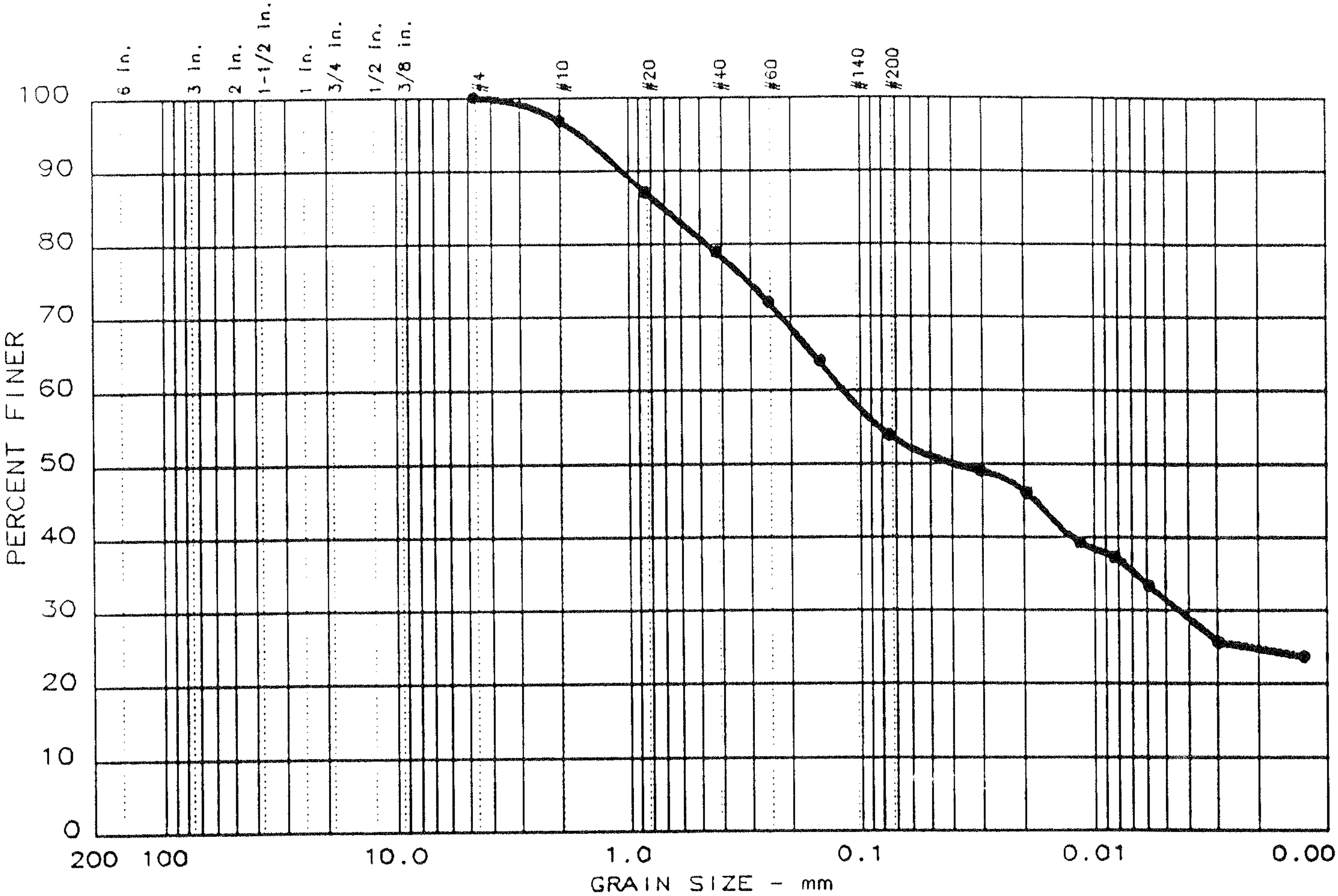
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

S&ME

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	46.1	22.4	31.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	55	5	0.72	0.12	0.04	0.004				

	MATERIAL DESCRIPTION	USCS	AASHTO
●	ORANGE TAN SILTY CLAYEY M-F SAND	ML	

Project No.: 1356-95-133

Project: FIELDCREST CANNON

● Location: B-23 ; 1-6' ; BAG

Date: 2/28/95

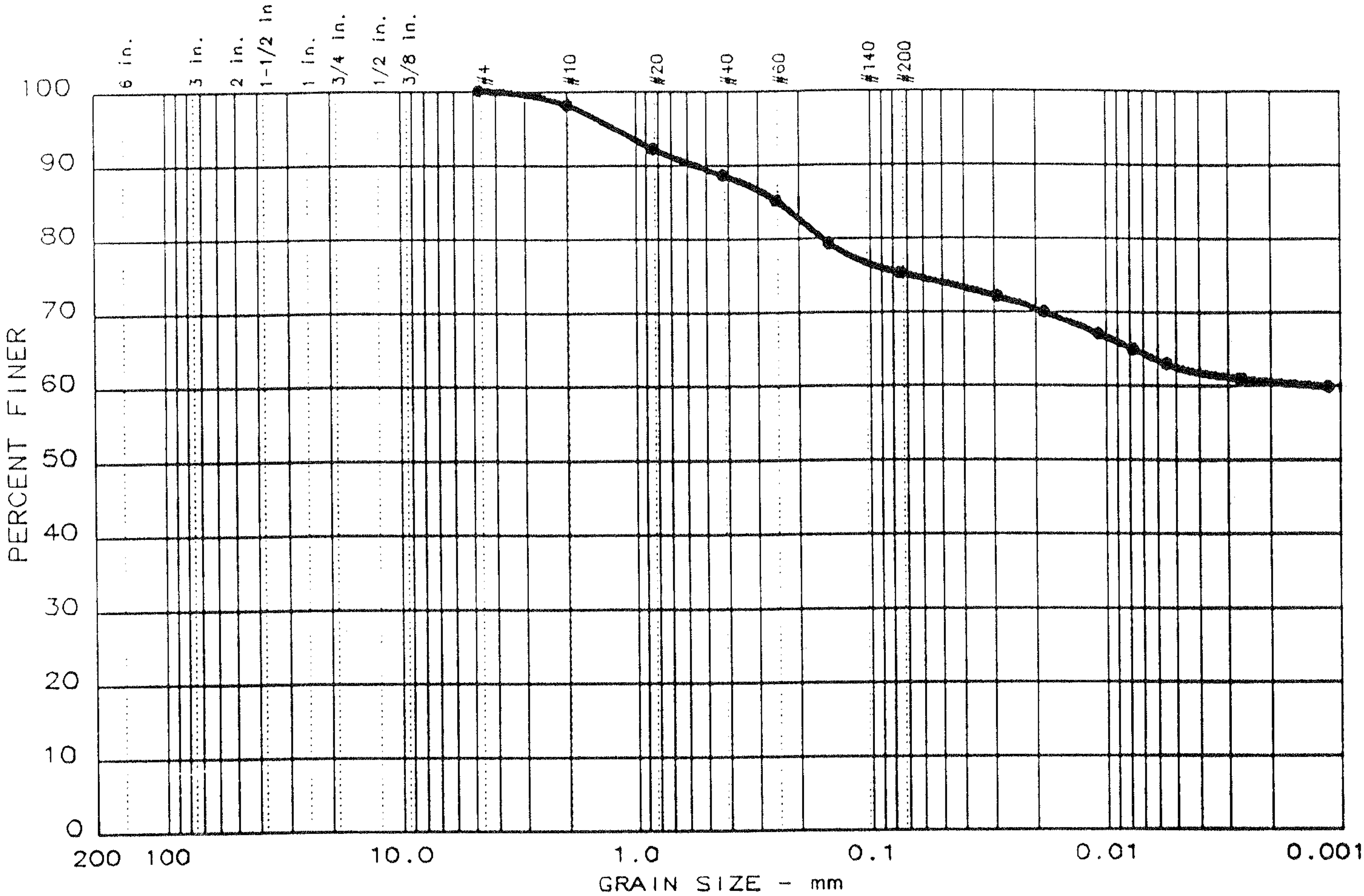
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

S&ME

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	18	0.0	0.0	24.7	12.9	62.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	86	40	0.25							

MATERIAL DESCRIPTION	USCS	AASHTO
● RED BROWN SILTY M-F SANDY CLAY	CH	

Project No.: 1356-95-133

Project: FIELDCREST CANNON

● Location: B-18; S-1; .5-2.0; SS

Date: 3/6/95

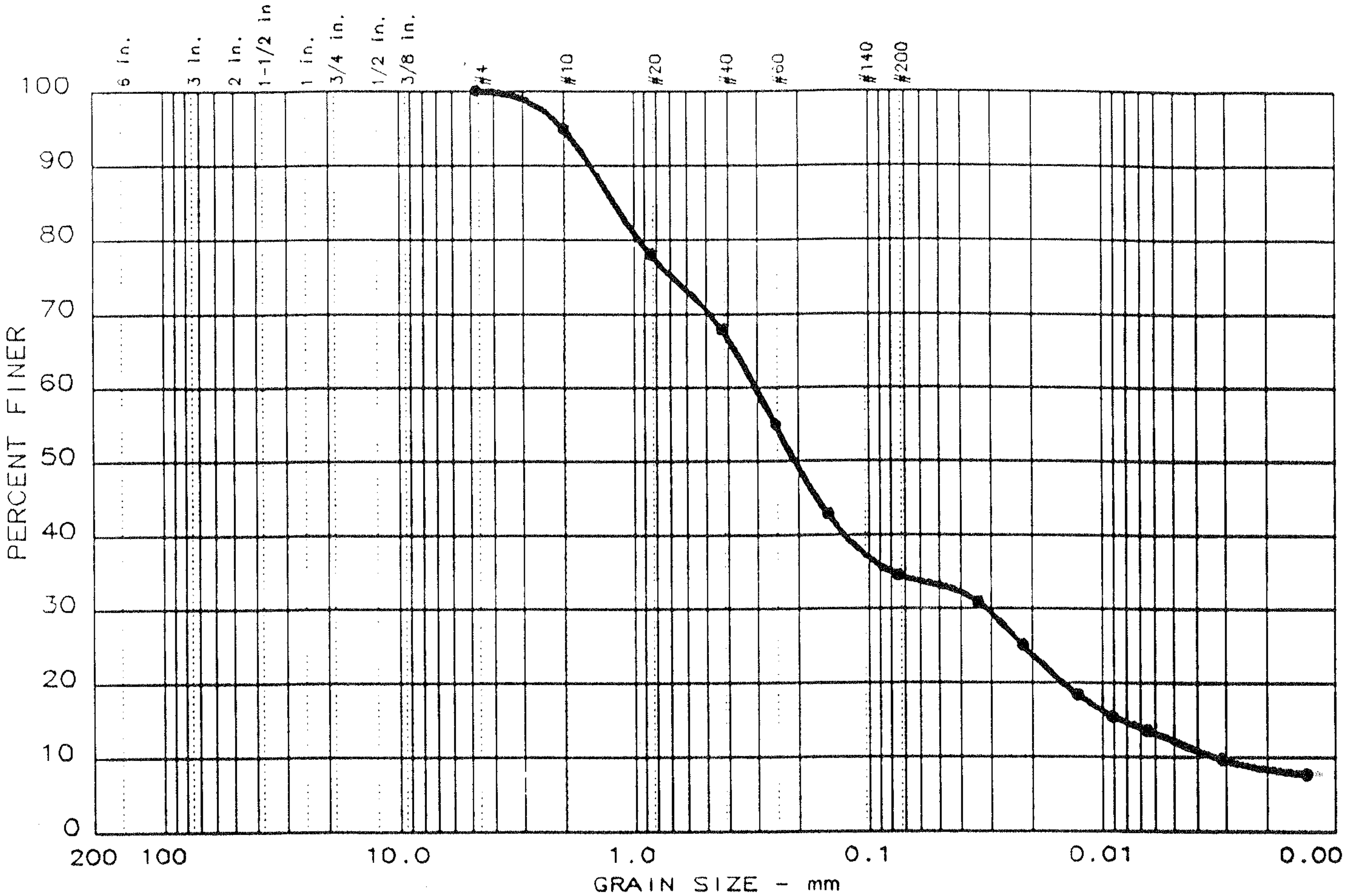
GRAIN SIZE DISTRIBUTION TEST REPORT

S&ME

Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	65.5	22.5	12.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	54	4	1.20	0.30	0.21	0.031	0.0085	0.0034	0.95	89.1

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN CLAYEY SILTY SAND	ML	

Project No.: 1356-95-133

Project: FIELDCREST CANNON

● Location: B-18; S-3; 6-7.5'; SS

Date: 3/8/95

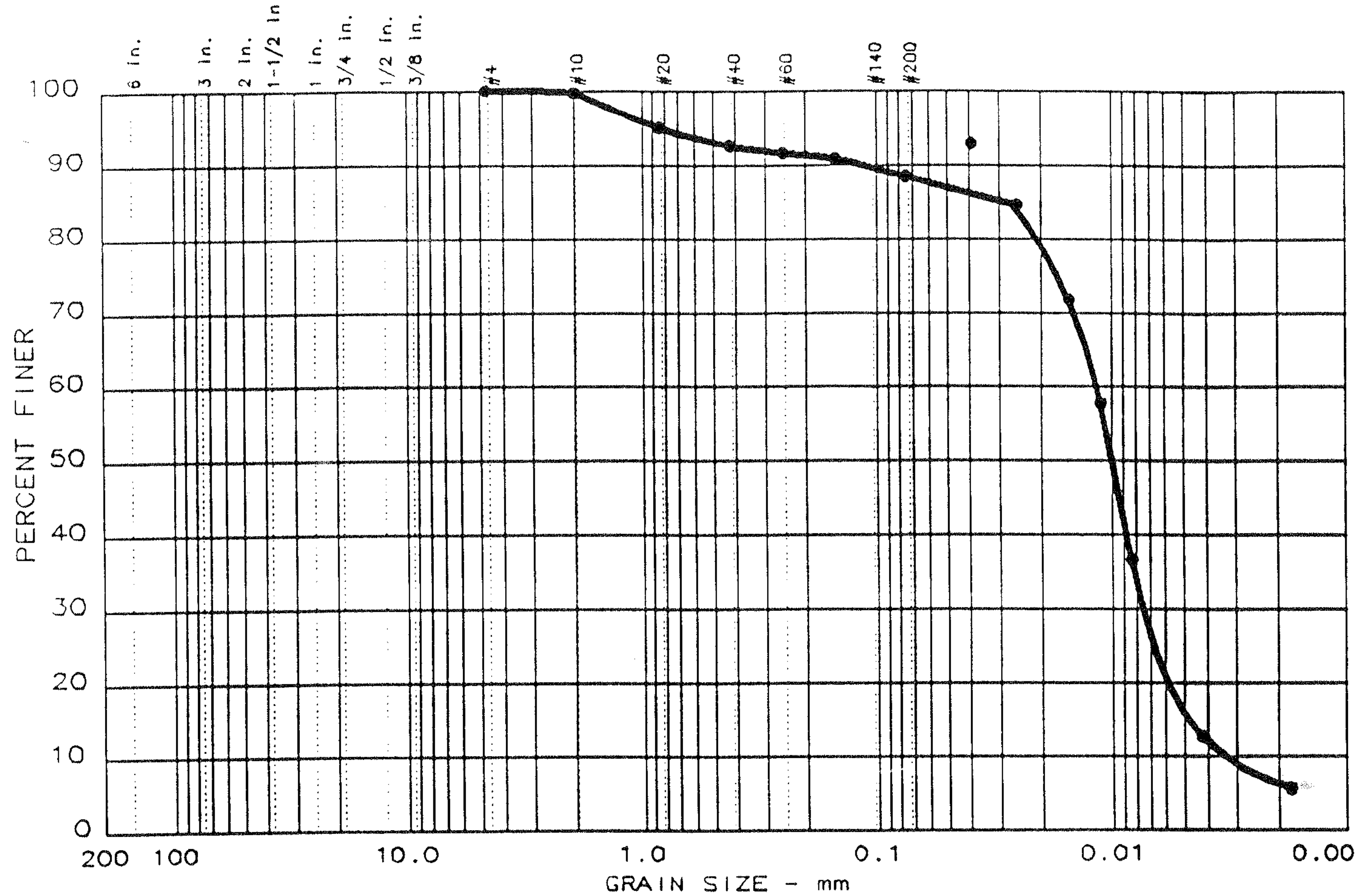
Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT

S&ME

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	11.6	72.6	15.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.01	0.007	0.0047	0.0034	1.42	3.5

MATERIAL DESCRIPTION	USCS	AASHTO
● BLACK GRAY CLAYEY MEDIUM TO FINE SANDY SILT	ML	

Project No.: 1356-95-133
Project: FIELDCREST CANNON
● Location: B-1 ; 17-19'; UD

Date: 3/14/95

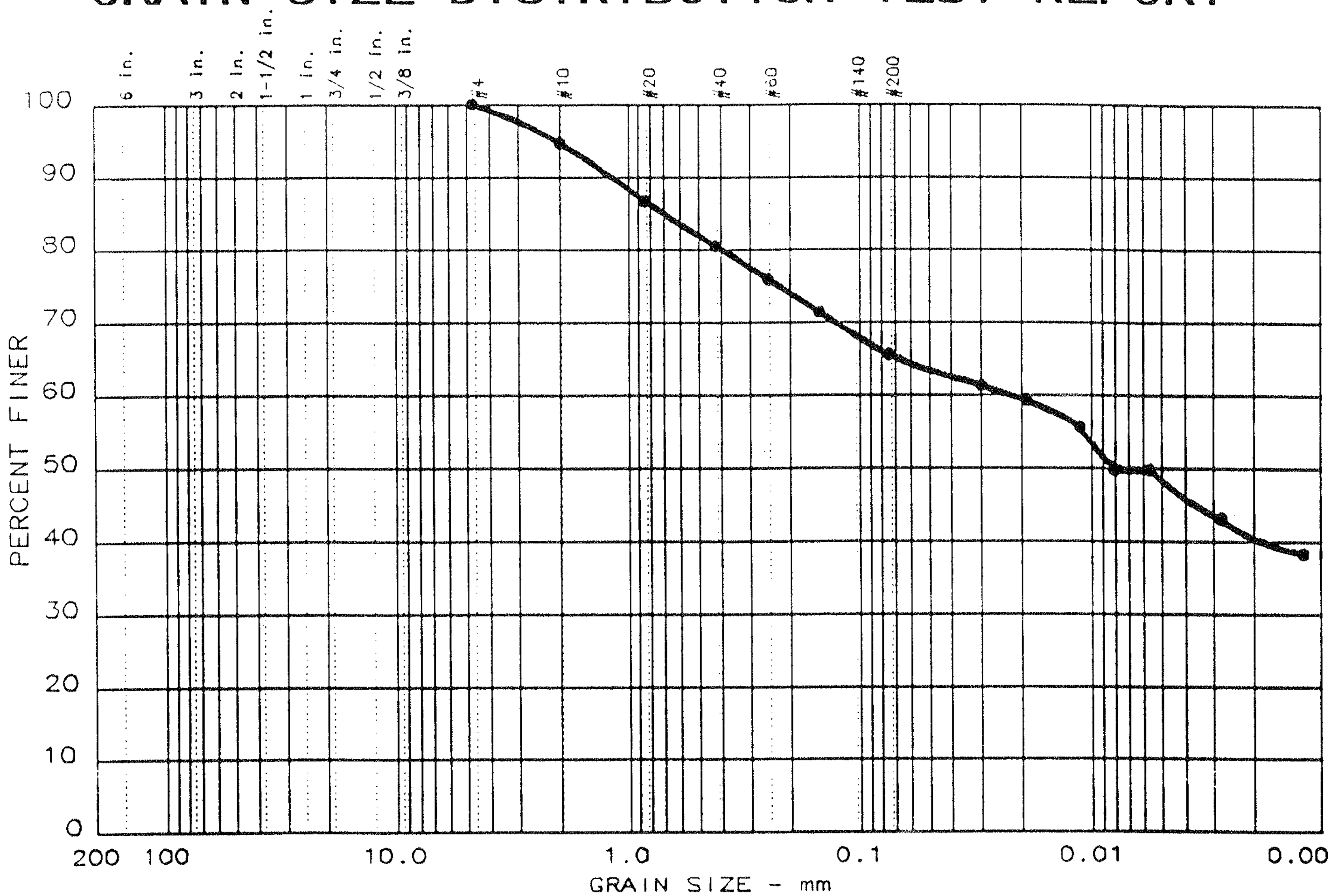
GRAIN SIZE DISTRIBUTION TEST REPORT

S&ME

Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	34.5	17.3	48.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	62	35	0.71		0.01					

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN SILTY M-F SANDY CLAY	CH	

Project No.: 1356-95-133

Project: FIELDCREST CANNON

● Location: B-7; S-2; 3.5-5'; SS

Date: 3/8/95

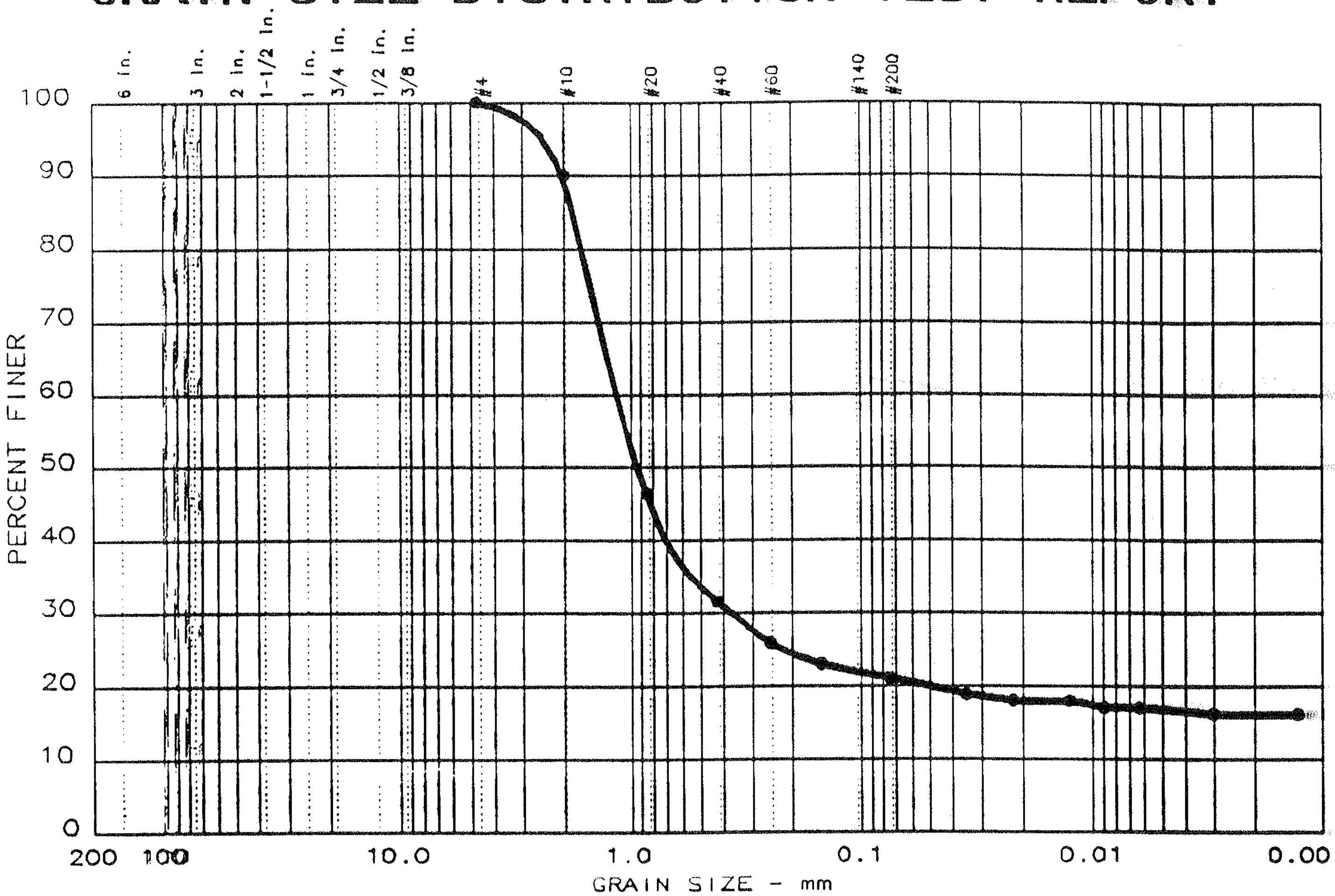
GRAIN SIZE DISTRIBUTION TEST REPORT

S&ME

Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	79.0	4.2	16.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	54	26	1.82	1.16	0.94	0.373				

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN BROWN SLIGHTLY SILTY CLAYEY M-F SAND	SC	

Project No.: 1356-95-133
Project: FIELDCREST CANNON
● Location: B-7; S-4; 8.5-10'; SS

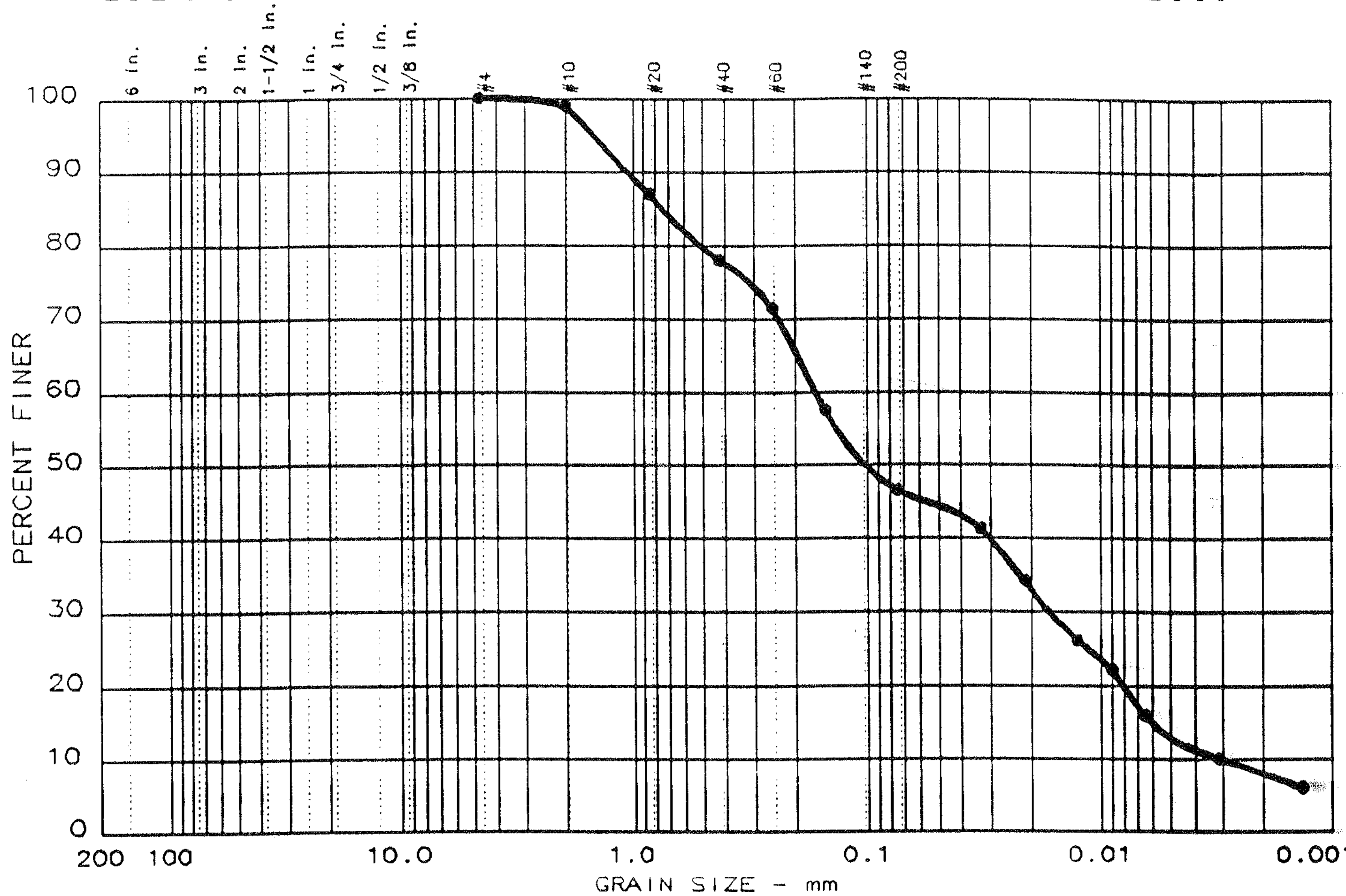
Date: 3/6/95

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
S&ME

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	53.6	33.7	12.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	53	8	0.74	0.16	0.10	0.017	0.0060	0.0031	0.56	53.1

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN CLAYEY SILTY MEDIUM TO FINE SAND	SM	

Project No.: 1356-95-133
Project: FIELDCREST CANNON
● Location: B-12; S-2; 3.5-5'; SS

Date: 3/8/95

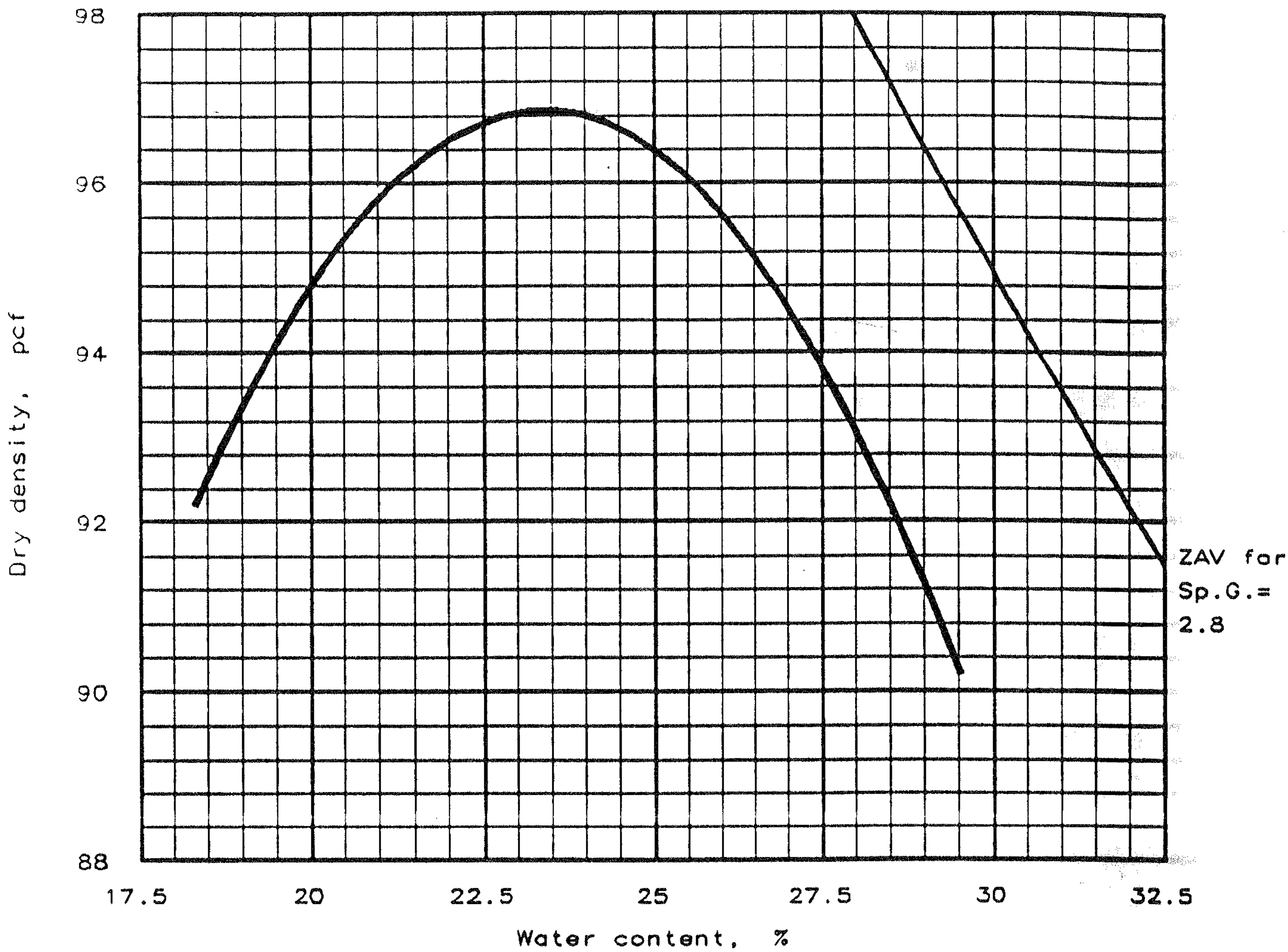
GRAIN SIZE DISTRIBUTION TEST REPORT

S&ME

Remarks:

Figure No. ______

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-78 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
1-6'	MH		26.3 %	2.70	55	5	0 %	53.9 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 96.9 pcf Optimum moisture = 23.4 %	ORANGE BROWN MICACEOUS C TO F SANDY SILT

Project No.: 1356-95-133

Project: FIELDCREST CANNON

Location: B-23

BAG

Date: 2-15-1995

MOISTURE-DENSITY RELATIONSHIP TEST

S&ME

Remarks:

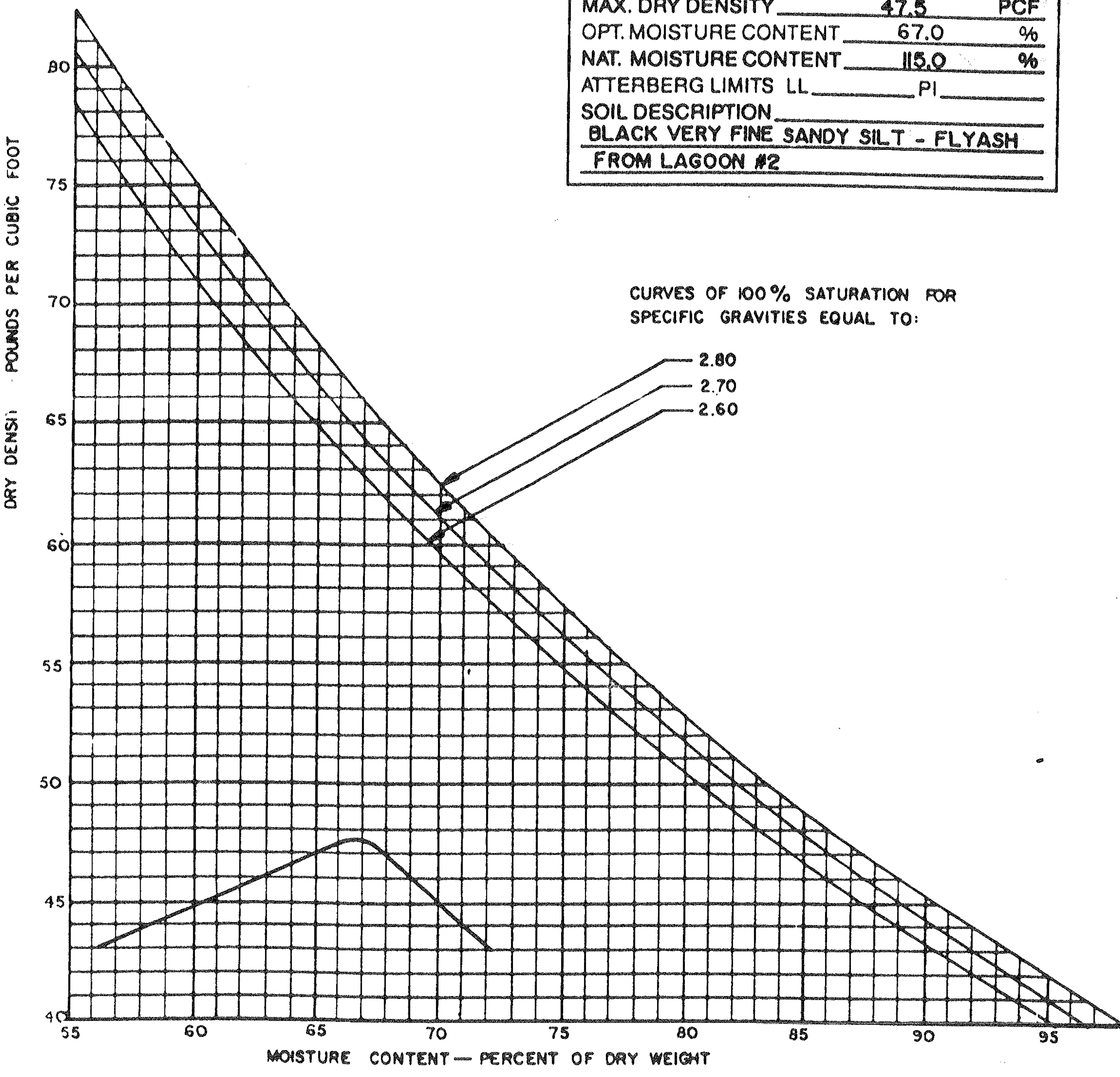
Fig. No. S-1

MOISTURE - DENSITY RELATIONSHIP

S&ME

JOB NUMBER 1051-92-382
JOB NAME FIELDCREST CANNON FLYASH
JOB LOCATION KANNAPOLIS, N.C.
BORING NO. TP-9
SAMPLE NO.
DEPTH 0 - 3'

METHOD OF TEST	ASTM D-698	
MAX. DRY DENSITY	47.5	PCF
OPT. MOISTURE CONTENT	67.0	%
NAT. MOISTURE CONTENT	115.0	%
ATTERBERG LIMITS LL		PI
SOIL DESCRIPTION		
BLACK VERY FINE SANDY SILT - FLYASH FROM LAGOON #2		

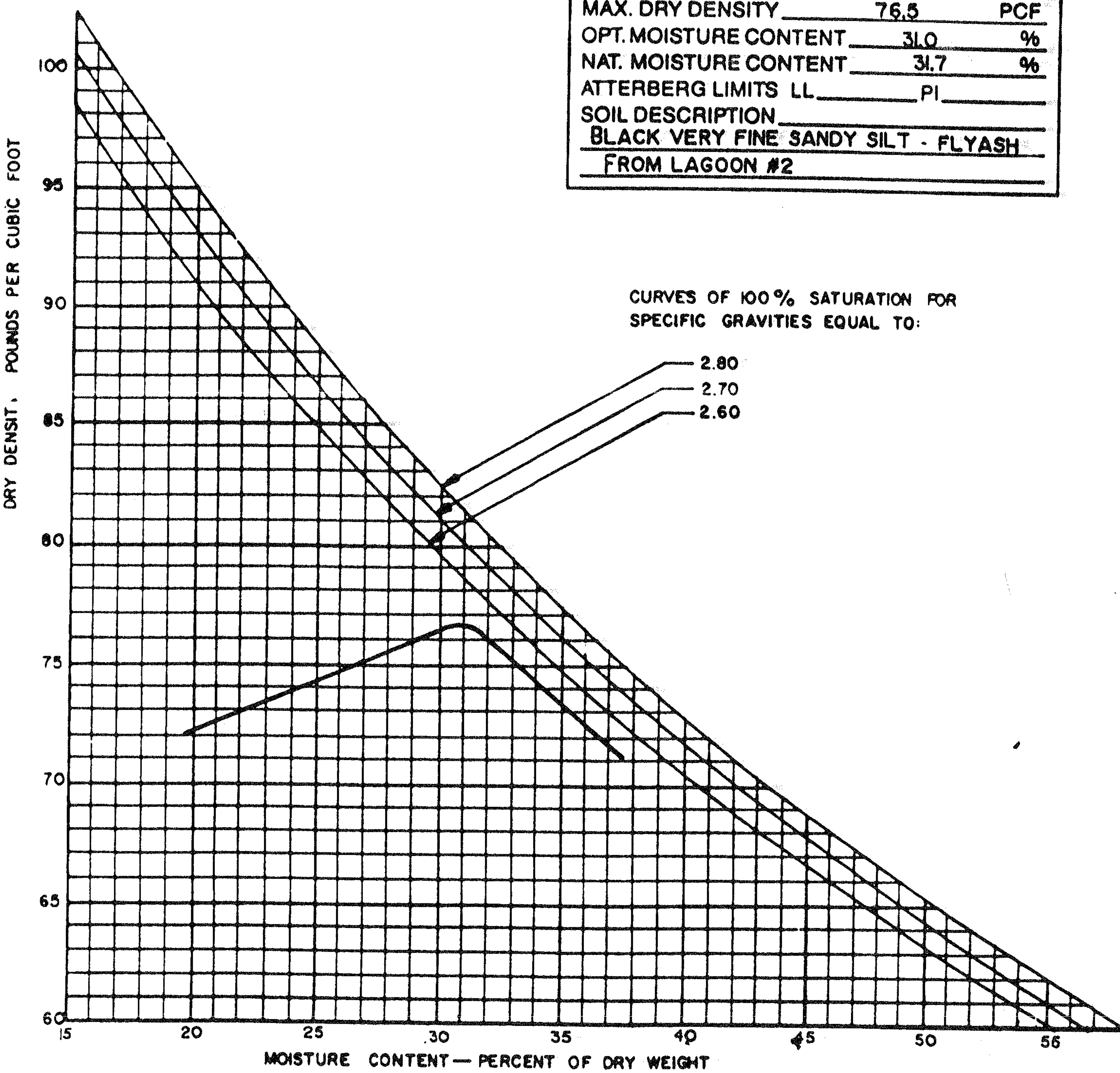


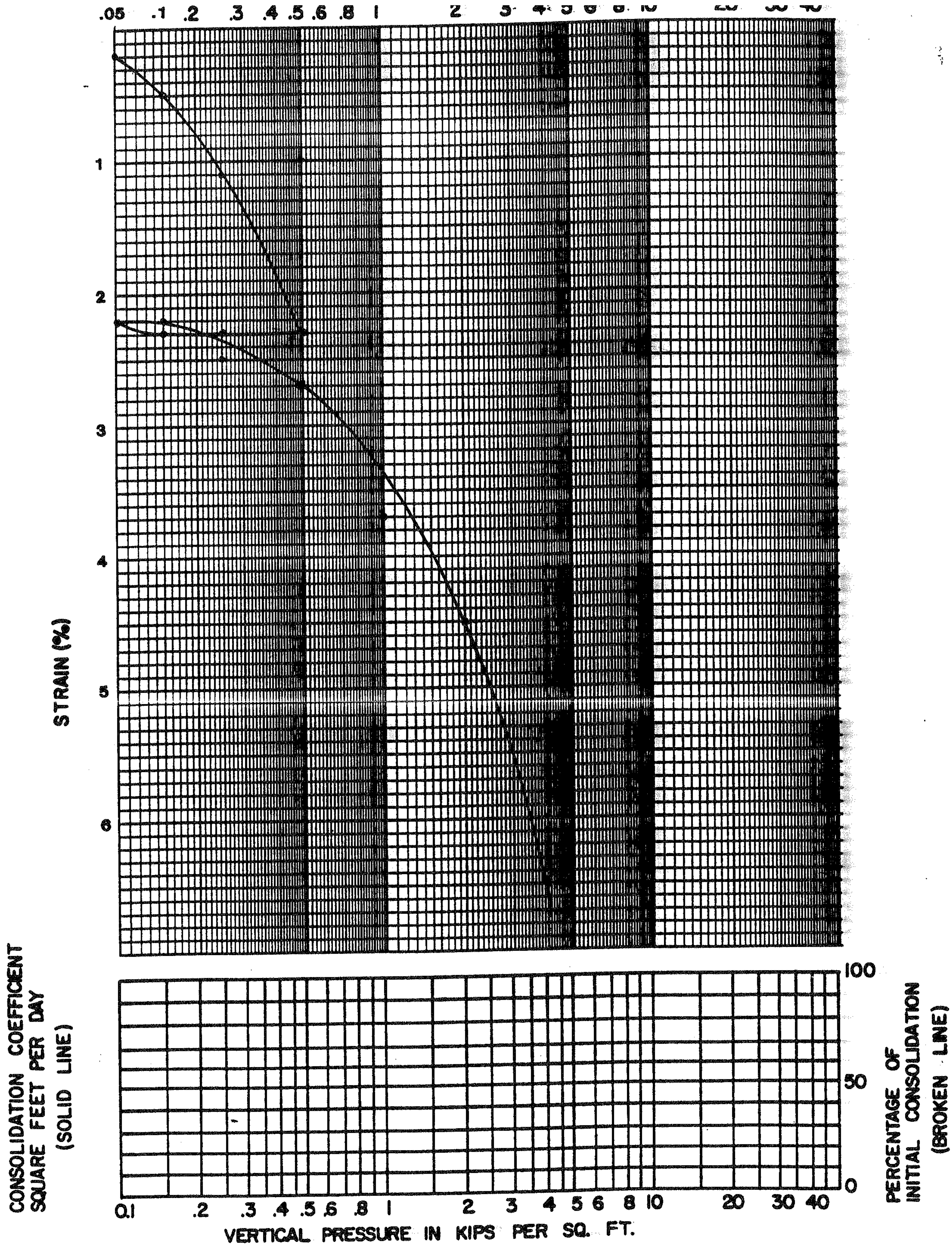
MOISTURE-DENSITY RELATIONSHIP

S&ME

JOB NUMBER 1051-92-382
JOB NAME FIELDCREST CANNON FLYASH
JOB LOCATION KANNAPOLIS N.C.
BORING NO. TP-1
SAMPLE NO.
DEPTH 0 - 3'

METHOD OF TEST	ASTM D-698	
MAX. DRY DENSITY	76.5	PCF
OPT. MOISTURE CONTENT	31.0	%
NAT. MOISTURE CONTENT	31.7	%
ATTERBERG LIMITS	LL	PI
SOIL DESCRIPTION		
BLACK VERY FINE SANDY SILT - FLYASH FROM LAGOON #2		





MODIFIED COMPRESSION INDEX 0.03

UNIT WEIGHT 84.69 (WET)

WATER CONTENT 79.9%

SATURATION 105%

INITIAL VOID RATIO 2.02

CONSOLIDATION TEST

BORING NO. B-3 SAMPLE NO. UD

ELEV. OR DEPTH 11'-13' JOB NO. 1356-95-1

S&ME ENVIRONMENTAL SERV...

WE-11

APPENDIX III

CALCULATIONS

S&ME

JOB NO. 1356-95-133
SHEET NO. 1
DATE 8-15-95

JOB NAME FIELDCREST CANNON
SUBJECT GLOBAL SLOPE STABILITY (SECTION 1-1)
COMPUTED BY PGG
CHECKED BY

OBJECTIVE: DETERMINE FACTOR OF SAFETY FOR GLOBAL FAILURE FOR COMPLETED ASH FILL

PARAMETERS:

- USE CROSS-SECTION THROUGH THE EAST SIDE OF THE ASH FILL SLOPE
- MODEL FINAL USE CONDITIONS WITH A LOADED, SINGLE AXLE TRUCK (30,000 lbs/ft LOAD ON EACH TIRE) AND A UNIFORMILY DISTRIBUTED LOAD OF 1000 lbs/sf OVER THE TOP OF THE ASH FILL (EQUIPMENT STORAGE AREA)
- CONSTRUCT CROSS-SECTION USING GROUNDWATER AND SUBSURFACE INFORMATION FROM GEOTECHNICAL STUDY, FINAL CONTOURS FROM CONSTRUCTION DRAWINGS, AND EXISTING TOPOGRAPHIC CONDITIONS

REFERENCE: STABL/6 COMPUTER PROGRAM BY GEOSOFT, 1992

RESULTS: MINIMUM CALCULATED SAFETY FACTOR = 2.06

** STABL/G **

Slope Stability Program
Portions of this program (c) 1992
by
GEOSOFT
1442 Lincoln Avenue, Suite 146
Orange, CA 92665
U.S.A.

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 08-15-1995
Input Data Filename: 133b2.stb
Output Filename: 133b2.out
Plotted Output Filename: 133b2.pl1

PROBLEM DESCRIPTION FIELDCREST CANNON SLOPE STABILITY SECTIO
N 1-1

BOUNDARY COORDINATES

3 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	83.00	143.00	84.00	1
2	143.00	84.00	430.00	140.00	1
3	430.00	140.00	520.00	144.50	1
4	143.00	84.00	153.00	84.00	2
5	153.00	84.00	430.00	138.50	2
6	430.00	138.50	520.00	143.00	2
7	.00	80.00	319.00	88.00	4
8	319.00	88.00	373.00	93.00	3
9	373.00	93.00	520.00	100.00	3
10	319.00	88.00	520.00	93.00	4
11	.00	50.00	520.00	51.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	110.0	120.0	150.0	20.0	.00	.0	1
2	70.0	70.0	100.0	15.0	.00	.0	1
3	70.0	70.0	.0	5.0	.00	.0	1
4	120.0	130.0	200.0	20.0	.00	.0	1
5	120.0	120.0	1000.0	45.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	75.50
2	175.00	78.00
3	373.00	95.00
4	520.00	101.00

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	432.00	432.20	30000.0	.0
2	440.00	440.20	30000.0	.0
3	445.00	520.00	1000.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 80.00 ft. and X = 120.00 ft.

Each Surface Terminates Between X = 460.00 ft. and X = 520.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 60.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	83.84
2	129.73	81.55
3	139.51	79.44
4	149.32	77.52
5	159.17	75.79
6	169.05	74.24
7	178.96	72.88
8	188.89	71.71
9	198.84	70.72
10	208.81	69.93
11	218.79	69.32
12	228.78	68.90
13	238.78	68.67
14	248.78	68.63
15	258.78	68.78
16	268.77	69.12
17	278.76	69.64
18	288.73	70.36
19	298.69	71.26
20	308.63	72.36
21	318.55	73.64
22	328.44	75.10
23	338.30	76.76
24	348.13	78.60
25	357.93	80.62
26	367.68	82.84
27	377.39	85.23
28	387.05	87.81
29	396.66	90.57
30	406.22	93.51
31	415.72	96.63
32	425.16	99.94
33	434.53	103.42
34	443.84	107.07
35	453.08	110.90
36	462.24	114.91
37	471.33	119.09
38	480.33	123.44
39	489.25	127.95
40	498.08	132.64
41	506.83	137.49
42	515.48	142.51
43	518.65	144.43

Circle Center At X = 245.9 ; Y = 597.3 and Radius, 528.6

*** 2.057 ***

Individual data on the 60 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	3.2	135.3	.0	.0	.0	.0	.0	.0	.0
2	6.5	1182.9	.0	.0	.0	.0	.0	.0	.0
3	9.8	3986.1	.0	.0	.0	.0	.0	.0	.0
4	3.5	2030.2	.0	.0	.0	.0	.0	.0	.0
5	5.8	4304.7	.0	.0	.0	.0	.0	.0	.0
6	.5	464.9	.0	1.8	.0	.0	.0	.0	.0
7	3.7	3621.7	.0	107.0	.0	.0	.0	.0	.0
8	6.2	7323.4	.0	546.4	.0	.0	.0	.0	.0
9	9.9	14601.2	.0	1765.2	.0	.0	.0	.0	.0
10	5.9	10409.6	.0	1544.9	.0	.0	.0	.0	.0
11	4.0	7579.1	.0	1246.6	.0	.0	.0	.0	.0
12	9.9	21200.3	.0	4023.5	.0	.0	.0	.0	.0
13	10.0	24192.5	.0	5224.9	.0	.0	.0	.0	.0
14	10.0	26946.2	.0	6310.2	.0	.0	.0	.0	.0
15	10.0	29456.2	.0	7279.1	.0	.0	.0	.0	.0
16	10.0	31718.0	.0	8131.3	.0	.0	.0	.0	.0
17	10.0	33727.6	.0	8866.3	.0	.0	.0	.0	.0
18	10.0	35481.9	.0	9484.0	.0	.0	.0	.0	.0
19	10.0	36978.0	.0	9984.2	.0	.0	.0	.0	.0
20	10.0	38213.9	.0	10366.6	.0	.0	.0	.0	.0
21	10.0	39188.2	.0	10631.1	.0	.0	.0	.0	.0
22	1.4	5372.3	.0	1456.1	.0	.0	.0	.0	.0
23	8.6	34510.6	.0	9321.6	.0	.0	.0	.0	.0
24	10.0	40273.2	.0	10806.2	.0	.0	.0	.0	.0
25	9.9	40400.1	.0	10716.7	.0	.0	.0	.0	.0
26	9.9	40266.3	.0	10509.2	.0	.0	.0	.0	.0
27	.4	1819.8	.0	470.8	.0	.0	.0	.0	.0
28	9.4	38052.9	.0	9712.9	.0	.0	.0	.0	.0
29	9.9	39222.0	.0	9740.5	.0	.0	.0	.0	.0
30	9.8	38317.4	.0	9179.6	.0	.0	.0	.0	.0
31	9.8	37162.9	.0	8501.3	.0	.0	.0	.0	.0
32	9.8	35762.4	.0	7705.7	.0	.0	.0	.0	.0
33	5.3	18898.8	.0	3843.4	.0	.0	.0	.0	.0
34	4.4	15222.1	.0	2930.4	.0	.0	.0	.0	.0
35	9.7	32243.8	.0	5521.6	.0	.0	.0	.0	.0
36	7.2	22703.1	.0	3203.6	.0	.0	.0	.0	.0
37	2.4	7480.4	.0	898.8	.0	.0	.0	.0	.0
38	9.6	28948.4	.0	2568.5	.0	.0	.0	.0	.0
39	3.8	11315.3	.0	573.5	.0	.0	.0	.0	.0
40	5.7	16673.5	.0	347.0	.0	.0	.0	.0	.0
41	.4	1024.4	.0	1.3	.0	.0	.0	.0	.0
42	9.1	25878.2	.0	.0	.0	.0	.0	.0	.0
43	4.8	13406.5	.0	.0	.0	.0	.0	.0	.0
44	2.0	5432.4	.0	.0	.0	.0	.0	.0	.0
45	.2	538.3	.0	.0	.0	.0	.0	.0	6000.4
46	2.3	6212.7	.0	.0	.0	.0	.0	.0	.0
47	5.5	14056.8	.0	.0	.0	.0	.0	.0	.0
48	.2	500.7	.0	.0	.0	.0	.0	.0	6000.4
49	3.6	8945.5	.0	.0	.0	.0	.0	.0	.0
50	1.2	2780.9	.0	.0	.0	.0	.0	.0	.0
51	8.1	18422.3	.0	.0	.0	.0	.0	.0	8077.5
52	9.2	18814.8	.0	.0	.0	.0	.0	.0	9162.7

53	9.1	16343.6	.0	.0	.0	.0	.0	.0	9085.3
54	9.0	13796.0	.0	.0	.0	.0	.0	.0	9004.6
55	8.9	11178.5	.0	.0	.0	.0	.0	.0	8920.8
56	8.8	8497.7	.0	.0	.0	.0	.0	.0	8833.7
57	8.7	5760.4	.0	.0	.0	.0	.0	.0	8743.5
58	8.7	2973.9	.0	.0	.0	.0	.0	.0	8650.1
59	.5	82.0	.0	.0	.0	.0	.0	.0	470.9
60	2.7	222.7	.0	.0	.0	.0	.0	.0	2699.7

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	83.84
2	129.70	81.40
3	139.44	79.15
4	149.23	77.09
5	159.05	75.24
6	168.92	73.58
7	178.81	72.11
8	188.73	70.85
9	198.67	69.78
10	208.63	68.92
11	218.61	68.25
12	228.60	67.78
13	238.60	67.52
14	248.60	67.45
15	258.60	67.58
16	268.59	67.92
17	278.58	68.45
18	288.55	69.18
19	298.51	70.11
20	308.44	71.24
21	318.35	72.57
22	328.24	74.10
23	338.09	75.82
24	347.90	77.75
25	357.67	79.86
26	367.40	82.18
27	377.08	84.68
28	386.71	87.38
29	396.28	90.28
30	405.80	93.36
31	415.25	96.63
32	424.63	100.09
33	433.94	103.74
34	443.17	107.57
35	452.33	111.59
36	461.41	115.79
37	470.40	120.17
38	479.30	124.73
39	488.10	129.47
40	496.81	134.38
41	505.42	139.47
42	513.00	144.15

Circle Center At X = 247.0 ; Y = 567.2 and Radius, 499.8

*** 2.058 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	83.84
2	129.83	81.98
3	139.68	80.30
4	149.57	78.80
5	159.48	77.48
6	169.42	76.33
7	179.37	75.37
8	189.34	74.58
9	199.32	73.97
10	209.31	73.55
11	219.31	73.30
12	229.31	73.24
13	239.31	73.35
14	249.30	73.65
15	259.29	74.12
16	269.27	74.78
17	279.24	75.62
18	289.18	76.63
19	299.11	77.83
20	309.02	79.20
21	318.90	80.75
22	328.75	82.48
23	338.56	84.39
24	348.34	86.47
25	358.08	88.73
26	367.78	91.17
27	377.44	93.78
28	387.04	96.56
29	396.59	99.52
30	406.09	102.64
31	415.53	105.94
32	424.91	109.41
33	434.23	113.05
34	443.48	116.85
35	452.65	120.82
36	461.76	124.96
37	470.79	129.26
38	479.74	133.72
39	488.60	138.34
40	497.39	143.12
41	497.86	143.39

Circle Center At X = 227.9 ; Y = 627.7 and Radius, 554.5

*** 2.061 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.56	83.81
2	125.43	82.20
3	135.32	80.74

4	145.23	79.44
5	155.17	78.29
6	165.12	77.30
7	175.08	76.46
8	185.06	75.78
9	195.05	75.26
10	205.04	74.89
11	215.04	74.68
12	225.04	74.63
13	235.04	74.73
14	245.03	74.99
15	255.02	75.40
16	265.01	75.97
17	274.98	76.70
18	284.94	77.58
19	294.89	78.62
20	304.82	79.82
21	314.73	81.17
22	324.61	82.67
23	334.47	84.33
24	344.31	86.14
25	354.11	88.11
26	363.89	90.23
27	373.62	92.50
28	383.33	94.92
29	392.99	97.50
30	402.61	100.22
31	412.19	103.10
32	421.72	106.13
33	431.20	109.30
34	440.63	112.62
35	450.01	116.09
36	459.34	119.71
37	468.60	123.47
38	477.81	127.38
39	486.95	131.42
40	496.03	135.62
41	505.04	139.95
42	513.49	144.17

Circle Center At X = 223.5 ; Y = 713.9 and Radius, 639.3

*** 2.063 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.56	83.81
2	125.44	82.29
3	135.35	80.92
4	145.27	79.70
5	155.21	78.63
6	165.17	77.72
7	175.14	76.96
8	185.12	76.35
9	195.11	75.90
10	205.11	75.60
11	215.11	75.45

12	225.11	75.46
13	235.11	75.62
14	245.10	75.93
15	255.09	76.40
16	265.07	77.02
17	275.04	77.79
18	285.00	78.71
19	294.94	79.79
20	304.87	81.02
21	314.77	82.40
22	324.65	83.94
23	334.51	85.62
24	344.34	87.46
25	354.14	89.44
26	363.91	91.58
27	373.64	93.87
28	383.34	96.30
29	393.00	98.89
30	402.62	101.62
31	412.20	104.50
32	421.73	107.52
33	431.21	110.69
34	440.65	114.01
35	450.03	117.47
36	459.36	121.08
37	468.63	124.82
38	477.84	128.71
39	486.99	132.74
40	496.08	136.91
41	505.11	141.22
42	510.79	144.04

Circle Center At X = 219.7 ; Y = 727.3 and Radius, 651.8

*** 2.068 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	83.84
2	129.57	80.94
3	139.21	78.27
4	148.90	75.82
5	158.65	73.60
6	168.45	71.60
7	178.29	69.83
8	188.17	68.29
9	198.09	66.98
10	208.03	65.90
11	217.99	65.05
12	227.97	64.43
13	237.97	64.05
14	247.97	63.90
15	257.97	63.97
16	267.96	64.29
17	277.95	64.83
18	287.92	65.60
19	297.87	66.61
20	307.79	67.84

21	317.68	69.31
22	327.54	71.01
23	337.35	72.93
24	347.11	75.08
25	356.83	77.46
26	366.48	80.06
27	376.08	82.89
28	385.60	85.93
29	395.05	89.20
30	404.42	92.69
31	413.71	96.39
32	422.91	100.31
33	432.02	104.44
34	441.03	108.78
35	449.94	113.32
36	458.74	118.08
37	467.42	123.03
38	475.99	128.19
39	484.43	133.54
40	492.75	139.09
41	498.97	143.45

Circle Center At X = 249.6 ; Y = 494.7 and Radius, 430.8

*** 2.070 ***

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.56	83.81
2	125.14	80.94
3	134.78	78.29
4	144.48	75.86
5	154.23	73.64
6	164.03	71.63
7	173.86	69.85
8	183.74	68.28
9	193.65	66.93
10	203.59	65.80
11	213.54	64.89
12	223.52	64.20
13	233.51	63.73
14	243.51	63.49
15	253.51	63.46
16	263.50	63.66
17	273.50	64.08
18	283.48	64.72
19	293.44	65.58
20	303.38	66.66
21	313.29	67.96
22	323.18	69.48
23	333.03	71.22
24	342.83	73.18
25	352.59	75.36
26	362.30	77.75
27	371.96	80.35
28	381.55	83.17
29	391.08	86.20

30	400.54	89.44
31	409.93	92.88
32	419.24	96.54
33	428.46	100.40
34	437.60	104.46
35	446.64	108.73
36	455.59	113.20
37	464.44	117.86
38	473.18	122.71
39	481.81	127.76
40	490.33	133.00
41	498.73	138.43
42	506.70	143.84

Circle Center At X = 249.6 ; Y = 514.8 and Radius, 451.4

*** 2.073 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	115.56	83.81
2	125.15	80.97
3	134.79	78.34
4	144.49	75.92
5	154.25	73.70
6	164.04	71.69
7	173.88	69.88
8	183.75	68.29
9	193.65	66.91
10	203.59	65.74
11	213.54	64.78
12	223.51	64.03
13	233.50	63.50
14	243.49	63.18
15	253.49	63.07
16	263.49	63.17
17	273.49	63.49
18	283.47	64.02
19	293.44	64.76
20	303.40	65.71
21	313.33	66.88
22	323.24	68.25
23	333.11	69.84
24	342.95	71.63
25	352.74	73.64
26	362.50	75.85
27	372.20	78.27
28	381.85	80.90
29	391.44	83.73
30	400.97	86.76
31	410.43	90.00
32	419.82	93.43
33	429.14	97.07
34	438.37	100.90
35	447.52	104.93
36	456.59	109.15
37	465.56	113.57
38	474.44	118.17

39	483.22	122.96
40	491.89	127.94
41	500.46	133.10
42	508.91	138.44
43	517.25	143.96
44	517.87	144.39

Circle Center At X = 253.6 ; Y = 533.0 and Radius, 469.9

*** 2.073 ***

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	83.84
2	129.51	80.75
3	139.09	77.87
4	148.73	75.22
5	158.43	72.79
6	168.19	70.59
7	177.99	68.61
8	187.83	66.85
9	197.72	65.33
10	207.63	64.03
11	217.57	62.96
12	227.54	62.11
13	237.52	61.50
14	247.51	61.12
15	257.51	60.97
16	267.51	61.04
17	277.50	61.35
18	287.49	61.89
19	297.46	62.65
20	307.41	63.65
21	317.34	64.88
22	327.23	66.33
23	337.09	68.01
24	346.90	69.91
25	356.67	72.04
26	366.39	74.40
27	376.06	76.98
28	385.66	79.78
29	395.19	82.80
30	404.65	86.04
31	414.03	89.49
32	423.34	93.16
33	432.55	97.05
34	441.67	101.14
35	450.70	105.44
36	459.63	109.95
37	468.45	114.67
38	477.15	119.58
39	485.75	124.70
40	494.22	130.01
41	502.57	135.51
42	510.79	141.21
43	514.97	144.25

Circle Center At X = 259.2 ; Y = 495.6 and Radius, 434.7

*** 2.075 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	111.11	83.78
2	120.73	81.05
3	130.41	78.53
4	140.13	76.20
5	149.90	74.06
6	159.72	72.13
7	169.56	70.40
8	179.45	68.87
9	189.36	67.54
10	199.29	66.42
11	209.25	65.49
12	219.23	64.77
13	229.21	64.25
14	239.21	63.94
15	249.21	63.83
16	259.21	63.92
17	269.20	64.22
18	279.19	64.72
19	289.16	65.43
20	299.12	66.33
21	309.06	67.45
22	318.97	68.76
23	328.86	70.27
24	338.71	71.99
25	348.53	73.90
26	358.30	76.02
27	368.03	78.33
28	377.71	80.84
29	387.33	83.55
30	396.90	86.46
31	406.41	89.56
32	415.85	92.85
33	425.23	96.33
34	434.53	100.00
35	443.75	103.87
36	452.90	107.92
37	461.95	112.15
38	470.92	116.57
39	479.80	121.17
40	488.59	125.95
41	497.27	130.91
42	505.85	136.04
43	514.33	141.35
44	519.06	144.45

Circle Center At X = 249.6 ; Y = 554.4 and Radius, 490.6

*** 2.079 ***

S&ME

JOB NO. 1356-95-133
SHEET NO. 1
DATE 8-15-95

JOB NAME Hillcrest Cannon
COMPUTED BY PGG
SUBJECT Global Slope Stability (Section 1-2)
CHECKED BY

OBJECTIVE: Determine factor of safety for global failure for completed ash fill

PARAMETERS:
- Use cross-section through south side of the ash fill slope
- Model final use conditions same as for Section 1-1
- Construct cross-section using groundwater and subsurface information from geotechnical study, final contours from construction drawings, and existing topographic conditions

REFERENCE: STABL/6 Computer Program by Geosoft, 1992

RESULTS: Minimum calculated safety factor = 1.52

** STABL/G **

Slope Stability Program
Portions of this program (c) 1992
by
GEOSOFT
1442 Lincoln Avenue, Suite 146
Orange, CA 92665
U.S.A.

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 08-15-1995
Input Data Filename: 133c3.stb
Output Filename: 133c3.out
Plotted Output Filename: 133c3.pl1

PROBLEM DESCRIPTION FIELDCREST CANNON SLOPE STABILITY SECTI
ON 1-2

BOUNDARY COORDINATES

6 Top Boundaries
24 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	22.00	27.00	23.00	6
2	27.00	23.00	88.00	43.00	4
3	88.00	43.00	98.00	43.20	4
4	98.00	43.20	102.00	41.50	4
5	102.00	41.50	306.00	85.00	1
6	306.00	85.00	406.00	90.00	1
7	105.00	40.50	306.00	83.50	2
8	306.00	83.50	406.00	88.50	2
9	105.00	40.50	128.00	33.00	4
10	128.00	33.00	171.00	32.00	3
11	171.00	32.00	213.00	33.00	3
12	213.00	33.00	256.00	47.00	5
13	256.00	47.00	291.00	49.00	5
14	291.00	49.00	338.00	33.00	5
15	338.00	33.00	406.00	33.00	6
16	128.00	33.00	144.00	28.00	4
17	27.00	23.00	80.00	25.00	6
18	80.00	25.00	144.00	28.00	6
19	144.00	28.00	160.00	29.00	6
20	160.00	29.00	213.00	33.00	6
21	213.00	33.00	261.00	35.00	6
22	261.00	35.00	288.00	35.00	6
23	288.00	35.00	338.00	33.00	6
24	.00	.00	406.00	3.00	7

ISOTROPIC SOIL PARAMETERS

7 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	125.0	150.0	20.0	.00	.0	1
2	70.0	70.0	100.0	15.0	.00	.0	1
3	70.0	70.0	.0	5.0	.00	.0	1
4	110.0	125.0	200.0	20.0	.00	.0	1
5	110.0	125.0	150.0	15.0	.00	.0	1
6	120.0	130.0	200.0	20.0	.00	.0	1
7	120.0	120.0	1000.0	45.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	5.00
2	111.00	15.00
3	350.00	40.00
4	406.00	40.10

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	308.00	308.20	30000.0	.0
2	316.00	316.20	30000.0	.0
3	320.00	400.00	1000.0	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 20.00 ft.
and X = 100.00 ft.

Each Surface Terminates Between X = 320.00 ft.
and X = 400.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 15.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.22	41.11
2	92.03	39.15
3	101.88	37.41
4	111.76	35.91
5	121.68	34.64
6	131.63	33.60
7	141.60	32.79
8	151.58	32.21
9	161.57	31.86
10	171.57	31.75
11	181.57	31.87
12	191.57	32.22
13	201.55	32.80
14	211.51	33.62
15	221.46	34.67
16	231.38	35.95
17	241.26	37.46
18	251.11	39.19
19	260.92	41.16
20	270.67	43.36
21	280.37	45.78
22	290.02	48.42
23	299.60	51.29
24	309.11	54.38
25	318.54	57.69
26	327.90	61.22
27	337.17	64.97
28	346.35	68.93
29	355.44	73.10
30	364.43	77.49

31	373.31	82.08
32	382.09	86.88
33	385.75	88.99

Circle Center At X = 171.4 ; Y = 461.8 and Radius, 430.0

*** 1.517 ***

Individual data on the 51 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	5.8	969.0	.0	.0	.0	.0	.0	.0	.0
2	4.0	1547.7	.0	.0	.0	.0	.0	.0	.0
3	6.0	2969.2	.0	.0	.0	.0	.0	.0	.0
4	3.9	1971.5	.0	.0	.0	.0	.0	.0	.0
5	.1	55.6	.0	.0	.0	.0	.0	.0	.0
6	3.0	1535.7	.0	.0	.0	.0	.0	.0	.0
7	6.8	4295.0	.0	.0	.0	.0	.0	.0	.0
8	9.9	7706.7	.0	.0	.0	.0	.0	.0	.0
9	1.9	1657.8	.0	.0	.0	.0	.0	.0	.0
10	8.0	7804.8	.0	.0	.0	.0	.0	.0	.0
11	10.0	11591.3	.0	.0	.0	.0	.0	.0	.0
12	3.0	3826.6	.0	.0	.0	.0	.0	.0	.0
13	7.0	9752.1	.0	.0	.0	.0	.0	.0	.0
14	10.0	15403.7	.0	.0	.0	.0	.0	.0	.0
15	9.4	16043.4	.0	.0	.0	.0	.0	.0	.0
16	.6	1018.4	.0	.0	.0	.0	.0	.0	.0
17	10.0	18549.1	.0	.0	.0	.0	.0	.0	.0
18	10.0	19862.6	.0	.0	.0	.0	.0	.0	.0
19	7.7	16205.1	.0	.0	.0	.0	.0	.0	.0
20	2.2	4794.4	.0	.0	.0	.0	.0	.0	.0
21	10.0	21957.9	.0	.0	.0	.0	.0	.0	.0
22	5.0	11373.4	.0	.0	.0	.0	.0	.0	.0
23	4.9	11470.3	.0	.0	.0	.0	.0	.0	.0
24	9.9	24152.4	.0	.0	.0	.0	.0	.0	.0
25	9.9	25291.0	.0	.0	.0	.0	.0	.0	.0
26	9.8	26148.6	.0	.0	.0	.0	.0	.0	.0
27	4.9	13256.8	.0	.0	.0	.0	.0	.0	.0
28	4.9	13339.7	.0	.0	.0	.0	.0	.0	.0
29	9.8	25999.9	.0	.0	.0	.0	.0	.0	.0
30	9.7	25016.5	.0	.0	.0	.0	.0	.0	.0
31	9.6	23780.5	.0	.0	.0	.0	.0	.0	.0
32	1.0	2352.0	.0	.0	.0	.0	.0	.0	.0
33	.4	1057.8	.0	.0	.0	.0	.0	.0	.0
34	8.2	19152.4	.0	.0	.0	.0	.0	.0	.0
35	6.4	14719.6	.0	.0	.0	.0	.0	.0	.0
36	2.0	4509.5	.0	.0	.0	.0	.0	.0	.0
37	.2	446.7	.0	.0	.0	.0	.0	.0	6000.4
38	.9	2018.4	.0	.0	.0	.0	.0	.0	.0
39	6.9	14759.6	.0	.0	.0	.0	.0	.0	.0
40	.2	413.4	.0	.0	.0	.0	.0	.0	6000.4
41	2.3	4781.7	.0	.0	.0	.0	.0	.0	.0
42	1.5	2910.4	.0	.0	.0	.0	.0	.0	.0
43	7.9	14943.5	.0	.0	.0	.0	.0	.0	7900.2
44	9.3	15633.5	.0	.0	.0	.0	.0	.0	9271.7
45	9.2	13302.0	.0	.0	.0	.0	.0	.0	9182.1
46	9.1	10868.2	.0	.0	.0	.0	.0	.0	9087.5
47	9.0	8341.6	.0	.0	.0	.0	.0	.0	8988.0

48	8.9	5732.1	.0	.0	.0	.0	.0	.0	8883.6
49	8.8	3049.6	.0	.0	.0	.0	.0	.0	8774.5
50	.8	146.4	.0	.0	.0	.0	.0	.0	813.4
51	2.8	234.7	.0	.0	.0	.0	.0	.0	2844.8

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.44	35.28
2	74.32	33.70
3	84.23	32.36
4	94.17	31.26
5	104.13	30.40
6	114.11	29.79
7	124.11	29.41
8	134.11	29.28
9	144.10	29.40
10	154.10	29.75
11	164.08	30.35
12	174.05	31.19
13	183.99	32.27
14	193.90	33.59
15	203.78	35.15
16	213.61	36.96
17	223.40	38.99
18	233.14	41.27
19	242.82	43.78
20	252.43	46.53
21	261.98	49.51
22	271.45	52.72
23	280.84	56.16
24	290.15	59.82
25	299.36	63.71
26	308.47	67.83
27	317.49	72.16
28	326.39	76.71
29	335.18	81.47
30	343.86	86.45
31	344.65	86.93

Circle Center At X = 134.5 ; Y = 441.3 and Radius, 412.0

*** 1.674 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.33	38.19
2	83.17	36.41
3	93.06	34.90
4	102.98	33.67
5	112.94	32.72
6	122.92	32.05
7	132.91	31.65
8	142.91	31.53

9	152.91	31.69
10	162.90	32.13
11	172.87	32.85
12	182.82	33.85
13	192.74	35.12
14	202.62	36.67
15	212.45	38.50
16	222.23	40.60
17	231.94	42.97
18	241.59	45.61
19	251.16	48.52
20	260.64	51.69
21	270.03	55.13
22	279.32	58.83
23	288.50	62.78
24	297.57	66.99
25	306.52	71.45
26	315.35	76.16
27	324.03	81.12
28	332.58	86.31
29	332.61	86.33

Circle Center At X = 142.1 ; Y = 390.0 and Radius, 358.5

*** 1.708 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	32.36
2	65.52	31.50
3	75.49	30.78
4	85.48	30.21
5	95.47	29.78
6	105.46	29.50
7	115.46	29.37
8	125.46	29.38
9	135.46	29.54
10	145.46	29.85
11	155.45	30.31
12	165.43	30.91
13	175.40	31.65
14	185.36	32.54
15	195.31	33.58
16	205.24	34.77
17	215.15	36.10
18	225.04	37.57
19	234.91	39.19
20	244.75	40.96
21	254.57	42.86
22	264.35	44.92
23	274.11	47.11
24	283.83	49.45
25	293.52	51.93
26	303.17	54.55
27	312.78	57.32
28	322.35	60.22
29	331.87	63.26
30	341.35	66.45

31	350.79	69.77
32	360.17	73.23
33	369.50	76.83
34	378.78	80.56
35	388.00	84.43
36	397.16	88.43
37	399.94	89.70

Circle Center At X = 119.5 ; Y = 711.4 and Radius, 682.0

*** 1.748 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	29.45
2	56.64	28.77
3	66.63	28.22
4	76.62	27.81
5	86.62	27.55
6	96.62	27.42
7	106.62	27.43
8	116.62	27.58
9	126.61	27.86
10	136.60	28.29
11	146.59	28.85
12	156.56	29.55
13	166.53	30.39
14	176.48	31.37
15	186.42	32.49
16	196.34	33.74
17	206.24	35.14
18	216.12	36.66
19	225.98	38.33
20	235.82	40.13
21	245.63	42.07
22	255.41	44.15
23	265.16	46.35
24	274.89	48.70
25	284.57	51.18
26	294.23	53.79
27	303.84	56.54
28	313.42	59.42
29	322.95	62.43
30	332.45	65.58
31	341.89	68.85
32	351.30	72.26
33	360.65	75.80
34	369.95	79.46
35	379.20	83.26
36	388.40	87.18
37	393.35	89.37

Circle Center At X = 100.9 ; Y = 748.6 and Radius, 721.2

*** 1.765 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	29.45
2	56.62	28.51
3	66.59	27.76
4	76.58	27.21
5	86.57	26.84
6	96.57	26.68
7	106.57	26.70
8	116.57	26.92
9	126.56	27.33
10	136.54	27.93
11	146.51	28.73
12	156.46	29.72
13	166.39	30.90
14	176.30	32.27
15	186.17	33.83
16	196.02	35.59
17	205.83	37.53
18	215.60	39.66
19	225.33	41.98
20	235.01	44.49
21	244.64	47.19
22	254.21	50.07
23	263.73	53.13
24	273.19	56.38
25	282.58	59.81
26	291.91	63.42
27	301.16	67.21
28	310.34	71.18
29	319.44	75.33
30	328.46	79.65
31	337.39	84.14
32	342.48	86.82

Circle Center At X = 100.3 ; Y = 544.1 and Radius, 517.4

*** 1.824 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.44	35.28
2	74.43	34.69
3	84.42	34.23
4	94.41	33.91
5	104.41	33.71
6	114.41	33.65
7	124.41	33.73
8	134.41	33.93
9	144.40	34.26

10	154.39	34.73
11	164.37	35.33
12	174.35	36.07
13	184.31	36.93
14	194.26	37.92
15	204.20	39.05
16	214.12	40.31
17	224.02	41.70
18	233.90	43.22
19	243.77	44.87
20	253.61	46.65
21	263.42	48.56
22	273.21	50.60
23	282.97	52.77
24	292.71	55.07
25	302.41	57.49
26	312.07	60.05
27	321.71	62.73
28	331.31	65.54
29	340.86	68.48
30	350.38	71.54
31	359.86	74.73
32	369.30	78.04
33	378.69	81.48
34	388.03	85.04
35	397.33	88.72
36	399.67	89.68

Circle Center At X = 114.0 ; Y = 789.9 and Radius, 756.3

*** 1.857 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	37.78	26.53
2	47.78	26.42
3	57.78	26.41
4	67.78	26.50
5	77.78	26.69
6	87.77	26.99
7	97.76	27.39
8	107.75	27.89
9	117.73	28.49
10	127.71	29.20
11	137.67	30.01
12	147.63	30.92
13	157.58	31.94
14	167.52	33.05
15	177.44	34.27
16	187.36	35.59
17	197.25	37.01
18	207.14	38.54
19	217.01	40.16
20	226.86	41.89
21	236.69	43.72
22	246.50	45.64
23	256.29	47.67
24	266.06	49.80

25	275.81	52.03
26	285.53	54.36
27	295.23	56.79
28	304.91	59.32
29	314.56	61.95
30	324.18	64.68
31	333.77	67.51
32	343.33	70.43
33	352.87	73.45
34	362.37	76.57
35	371.83	79.79
36	381.27	83.11
37	390.67	86.52
38	399.02	89.65

Circle Center At X = 53.9 ; Y = 999.3 and Radius, 972.9

*** 1.863 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.33	38.19
2	83.33	38.02
3	93.33	37.97
4	103.33	38.02
5	113.33	38.19
6	123.33	38.46
7	133.32	38.85
8	143.31	39.35
9	153.29	39.95
10	163.26	40.67
11	173.23	41.50
12	183.18	42.44
13	193.13	43.49
14	203.06	44.64
15	212.98	45.91
16	222.89	47.29
17	232.77	48.78
18	242.65	50.38
19	252.50	52.08
20	262.33	53.90
21	272.15	55.82
22	281.94	57.85
23	291.71	60.00
24	301.45	62.24
25	311.17	64.60
26	320.86	67.07
27	330.52	69.64
28	340.16	72.32
29	349.76	75.10
30	359.34	77.99
31	368.88	80.99
32	378.38	84.09
33	387.85	87.30
34	393.82	89.39

Circle Center At X = 93.5 ; Y = 940.8 and Radius, 902.9

*** 1.875 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.22	41.11
2	91.93	38.70
3	101.69	36.55
4	111.51	34.65
5	121.38	33.00
6	131.28	31.61
7	141.21	30.47
8	151.17	29.59
9	161.15	28.96
10	171.15	28.60
11	181.15	28.49
12	191.15	28.64
13	201.14	29.05
14	211.12	29.71
15	221.07	30.63
16	231.00	31.81
17	240.90	33.24
18	250.76	34.93
19	260.57	36.87
20	270.32	39.06
21	280.02	41.51
22	289.65	44.20
23	299.21	47.14
24	308.69	50.33
25	318.08	53.76
26	327.38	57.43
27	336.59	61.34
28	345.69	65.48
29	354.68	69.86
30	363.56	74.47
31	372.31	79.30
32	380.93	84.36
33	388.61	89.13

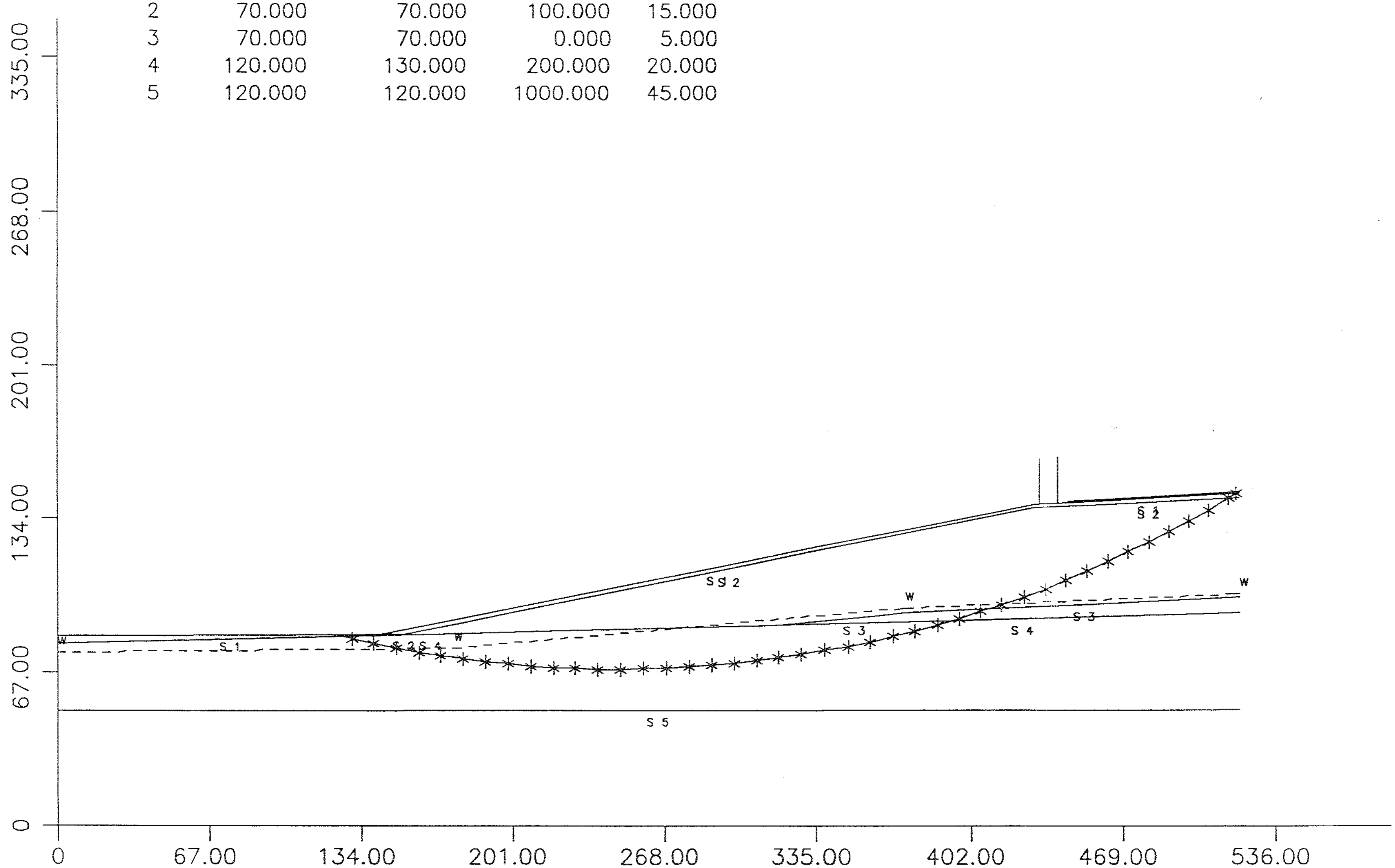
Circle Center At X = 180.4 ; Y = 416.5 and Radius, 388.0

*** 1.884 ***

FIELDCREST CANNON SLOPE STABILITY SECTION 1-1

Soil	Moist Unit Weight	Saturated Unit Weight	Cohesion	Friction Angle
1	110.000	120.000	150.000	20.000
2	70.000	70.000	100.000	15.000
3	70.000	70.000	0.000	5.000
4	120.000	130.000	200.000	20.000
5	120.000	120.000	1000.000	45.000

Minimum Factor of Safety 2.057



S&ME

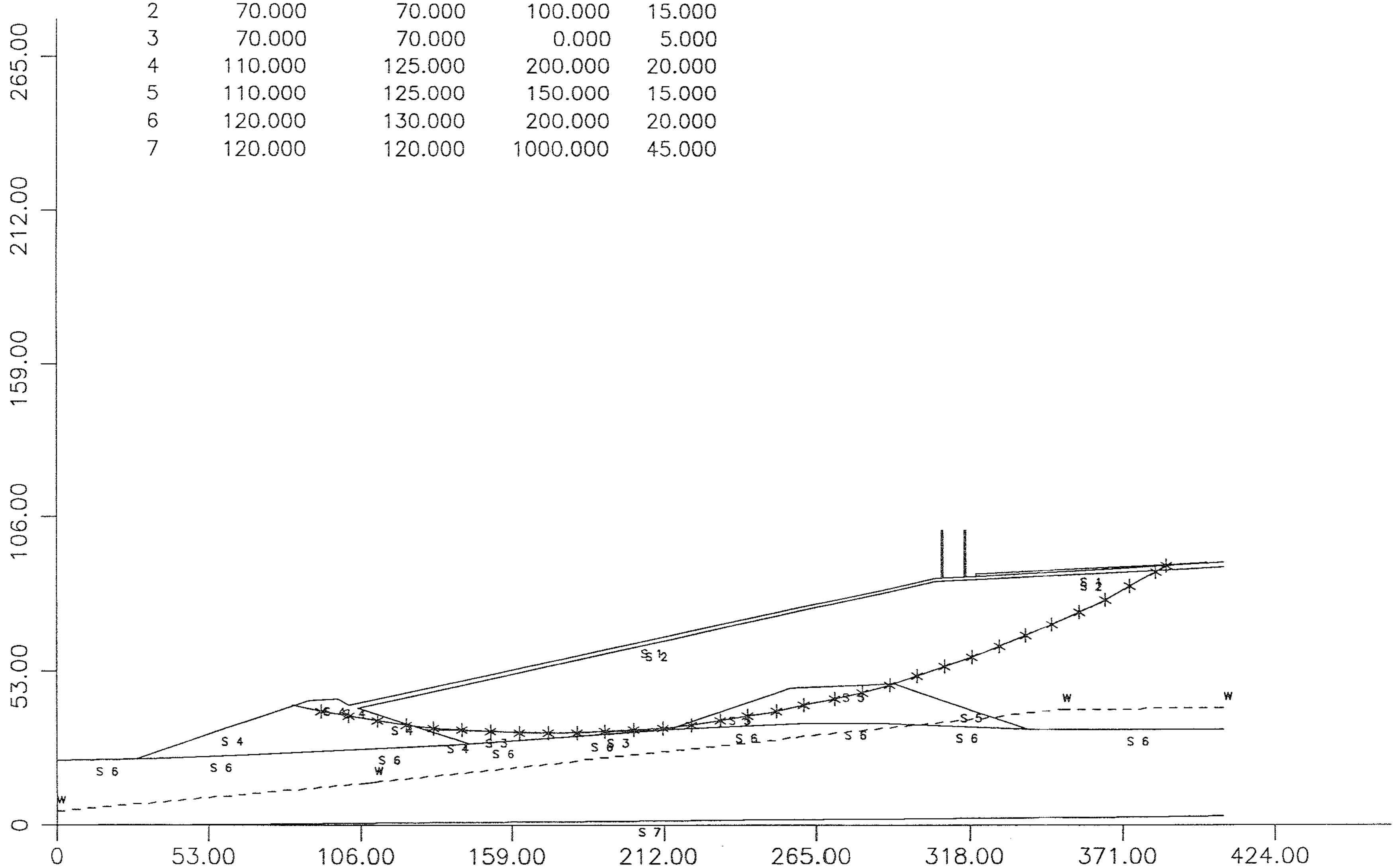
JOB NO. 1356-95-133

FIGURE 3

FIELDCREST CANNON SLOPE STABILITY SECTION 1-2

Minimum Factor of Safety 1.517

Soil	Moist Unit Weight	Saturated Unit Weight	Cohesion	Friction Angle
1	110.000	125.000	150.000	20.000
2	70.000	70.000	100.000	15.000
3	70.000	70.000	0.000	5.000
4	110.000	125.000	200.000	20.000
5	110.000	125.000	150.000	15.000
6	120.000	130.000	200.000	20.000
7	120.000	120.000	1000.000	45.000



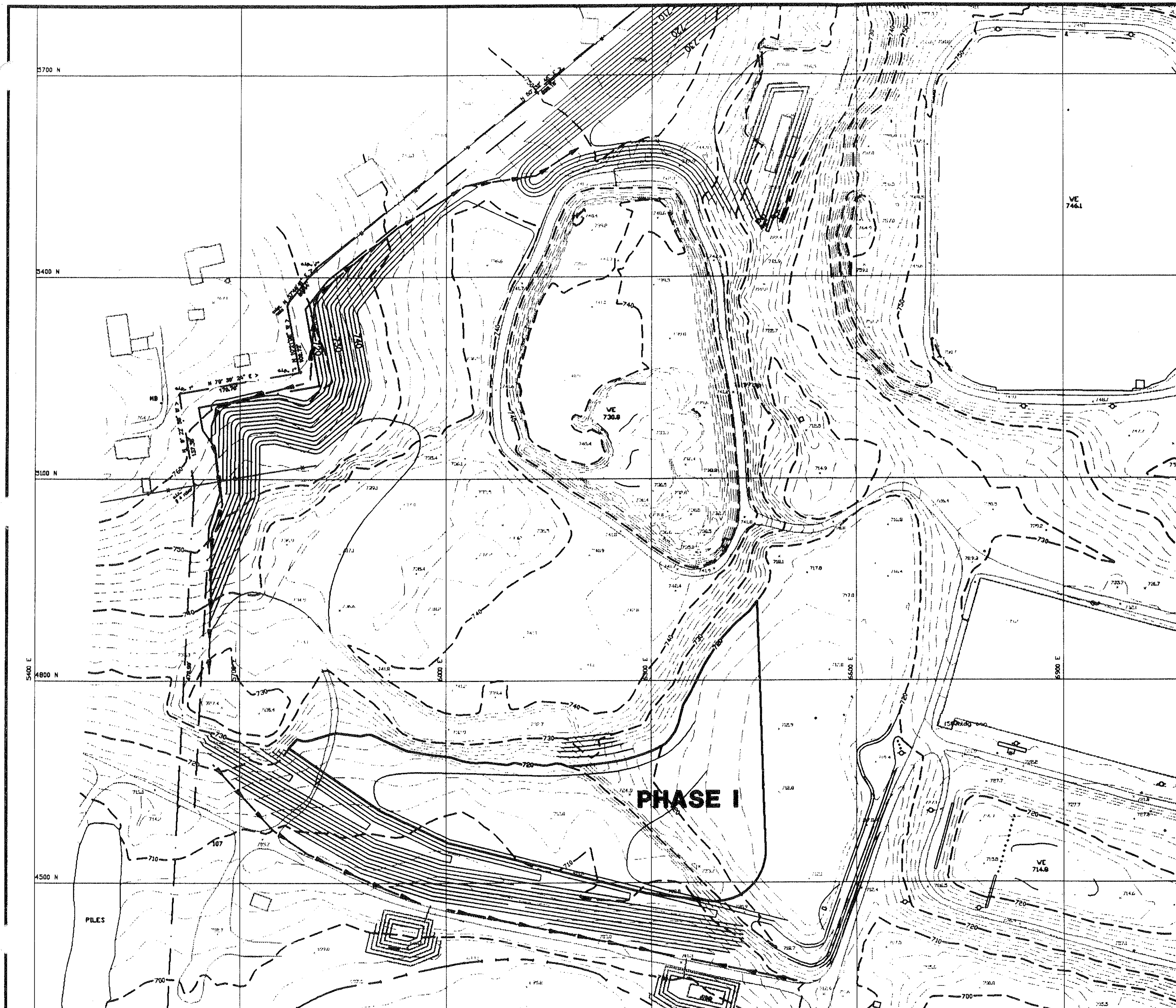
S&ME

JOB NO. 1356-85-133

FIGURE 4

Ref: Enochville, N.C. USGS Quad Sheet, 1970

NTS	S&ME ENVIRONMENTAL SERVICES ENGINEERING · TESTING	LOCATION MAP	FIGURE NO.
CHECKED BY: PGG		FIELDCREST CANNON ASH HANDLING FACILITY KANNAPOLIS, NORTH CAROLINA	1
DRAWN BY: JRB			
DATE: 7-13-95		JOB NO: 1356-95-133	



LEGEND

- — — — EXISTING GRADE CONTOUR
- ——— PROPOSED GRADING PLAN
- ━━━ PHASE CONTOUR

NOTE:

1) PHASE I COMPLETE AT ELEVATION 720.
2) DO NOT INSTALL STRIP DRAINS AT ELEVATION 720.

GRAPHIC SCALE

150 0 75 150 300

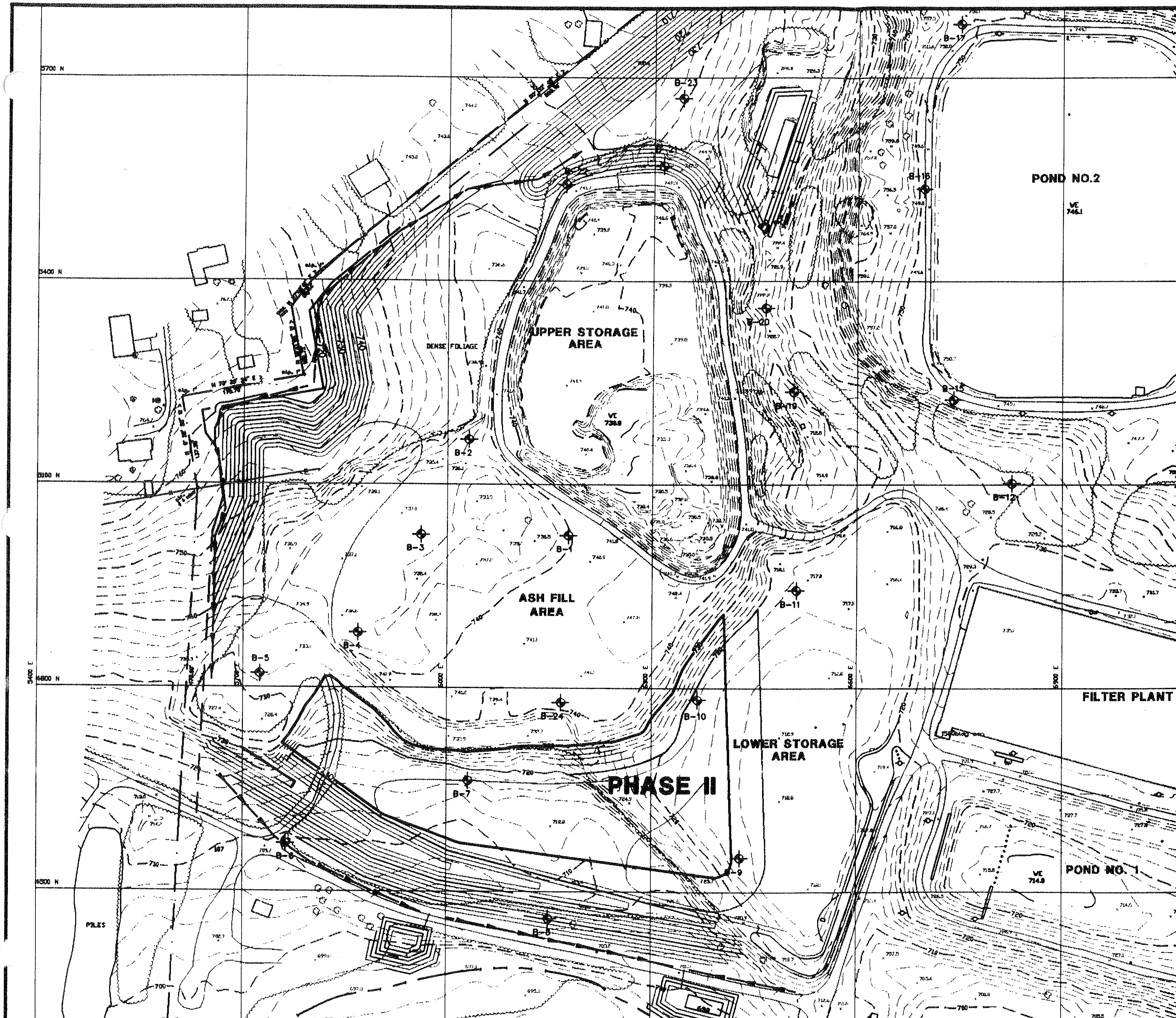
(IN FEET)

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING

PHASING DIAGRAM
PHASE I

ASH HANDLING FACILITY EXPANSION – FIELDREST CANNON INC.
KANNAPOLIS, NORTH CAROLINA

SCALE: 1" = 150'	DRAWN BY: CLD	CHECKED BY:
JOB NO. 1356-95-133	DATE: 9-15-95	FIGURE NO. 5



LEGEND

- EXISTING GRADE CONTOUR
- PROPOSED GRADING PLAN
- PHASE CONTOUR

NOTE:

1) INSTALL TOE DRAIN FOLLOWING COMPLETION OF INITIAL 5-FOOT LIFT IN PHASE II.(SEE UNDERDRAIN SYSTEM PLAN SHEET 3.)
2) PHASE II COMPLETE AT ELEVATION 730.
3) INSTALL STRIP DRAINS AT 20' O.C. SPACING AFTER REACHING ELEVATION 730 IN PHASE II.

GRAPHIC SCALE

150 0 75 150 300

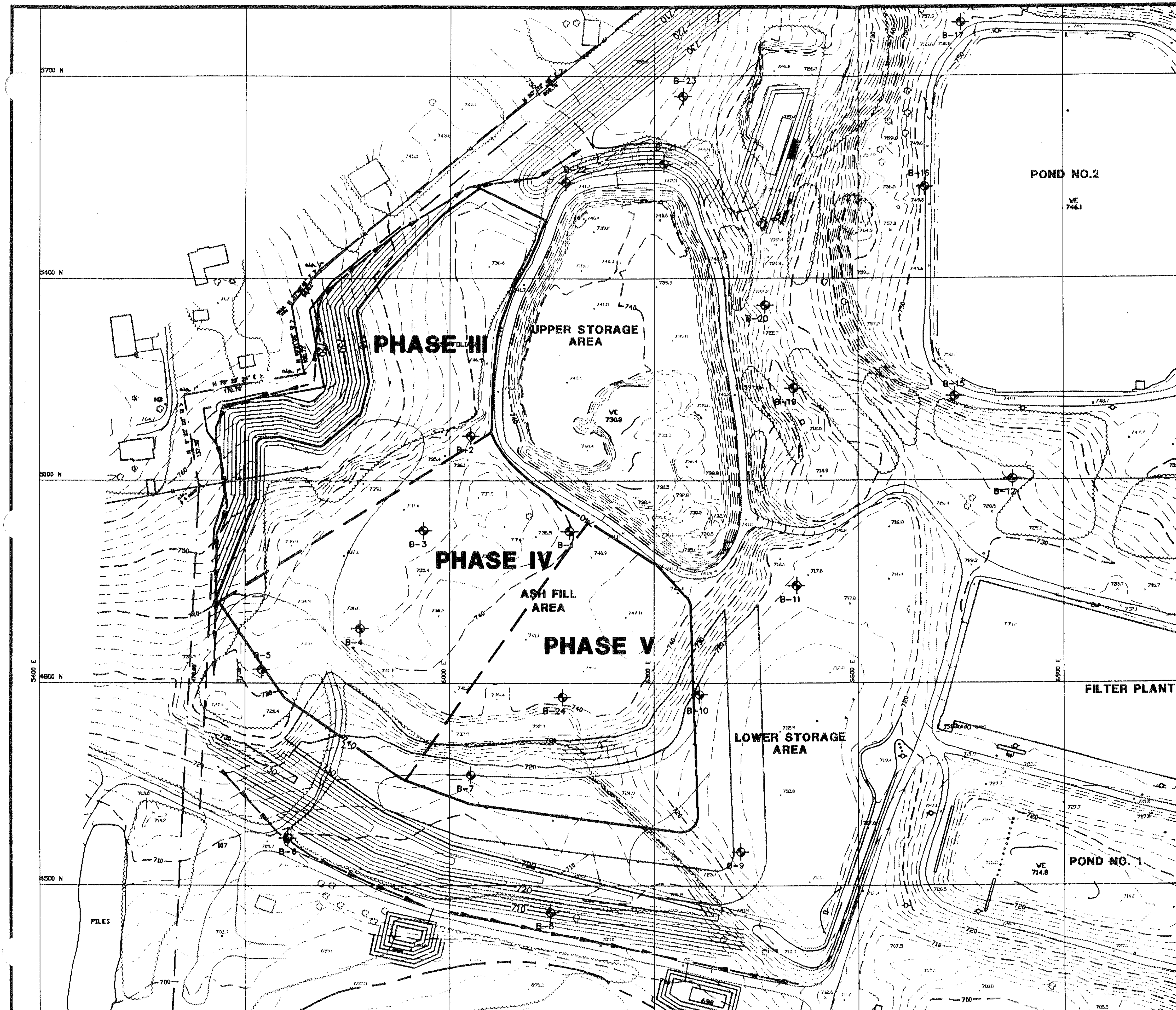
(IN FEET)

S&ME ENVIRONMENTAL SERVICES ENGINEERING · TESTING

PHASING DIAGRAM
PHASE II

ASH HANDLING FACILITY EXPANSION – FIELDREST CANNON INC.
KANNAPOLIS, NORTH CAROLINA

SCALE: 1" = 150'	DRAWN BY: CLD	CHECKED BY:
JOB NO. 1356-95-133	DATE: 9-15-95	FIGURE NO. 6



LEGEND

- - - - - EXISTING GRADE CONTOUR

——— PROPOSED GRADING PLAN

——— PHASE CONTOUR

NOTE:

1) PHASE III, IV, & V COMPLETED AT ELEVATION 740.
2) INSTALL STRIP DRAINS IN PHASE III UPON REACHING ELEVATION 740. STRIP DRAINS IN PHASES IV & V WILL HAVE ALREADY BEEN INSTALLED.

GRAPHIC SCALE

150 0 75 150 300

(IN FEET)

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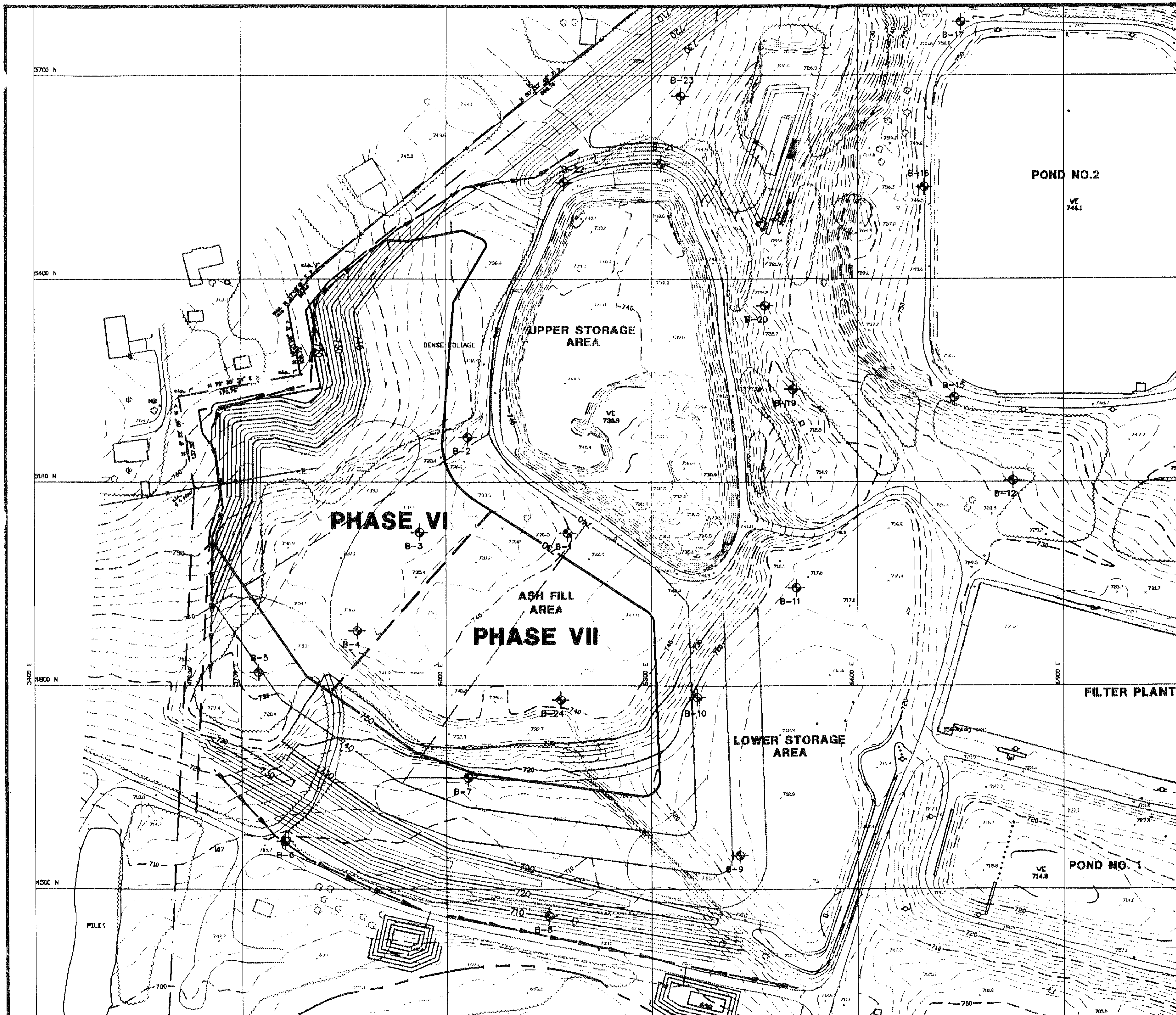
PHASING DIAGRAM
PHASE III, IV & V

ASH HANDLING FACILITY EXPANSION – FIELDREST CANNON INC.
KANNAPOLIS, NORTH CAROLINA

SCALE: 1" = 150'	DRAWN BY: CLD	CHECKED BY:
JOB NO. 1356-95-133	DATE: 9-15-95	FIGURE NO. 7



LEGEND

- – – – – – EXISTING GRADE CONTOUR
- ———— PROPOSED GRADING PLAN
- ━━━━ PHASE CONTOUR

NOTE:

1) PHASE VI & VII COMPLETED AT ELEVATION 750.
2) INSTALL STRIP DRAINS AT 20' O.C. SPACING AFTER REACHING ELEVATION 750 IN PHASES VI & VII.

GRAPHIC SCALE

150 0 75 150 300

(IN FEET)

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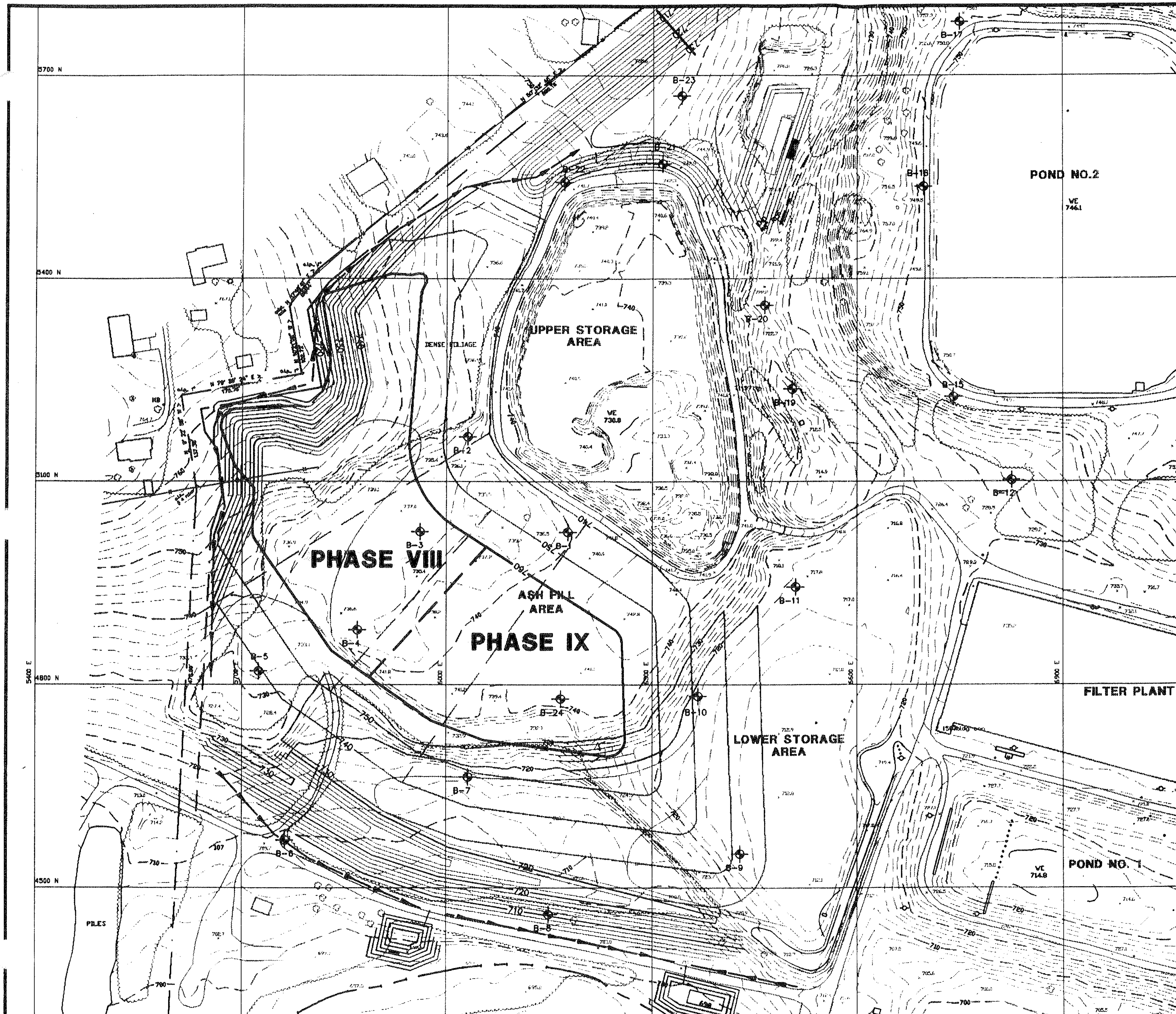
PHASING DIAGRAM
PHASE VI & VII

ASH HANDLING FACILITY EXPANSION – FIELDREST CANNON INC.
KANNAPOLIS, NORTH CAROLINA

SCALE: 1" = 150'	DRAWN BY: CLD	CHECKED BY:
JOB NO. 1356-95-133	DATE: 9-15-95	FIGURE NO. 8



LEGEND

- EXISTING GRADE CONTOUR
- PROPOSED GRADING PLAN
- PHASE CONTOUR

NOTE:

1) PHASE VIII & IX COMPLETED AT ELEVATION 760.
2) INSTALL STRIP DRAINS AT 20' O.C. SPACING AFTER REACHING ELEVATION 760 IN PHASES VIII & IX

GRAPHIC SCALE

150 0 75 150 300

(IN FEET)

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING · TESTING

PHASING DIAGRAM
PHASE VIII & IX

ASH HANDLING FACILITY EXPANSION – FIELDREST CANNON INC.
KANNAPOLIS, NORTH CAROLINA

SCALE: 1" = 150'	DRAWN BY: CLD	CHECKED BY:
JOB NO. 1356-95-133	DATE: 9-15-95	FIGURE NO. 9

APPENDIX V

EROSION AND SEDIMENTATION CONTROL PLAN

S&ME

October 5, 1995

North Carolina Department of Environment,
Health, and Natural Resources
Land Quality Section
919 North Main Street
Mooresville, North Carolina, 28115

Attention: Mr. Jerry Cook

Reference: **Erosion and Sedimentation Control Plan**
Ash Handling Facility Expansion
Fieldcrest Cannon, Inc.
Kannapolis, North Carolina
S&ME Job No. 1356-95-133

Gentlemen:

On behalf of Fieldcrest Cannon, Inc., S&ME, Inc. presents this Erosion and Sedimentation Control Plan for expansion of Fieldcrest Cannon's existing ash handling facility in Kannapolis, North Carolina. Expansion of the facility involves clearing two borrow areas, heavy grading, and construction of a new containment dike. These activities will disturb about 10 acres. This plan consists of engineering drawings, calculations, and a narrative that describes the construction, operation and maintenance of stormwater control measures for this project.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

S&ME, INC.

P. Greg Garrett, E.I.T.
Project Professional

Dan E. Brewer, P.E.
Project Manager
N.C. Registration No. 17582

NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER DAN E. BREWER

attachments

EROSION & SEDIMENTATION CONTROL PLAN
ASH HANDLING FACILITY EXPANSION
FIELDCREST CANNON, INC.
KANNAPOLIS, NORTH CAROLINA
S&ME JOB NO. 1356-95-133

Prepared For:

North Carolina Department of Environment,
Health and Natural Resources
Land Quality Section

Prepared By:

S&ME, Inc.
Charlotte, North Carolina

October 1995

EROSION & SEDIMENTATION CONTROL PLAN

Table of Contents

1.0 PROJECT INFORMATION

1.1 Site and Project Description

Fieldcrest Cannon, Inc. plans to expand their existing coal ash handling facility which is located approximately 2 miles northeast of Kannopolis, North Carolina. The property is located between Pump Station Road and Glenn Avenue, just southeast of Kannopolis Lake in Rowan County, North Carolina (See attached Location Map).

Past site operations have altered the site topography. Several containment ponds exist adjacent to an ash fill area. Site drainage is predominantly to the south to the unnamed creek which discharges to Irish Buffalo Creek just south of Kannopolis Lake. A small unnamed creek flows through the center of the northern portion of the site between Pond No.2 and the Upper Storage Area. This creek flows beneath the central and southern portions of the site in a 48-inch diameter reinforced concrete pipe that discharges to the unnamed creek near the bridge shown on the drawings. Runoff from the Upper Storage Area, the Lower Storage Area and a portion of the ash fill area flows to the overflow device in the southeast corner of the Lower Storage Area. All runoff to this device enters the wastewater treatment plant for treatment.

The site has been used for ash handling since the early 1970's. Fieldcrest would like to expand the facility to the south by constructing a new perimeter dike south of the existing ash fill and to the west by clearing and grading a wooded area. A portion of the property is located in the 100-year floodplain and will not be disturbed by this project.

The proposed expansion areas are shown on Sheet 6, Erosion Control Plan in Appendix A. The wooded area south of the existing ash fill will be cleared prior to construction of the new soil dike. Borrow Area I will be cleared and excavated to the grades shown. Soil from Borrow Area I will be used to construct the new containment dike. Soil from Borrow Area II will be used as needed to complete expansion of the facility and later for operation and closure of the facility. The total disturbed area for the expansion will be approximately 10 acres.

Following completion of the expansion, the ash fill will be operated so that runoff from the ash will be directed into the lower storage area. Runoff collected in the lower storage area will be treated in Fieldcrest's wastewater treatment plant.

1.2 Soils Information

Based on samples obtained by S&ME during a recent site investigation, residual soils at the site vary from clayey silts and sandy silts to clayey/silty sands and sandy clays. Ash materials at the site vary from fine sandy silts to silty fine sands. Erosion of bare, unvegetated areas is likely. Groundwater is not anticipated to be encountered during construction activities.

2.0 EROSION AND SEDIMENTATION CONTROL MEASURES

Various temporary and permanent erosion and sedimentation control measures will be required during the expansion and operation of the ash handling facility. These measures are illustrated on the drawings in Appendix A. The various erosion and sedimentation control measures have been designed in accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual, 1988.

2.1 Temporary Sediment Traps

Two temporary sediment traps will be constructed at the locations shown on Sheet 6. Less than 5 acres of disturbed area will drain into each sediment trap. The traps will not be located within the 100-year floodplain. Details for construction of the sediment traps are presented on the attached drawings. Sediment trap calculations are included Appendix B.

2.2 Rock Dams

Runoff from Borrow Area II will be routed through a sediment basin with a rock dam outlet structure (RD_1). The basin and rock dam have been designed for runoff assuming the entire Borrow Area II is developed. This will allow Borrow Area II to be developed as needed during construction and operation of the expansion area without upgrading the outlet structure. The rock dam will be maintained throughout the life of the borrow area.

An existing containment dike in the southwest corner of the ash fill will be used to form a sediment basin with a rock dam outlet structure (RD_2). By using this embankment with a rock dam outlet structure, sediment laden runoff can be controlled during clearing and grading of Borrow Area I.

2.3 Land Grading

Heavy grading will be required to establish grades in Borrow Area I. Grading in Borrow Area II will be confined to as small an area as possible to provide borrow soil as needed. All land grading will be controlled to the areas identified on the attached drawings.

All permanent soil cut and fill slopes will be 3H:1V or flatter across the site. If necessary, ash fill may be graded on 5H:1V or flatter slopes. Fill will be placed in eight inch thick loose lifts and compacted with compaction equipment.

2.4 Permanent Ditches

Both grass-lined and riprap-lined ditches will be used to convey runoff to the sediment traps and rock dams. Grass-lined ditches will be constructed with temporary straw with net liners to prevent erosion of bare soils prior to the establishment of grass in the ditches. A grass-lined ditch detail is included on Sheet 6. Ditch sizing calculations are included in Appendix B.

Riprap-lined ditches will be constructed in steep channel sections where flow velocities will be greater than the permissible velocity of a grass-lined ditch. Locations of riprap-lined ditches are shown on Sheet 5. A riprap-lined ditch detail is included on Sheet 6. Ditch sizing calculations are included in Appendix B.

2.5 Riprap Inlet/Outlet Protection

Inlets and outlets of each culvert will be protected from erosion by a riprap protection device. The riprap protection should be installed immediately following culvert installation. A detail is included on Sheet 6.

2.6 Surface Roughening

All cut and fill slopes will be roughened by discing or tracking with a tracked loader or dozer prior to vegetating. Surface stabilization will be accomplished with vegetation and mulch as soon as possible as specified in the seeding schedule on Sheet 7.

2.7 Permanent Seeding

Following grading and construction of the new containment dike, all disturbed areas including areas inside the ash fill boundary, will be permanently seeded. Seeding shall be performed according to the seeding specifications shown in the drawings.

During site operations, borrow soil may be needed to maintain access roads, ramps, and side slopes. Borrow Area II will be maintained as a borrow source during site operations. Disturbed areas within Borrow Area II that will not be used for 60 days will be seeded according to the seeding schedule on Sheet 6.

3.0 CONSTRUCTION SEQUENCE

1. Obtain plan approval and permits prior to beginning work.

2. Flag the work limits to prevent unnecessary clearing.

3. Hold preconstruction meeting at least one week prior to starting construction.

4. Install sediment traps and rock dams as first construction activity. Excavate temporary drainage channels in cut/fill areas as needed to ensure runoff from cleared areas will flow through the sediment traps and rock dams. Install permanent culverts at locations shown on Drawing 1.

5. Clear Borrow Area I and the wooded area south of the existing containment dike. Prepare subgrade for construction of new soil containment dike by removing vegetation and grubbing roots. If cleared brush is to be burned, Contractor shall be responsible for obtaining required burn permits.

6. Grade Borrow Area I to the contours shown on the Grading Plan. Soil excavated from Borrow Area II shall be used to construct the new containment dike.

7. Following completion of grading of Borrow Area I and construction of the new soil dike, construct permanent channels at locations shown on Drawing 1. Channel details are shown on Drawing 2.

8. Finish all cut and fill slopes as soon as rough grading is complete. Leave slopes slightly roughened and vegetate and mulch in accordance with the seeding specifications immediately. Grass-lined channels shall be vegetated as soon as possible.

9. All erosion and sediment control structures will be inspected weekly and after each rainfall event during construction. Maintain all erosion control measures according to the attached maintenance plan.

4.0 MAINTENANCE PLAN

The following maintenance plan shall be followed until the site is completely stabilized after construction. During construction the Contractor shall be responsible for inspection and maintenance of all erosion control features.

1. All erosion control measures will be checked for stability and operation following any runoff producing rainfall and at least once every week. Any needed repairs will be made immediately so that all erosion control measures are maintained as designed.

2. The sediment traps and rock dams will be cleaned out when the level of sediment reaches the mid-depth point below the weir elevation. Gravel will be cleaned or replaced when the sediment pool no longer drains properly.

3. All seeded areas will be fertilized, reseeded as necessary, and mulched according to the seeding specifications in order to maintain a dense vegetative cover.

5.0 FINANCIAL RESPONSIBLITY/OWNERSHIP FORM

FINANCIAL RESPONSIBILITY/OWNERSHIP FORM
SEDIMENTATION POLLUTION CONTROL ACT

No person may initiate any land-disturbing activity on one or more contiguous acres as covered by the Act before this form and an acceptable erosion and sedimentation control plan have been completed and approved by the Land Quality Section, N.C. Department of Environment, Health, and Natural Resources. (Please type or print and, if question is not applicable, place N/A in the blank.)

Part A.

1. Project Name Fieldcrest Cannon Ash Handling Facility Expansion

2. Location of land-disturbing activity: County Rowan, City or Township Kannapolis, and Highway / Street Pump Station Road

3. Approximate date land-disturbing activity will be commenced: ______

4. Purpose of development (residential, commercial, industrial, etc.) : Industrial

5. Total acreage disturbed or uncovered (including off-site borrow and waste areas) : 10

6. Amount of fee enclosed $ 210.00

7. Has an erosion and sedimentation control plan been filed ? Yes X No ______

8. Person to contact should sediment control issues arise during land-disturbing activity.

   Name Battle Moore Telephone (704) 939-2654

9. Landowner (s) of Record (Use blank page to list additional owners.):

   Fieldcrest Cannon, Inc.
   Name (s)

   P. O. Box 107
   Current Mailing Address

   Kannapolis NC 28082
   City State Zip

   One Lake Drive
   Current Street Address

   Kannapolis NC 28081
   City State Zip

10. Recorded in Deed Book No. 658 Page No. 956

Part B.

1. Person (s) or firms (s) who are financially responsible for this land-disturbing activity (Use the blank page to list additional persons or firms):

   Fieldcrest Cannon, Inc.
   Name of Person (s)or Firm (s)

   P. O. Box 107
   Mailing Address

   Kannapolis NC 28082
   City State Zip

   Telephone (704) 939-2654

   One Lake Drive
   Street Address

   Kannapolis NC 28081
   City State Zip

   Telephone (704) 939-2654

2. (a) If the Financially Responsible Party is not a resident of North Carolina give name and street address of a North Carolina Agent.

N/A

Name

Mailing Address | Street Address

City State Zip | City State Zip

Telephone | Telephone

(b) If the Financially Responsible Party is a Partnership or other person engaging in business under an assumed name, attach a copy of the certificate of assumed name. If the Financially Responsible Party is a Corporation give name and street address of the Registered Agent.

Prentice Hall Legal & Financial Services

Name of Registered Agent

32 Loockerman Square, Suite L-100 | Same

Mailing Address | Street Address

Dover DE 19901

City State Zip | City State Zip

(302) 674-1221

Telephone | Telephone

The above information is true and correct to the best of my knowledge and belief and was provided by me under oath. (This form must be signed by the financially responsible person if an individual or his attorney-in-fact or if not an individual by an officer, director, partner, or registered agent with authority to execute instruments for the finanacially responsible person). I agree to provide corrected information should there be any change in the information provided herein.

Type or print name | Title or Authority

Signature | Date

I, ______________________________, a Notary Public of the County of ______________

State of North Carolina, hereby certify that ______________________________ appeared personally before me this day and being duly sworn acknowledged that the above form was executed by him.

Witness my hand and notarial seal, this ______day of ____________________, 19________.

Seal

Notary

My commission expires______________________

Rev 11/90

APPENDIX B
EROSION AND SEDIMENTATION CONTROL CALCULATIONS

S&ME

JOB NO. 1356-95-133
SHEET NO. 1
DATE 7/21/95

JOB NAME FIELDCREST CANNON
COMPUTED BY PGG
SUBJECT EROSION CONTROL CALCS.
CHECKED BY DWJ

OBJECTIVE: DETERMINE EROSION CONTROL FEATURES NEEDED TO DEVELOP BORROW AREA II.

PARAMETERS: - MAX 3:1 SLOPES

- PROPOSED LAYOUT ON SITE DEVELOPMENT PLAN

REFERENCE: 1) NORTH CAROLINA EROSION & SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL

2) ELEMENTS OF URBAN STORMWATER DESIGN, MALCOM, 1989.

TOTAL DISTURBED AREA BY PLANIMETER = 13.3 in^2

$13.3 \text{ in}^2 \times 100^2 / 43560 = 3.05$ AC (BORROW AREA BOUNDARY)

OFF-SITE DRAINAGE AREA ≅ 4.4 AC (FROM PROPERTY LINE TO PUMP STATION ROAD)

SINCE DRAINAGE AREA > 5AC, USE A ROCK DAM AND BASIN

ROCK DAM RD1

DRAINAGE AREA = 7.45 AC (3.05 DISTURBED, 4.4 AC FROM OFF-SITE)

SEDIMENT CAPACITY:

REQUIRED SEDIMENT VOLUME = $1800 \text{ ft}^3 \times 3 \text{ ac} = 5400 \text{ ft}^3$

REQUIRED SURFACE AREA = 0.01 × PEAK INFLOW (cfs)

Q = PEAK INFLOW = CIA

FIND Q_{10} (FOR 10-YR STORM EVENT)

S&ME

JOB NO. 1356-95-133

SHEET NO. 2

DATE 7/21/95

JOB NAME FIELDCREST CANNON

COMPUTED BY PGG

SUBJECT EROSION CONTROL

CHECKED BY DWW

USE T_c = 5 MIN (conservative)

∴ $I_{10\text{-}YR} = 6.5$ in/hr FROM CHARLOTTE IDF, FIGURE 8.03g

USE C = 0.50 FOR DISTURBED, GRADED AREA, C = 0.3 FOR OFF-SITE AREA (UNDISTURBED)

$$C_c = \frac{(0.50 \times 3) + (0.3 \times 4.4)}{7.45} = 0.38$$

$$Q_{10} = (0.38)(6.5)(7.45) = 18.4 \text{ cfs}$$

∴ REQUIRED SURFACE AREA = $0.01 \times 18.4 = 0.184$ AC = 8015 ft²

SURFACE AREA PROVIDED AT ELEVATION 723.0 = 8200 ft² > 8015 ft² OK

CHECK VOLUME PROVIDED FROM 723 TO 721:

AREA AT 723.0 = 8200 FT²
AREA AT 721.0 = 85' x 15' = 1275 ft²

$$\frac{8200 + 1275}{2} \times 2' \text{ DEEP} = 9475 \text{ ft}^3$$

VOLUME REQUIRED = 1800 ft³ x 3 AC (DISTURBED) = 5400 ft³

SINCE 9475 > 5400 OK

SUMMARY

EMBANKMENT:

TOP ELEVATION = 725.0

EMBANKMENT HEIGHT ≈ 1' (REMAINING TRAP VOLUME FORMED BY EXCAVATION

EXCAVATE BASIN TO DIMENSIONS SHOWN ON PLAN. BOTTOM ELEVATION = 721.0

FIND STONE DAM LENGTH BY WEIR EQUATION: $Q = C_w L H^{3/2}$

$C_w = 3.0$ FOR BROAD CRESTED WEIR (REF 2)

LET H = 1' (FLOW DEPTH 1')

$$\therefore L = \frac{18.4 \text{ cfs}}{(3.0)(1)^{3/2}} = 6.1'$$

SET LENGTH = 8' AT ELEVATION 723.0.

Table 8.03a
Value of Runoff Coefficient (C) for Rational Formula

Land Use	C	Land Use	C
Business:		Lawns:	
Downtown areas	0.70-0.95	Sandy soil, flat, 2%	0.05-0.10
Neighborhood areas	0.50-0.70	Sandy soil, ave., 2-7%	0.10-0.15
		Sandy soil, steep, 7%	0.15-0.20
Residential:		Heavy soil, flat, 2%	0.13-0.17
Single-family areas	0.30-0.50	Heavy soil, ave., 2-7%	0.18-0.22
Multi units, detached	0.40-0.60	Heavy soil, steep, 7%	0.25-0.35
Multi units, attached	0.60-0.75		
Suburban	0.25-0.40	Agricultural land:	
		Bare packed soil	
Industrial:		Smooth	0.30-0.60
Light areas	0.50-0.80	Rough	0.20-0.50
Heavy areas	0.60-0.90	Cultivated rows	
		Heavy soil no crop	0.30-0.60
Parks, cemeteries	0.10-0.25	Heavy soil with crop	0.20-0.50
		Sandy soil no crop	0.20-0.40
Playgrounds	0.20-0.35	Sandy soil with crop	0.10-0.25
		Pasture	
Railroad yard areas	0.20-0.40	Heavy soil	0.15-0.45
		Sandy soil	0.05-0.25
Unimproved areas	0.10-0.30	Woodlands	0.05-0.25
Streets:			
Asphalt	0.70-0.95		
Concrete	0.80-0.95		
Brick	0.70-0.85		
Drives and walks	0.75-0.85		
Roofs	0.75-0.85		

NOTE: The designer must use judgment to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

The overland flow portion of flow time may be determined from Figure 8.03a. The flow time (in minutes) in the channel can be estimated by calculating the average velocity in feet per minute and dividing the length (in feet) by the average velocity.

Step 4. Determine the rainfall intensity, frequency, and duration (Figures 8.03b through 8.03g—source: North Carolina State Highway Commission; Jan. 1973). Select the chart for the locality closest to your location. Enter the "duration" axis of the chart with the calculated time of concentration, Tc. Move vertically until you intersect the curve of the appropriate design storm, then move horizontally to read the rainfall intensity factor, i, in inches per hour.

Step 5. Determine peak discharge, Q (ft^3/sec), by multiplying the previously determined factors using the rational formula (Sample Problem 8.03a).

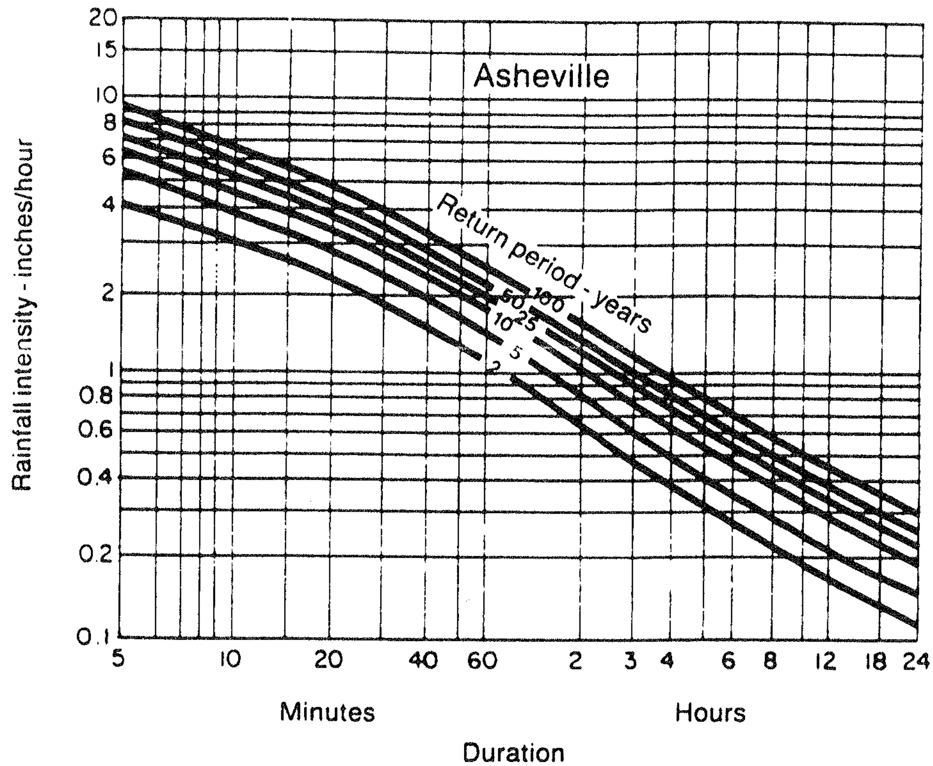


Figure 8.03f Rainfall intensity duration curves—Asheville.

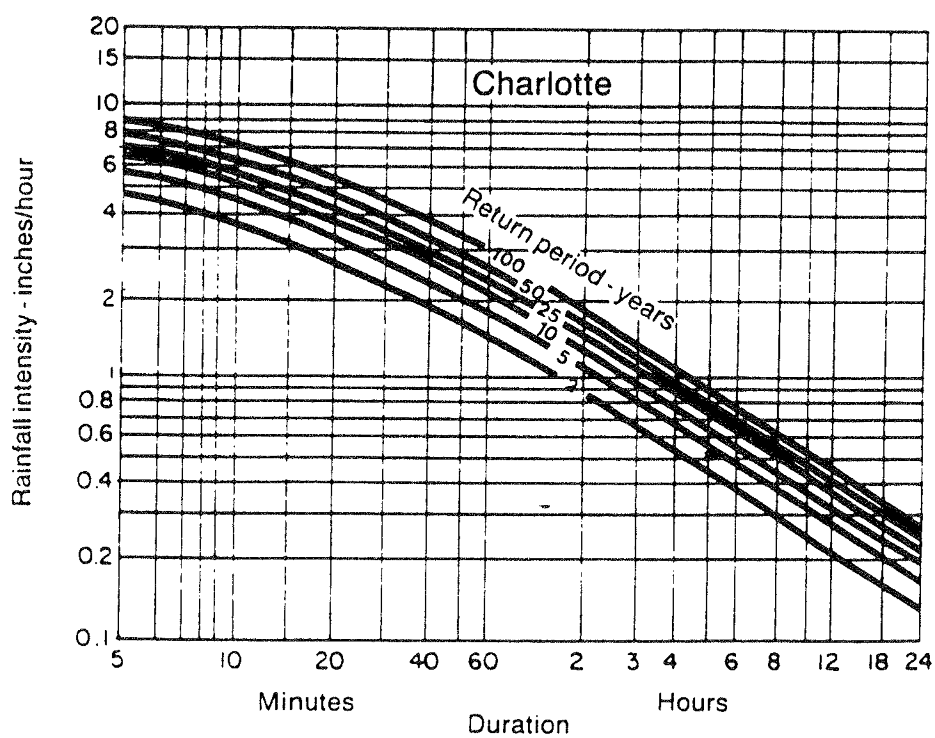
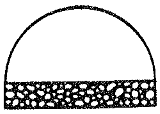


Figure 8.03g Rainfall intensity duration curves—Charlotte.

6.63 ROCK DAM



Definition

A rock embankment located to capture sediment.

Purpose

To retain sediment on the construction site and prevent sedimentation in off-site streams, lakes, and drainage ways.

Conditions Where Practice Applies

The rock dam may be used instead of the standard sediment basin with barrel and riser (Practice 6.61, *Sediment Basin*). The height of the dam is limited to 8 ft, and drainage area should be no larger than 50 acres.

The rock dam is preferred where a stable, earthen embankment would be difficult to construct, and riprap and gravel are readily available. The site must be accessible for periodic sediment removal.

A rock dam should not be located in a live stream.

Planning Considerations

A sediment basin formed by a rock embankment is used primarily where it is desirable to have the top of the structure serve as the overflow outlet and where suitable rock is readily available. A long weir crest is designed to keep flow depth shallow and discharge velocities low. The inside face of the rock dam must be covered with gravel to reduce the rate of seepage through the dam so that a sediment pool will form during runoff events. The pool should drain slowly through the gravel to improve basin trapping efficiency.

The abutments of the rock dam must be higher than the top of the dam to prevent any water from flowing against the soil. A cutoff trench should be installed under the entire length of dam and suitable filter fabric placed between the rock structure and its soil base and abutments. This prevents "piping" or soil movement in the foundation and abutments. Rock should extend downstream from the toe of the dam, on zero grade, a sufficient distance to stabilize flow and prevent erosion.

For other planning considerations see Practice 6.61, *Sediment Basin*.

Design Criteria

Drainage area—limited to 50 acres

Design basin life—3 years or less

Dam height—limited to 8 ft

Basin locations—select areas that:

- provide a large surface area to trap sediment;
- intercept runoff primarily from disturbed areas;
- are accessible for periodic sediment removal;
- interfere minimally with construction activities.

Basin volume—The volume of the basin should be at least 1800 ft^3/acre based on disturbed area draining into the basin, and measured 1 ft below the top of the dam.

Spillway capacity—The spillway should carry peak runoff for a 10-year storm with maximum flow depth 1 ft and a minimum freeboard 1 ft. The top of the rock embankment may serve as the spillway.

Embankment—
Top width— 5 ft minimum
Side slopes— Maximum: 2:1 upstream slope
3:1 downstream slope

Rock abutments should extend to an elevation at least 2 ft above the spillway. Abutments should be 2 ft thick with 2:1 side slopes. The rock abutments should extend down the downstream face of the dam to the toe, at least 1 ft higher than the rest of the dam to protect the earth abutments from scour.

Outlet protection—A rock apron at least 1.5 ft thick should extend downstream from the toe of the dam, on zero grade, a sufficient distance to prevent channel erosion, or a distance equal to the height of the dam whichever is greater.

Rock fill—Rock should be well graded, hard, erosion resistant stone with a minimum d_{50} size of 9 inches.

Protection from "piping"—A keyway lined with geotextile filter fabric should be on the soil foundation under the rock fill. To prevent soil movement and piping under the dam, the filter fabric must extend from the keyway to the downstream edge of the apron and must run under the dam's abutments.

Basin dewatering—The entire upstream face of the rock structure should be covered with fine gravel (NCDOT #57 washed stone or equivalent) a minimum of 1 ft thick to reduce the drainage rate.

Trap efficiency—To obtain maximum trapping efficiency, consider the following design principles:

- Allow surface area, 0.01 acres per cfs based on the 10-yr storm.
- Locate sediment inflow to the basin away from the dam to prevent short circuits from inlets to the outlet.
- Design for a long detention period before the basin is completely drained (8 hrs or more).

Construction Specifications

1. Clear the areas under the embankment and strip it of roots and other objectionable material. Clear the reservoir area to facilitate sediment removal.

2. Excavate a cutoff trench a minimum of 2 ft deep and 2 ft wide with 1:1 side slopes under the total length of the dam at its centerline. Line the trench with extra-strength filter fabric before backfilling with rock. Apply filter fabric under the rockfill embankment, from the upstream edge of the keyway to the

downstream edge of the apron. Overlap filter material a minimum of 1 ft at all joints, with the upstream strip laid over the downstream strip.

3. Construct the embankment with well-graded rock and gravel to the size and dimensions shown on the drawings. It is important that rock abutments be at least 2 ft higher than the spillway crest and at least 1 ft higher than the downstream face of the dam, all the way to the toe, to prevent scour and erosion at the abutments.

4. Sediment-laden water from the construction site should be diverted into the basin reservoir at the furthest area from the dam.

5. Construct the rock dam before the basin area is cleared to minimize sediment yield from construction of the basin. Stabilize immediately all areas disturbed during the construction of the dam except the sediment pool (*References: Surface Stabilization*).

6. Safety—Sediment basins should be considered dangerous because they attract children. Steep side slopes should be avoided. Fences with warning signs may be needed if trespassing is likely. All state and local requirements must be followed.

Maintenance

Check sediment basins after each rainfall. Remove sediment and restore original volume when sediment accumulates to about one-half the design volume.

Check the structure for erosion, piping, and rock displacement after each significant rainstorm and repair immediately.

Remove the structure and any unstable sediment immediately after the construction site has been permanently stabilized. Smooth the basin site to blend with the surrounding area and stabilize. All water and sediment should be removed from the basin prior to dam removal. Sediment should be placed in designated disposal areas and not allowed to flow into streams or drainageways during structure removal.

References

Surface Stabilization
6.10, Temporary Seeding
6.11, Permanent Seeding
6.12, Sodding
6.13, Trees, Shrubs, Vines, and Ground Covers

Runoff Control Measures
6.20, Temporary Diversions

Outlet Protection
6.41, Outlet Stabilization Structure

North Carolina Department of Transportation
Standard Specifications for Roads and Structures

S&ME

JOB NO. 1356-95-133
SHEET NO. 1
DATE 7/24/95
JOB NAME FIELDCREST CANNON
COMPUTED BY PGG
SUBJECT EROSION CONTROL
CHECKED BY DWW

OBJECTIVE: SIZE ASA FILL AREA PERIMETER DITCHES

PARAMETERS: DITCH ALONG NORTH AND WEST SIDES OF THE FILL SHOULD BE SIZED FOR BOTH RUN-ON CONTROL AND RUNOFF CONTROL FROM COMPLETED FILL. DITCH SOUTH OF PROPOSED PERIMETER BERM NEEDS TO BE SIZED FOR RUNOFF ONLY (THERE IS NO RUN-ON)

REFERENCE:
- NORTH CAROLINA EROSION & SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL.
- FLOWMASTER COMPUTER PROGRAM
- NORTH AMERICAN GREEN PRODUCT INFORMATION

FOR NORTH AND WEST SIDE DITCH DETERMINE A SUITABLE DITCH SIZE TO CONTROL STORMWATER RUN-ON:

DITCH "A" NORTH SIDE DITCH FLOWS TO BORROW AREA 1 AND ROCK DAM RD1. ∴ CONTRIBUTING OFF-SITE DRAINAGE AREA EXTENDS FROM PROPERTY LINE TO PUMP STATION ROAD (RIDGE LINE). APPROXIMATE DRAINAGE AREA = 200' x 400' = 80,000 ft², SAY 2.4 ACRES. THIS AREA IS HEAVILY WOODED OR GRASSED LAWNS, THEREFORE, $C \cong 0.30$ FOR 10 YR STORM, $T_c = 5$ MIN ∴ $I_{10} = 6.5$ in/hr (CHARLOTTE IDF, Fig. 8.03g)

$$Q_{10} = CIA$$

$$Q_{10} = (0.3)(6.5)(2.4) = 4.7 \text{ cfs}$$

WHEN FILL IS COMPLETE, CONTRIBUTING RUNOFF FROM THE FILL IS FROM AN AREA = 0.7 AC. $C \approx 0.5$ FOR FINAL SOIL CAP PRIOR TO GRASSING. $T_c < 5$ MIN ∴ $I_{10} = 6.5$ in/hr.

S&ME

JOB NO. 1356-95-133
SHEET NO. 2
DATE 7/24/94
JOB NAME FIELDCREST CANNON
COMPUTED BY PGG
SUBJECT EROSION CONTROL
CHECKED BY [signature]

FIND COMPOSITE C FOR ON-SITE AND OFF-SITE DRAINAGE AREAS :

$$C_c = \frac{(2.4\,AC \times 0.3) + (0.7\,AC \times 0.5)}{3.1\,AC} = 0.35$$

$$Q_{10}\ \text{TOTAL} = (0.35)(6.5)(3.1\ ac) = 7.05\ cfs$$

USE FLOWMASTER TO SIZE THE DITCH. USE PERMISSIBLE VELOCITY METHOD.

PARAMETERS :

DITCH SLOPE $= \frac{10'}{150'} = 0.067\ ft/ft$

FOR BARE SOIL $n = 0.02$ (Table 8.05 b)
PERMISSIBLE VELOCITY for $n = 0.02$ is $V_p = 2.5$ fps (FINE SAND AND SILT, TABLE 8.05 d)

TRY GRASS FOR PERMANENT LINER, $V_p = 4.0$ fps for FESCUE (Table 8.05 a)

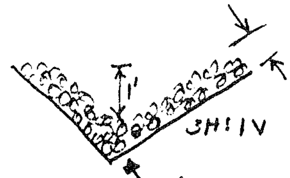
RESULTS:

FOR "V" DITCH, 1' DEEP WITH 3H:1V SIDE SLOPES

- V FOR $n = 0.02$ TOO HIGH, NEED TEMPORARY LINER. CAN'T MEET SHEAR STRESS REQUIREMENTS FOR TEMP. LINER SINCE VELOCITY SO HIGH, USE RIP RAP LINER

SHEAR STRESS for 9" RIP RAP OK. (SEE ATTACHED FLOWMASTER OUTPUT)
RIPRAP THICKNESS = $1.5^2 \times 9" =$ 20 INCHES

DESIGNATE DITCH TYPE R_1 :



1356-95-153 PAGE 3
COMPUTED BY: DWW
CHECKED BY: PGG
7/28/95

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: FIELDCREST CANNON

Comment: NORTH SIDE DITCH, d50=9 in RIPRAP

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.068
Channel Slope....	0.0600 ft/ft
Discharge........	7.05 cfs

Computed Results:

Depth............	0.88 ft
Velocity.........	3.00 fps
Flow Area........	2.35 sf
Flow Top Width...	5.31 ft
Wetted Perimeter.	5.60 ft
Critical Depth...	0.81 ft
Critical Slope...	0.0979 ft/ft
Froude Number....	0.80 (flow is Subcritical)

CHECK SHEAR STRESS:

$T = \gamma d s$

$T = (62.4)(0.88)(0.06)$

$T = 3.29 \text{ lb/ft}^2 < 3.8 \text{ lb/ft}^2$ OK (TABLE 8.05g)

Open Channel Flow Module, Version 3.42 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

S&ME

JOB NO. 1356-95-133
SHEET NO. 4
DATE 7/24/95

JOB NAME FIELDCREST CANNON
COMPUTED BY PGG
SUBJECT EROSION CONTROL
CHECKED BY DWW

DITCH "B", WEST SIDE DITCH:

BASED ON TOPOGRAPHY RUN-ON AREA IS MAINLY AT BEGINNING SECTION OF THE DITCH. THEREFORE, DITCH WILL BE SIZED IN TWO SECTIONS.

SECTION 1

RUN-ON DRAINAGE AREA ≈ 1.45 AC

FINAL FILL DRAINAGE AREA TO SECTION 1 = 0.8 AC

$C_{RUN-ON} = 0.30 \qquad C_{FILL} = 0.50$

$$C_c = \frac{0.30(1.45) + 0.50(0.8)}{2.6} = 0.32$$

$T_c = 5\text{MIN}$ (conservative), $\therefore I_{10} = 6.5\ \text{IN/hr}$

$Q_{10} = (0.32)(6.5)(2.6) = 5.4$ cfs

DITCH SLOPE = 0.06 ft/ft (SAME AS DITCH "A")

FROM CALCULATION FOR DITCH "A", R_1 TYPE DITCH WILL BE SUITABLE FOR USE SINCE SLOPE IS SIMILAR AND Q IS LESS THAN Q FOR DITCH "A".

REMAINING DITCH SECTION SHOULD BE SIZED FOR SECTION 1 FLOW PLUS ADDITIONAL FLOW FROM COMPLETED ASH FILL (TO ROCK DAM RD_2).

Q_{10} FROM FILL = CIA

$c = 0.5$

$I = 6.5$ in/hr

$A = 1.4$ AC

$Q_{10} = (0.5)(6.5)(1.4) = 4.55$ cfs (FROM FILL)

S&ME

JOB NO. 1356-95-133
SHEET NO. 5
DATE 7/24/95

JOB NAME Fieldcrest Cannon
COMPUTED BY PGG
SUBJECT Erosion Control
CHECKED BY DWW

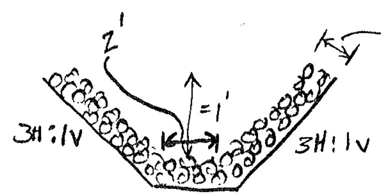
Q_{TOTAL} for Section 2 = 5.4 cfs + 4.55 cfs = 10 cfs

Avg. Slope for Section 2 = 0.10 ft/ft

Based on high flows, need to use a trapezodial channel.

From Flowmaster:

Use Rip Rap d_{50} = 12"



2' thick ; d_{50} = 12"

Designate this a R_2 ditch type.

This ditch will exit to Rock Dam RD2 during construction and will be routed to the lower storage area during ash fill operations.

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7/24/95
CALC. BY PGG
CK BY: DWW

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: FIELDCREST CANNON

Comment: WEST SIDE DITCH, SECTION 2

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.084
Channel Slope....	0.1000 ft/ft
Discharge........	10.00 cfs

d_{50} = 12" RIP RAP

Computed Results:

Depth............	0.72 ft
Velocity.........	3.32 fps
Flow Area........	3.01 sf
Flow Top Width...	6.33 ft
Wetted Perimeter.	6.57 ft
Critical Depth...	0.66 ft
Critical Slope...	0.1415 ft/ft
Froude Number....	0.85 (flow is Subcritical)

CHECK SHEAR STRESS:

$T = \gamma d s = (62.4)(0.72)(0.1) = 4.49$

T ALLOWABLE FOR 12" RIP RAP = 5.00 > 4.49 OK

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JOB NO. 1356-95-133
SHEET NO. 7
DATE 7/24/95
JOB NAME FIELDCREST CANNON
COMPUTED BY PGG
SUBJECT EROSION CONTROL
CHECKED BY DWW

SIZE DITCH SOUTH OF PROPOSED PERIMETER BERM. THIS DITCH WILL PROVIDE SHORT TERM SEDIMENT CONTROL FOR CLEARING AND CONSTRUCTION OF THE BERM. DITCH IS DIVIDED INTO SECTIONS THAT DISCHAGE TO SEDIMENT TRAPS ST3 AND ST4.
MAXIMUM DISTURBED AREA RUNOFF DITCH MUST CARRY IS APPROXIMATELY = 2 AC (FOR DITCH SECTION TO ST3)

USE $T_c = 5\,min$ $\therefore$ $I_{10} = 6.5\ in/hr$

FOR DISTURBED CONDITIONS USE $C = 0.5$ (BARE EARTH)

$$Q_{10} = CIA$$
$$= (0.5)(6.5)(2) = 6.5\ cfs$$

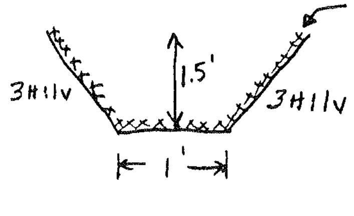
CHANNEL SLOPE (FLAT PORTION) = 0.01 ft/ft

FROM FLOWMASTER:

USE NORTH AMERICAN GREEN S75 STRAW WITH NET LINER AS A TEMPORARY LINER.

ESTABLISH A PERMANENT GRASS LINER AS SOON AS POSSIBLE

DESIGNATE DITCH AS G1.



FOR INITIAL STEEP SECTION OF DITCH, RUNOFF AREA IS APPROX. 1/4 OF TOTAL. TO BE CONSERVATIVE, SIZE DITCH FOR ABOUT HALF OF FLOW FOR TOTAL DRAINAGE AREA
$\therefore Q \approx 3\ cfs$ $S = 0.08\ FT/FT$
FROM FLOWMASTER, DITCH G1 IS OK FOR THIS SECTION.

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7/24/95
CALC. BY PGG
CK BY DWW

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: FIELDCREST CANNON

Comment: SOUTH DITCH TO SEDIMENT TRAP ST3 SHALLOW SLOPE SECTION

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.028 FOR NORTH AMERICAN GREEN S75
Channel Slope....	0.0100 ft/ft
Discharge........	6.50 cfs

Computed Results:

Depth............	0.71 ft
Velocity.........	2.91 fps
Flow Area........	2.23 sf
Flow Top Width...	5.27 ft
Wetted Perimeter.	5.50 ft
Critical Depth...	0.64 ft
Critical Slope...	0.0166 ft/ft
Froude Number....	0.79 (flow is Subcritical)

CHECK SHEAR STRESS:

$T = \gamma d s = (62.4)(0.71)(0.01) = 0.44$

T ALLOWABLE FOR NAG S75 = 1.55 > 0.44 OK

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7/24/95
CALC. BY PGG
CK. BY DWW

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: FIELDCREST CANNON

Comment: SOUTH DITCH TO SEDIMENT TRAP ST3 STEEP SLOPE SECTION

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.028 FOR NORTH AMERICAN GREEN S75
Channel Slope....	0.0800 ft/ft
Discharge........	3.00 cfs

Computed Results:

Depth............	0.31 ft
Velocity.........	5.13 fps
Flow Area........	0.59 sf
Flow Top Width...	2.83 ft
Wetted Perimeter.	2.93 ft
Critical Depth...	0.44 ft
Critical Slope...	0.0184 ft/ft
Froude Number....	1.99 (flow is Supercritical)

CHECK SHEAR STRESS:

$T = yds = (62.4)(0.31)(0.08) = 1.55$

$T_{ALLOWABLE} = 1.55 = 1.55$ ok

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7/24/95
CALC. BY PGG
CK BY DWW

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: FIELDCREST CANNON

Comment: SOUTH DITCH TO SEDIMENT TRAP ST3 SHALLOW SLOPE SECTION

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.077 WITH GRASS LINER, RETARDANCE "C"
Channel Slope....	0.0100 ft/ft
Discharge........	6.50 cfs

Computed Results:

Depth............	1.10 ft
Velocity.........	1.37 fps
Flow Area........	4.76 sf
Flow Top Width...	7.62 ft
Wetted Perimeter.	7.98 ft
Critical Depth...	0.64 ft
Critical Slope...	0.1258 ft/ft
Froude Number....	0.30 (flow is Subcritical)

ALLOWABLE VELOCITY = 4.0 FPS FOR TALL FESCUE

1.37 fps < 4.0 ∴ GRASS LINER IS OK

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7/24/95
CALC. BY PGG
CK BY [illegible]

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

: Name: FIELDCREST CANNON

SOUTH DITCH TO SEDIMENT TRAP ST3 STEEP SLOPE SECTION

r Depth

out Data:

3ottom Width.....	1.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n......	0.077 WITH GRASS LINER, RETARDANCE "C"
Channel Slope....	0.0800 ft/ft
Discharge........	3.00 cfs

Results:

Depth............	0.50 ft
Velocity.........	2.44 fps
Flow Area........	1.23 sf
Flow Top Width...	3.97 ft
Wetted Perimeter.	4.13 ft
Critical Depth...	0.44 ft
Critical Slope...	0.1395 ft/ft
Froude Number....	0.77 (flow is Subcritical)

LLOWABLE VELOCITY = 4.0 FPS FOR TALL FESCUE.

2.44 FPS < 4.0 ∴ GRASS LINER OK.

S&ME

JOB NO. 1356-95-133

SHEET NO. 12

DATE 7/24/95

...CREST CANNON

...ION CONTROL

COMPUTED BY PGG

CHECKED BY DWW

NEXT SECTION OF DITCH SOUTH OF PERIMETER BERM SIMILAR TO SECTION EXITING TO SEDIMENT TRAP ST3. ...AINAGE AREA, SLOPE, AND Q ARE SAME. PREVIOUS CALCULATIONS ...E SHOWN THAT A G1 TYPE DITCH WITH A TEMPORARY ...AW WITH NET LINER AND PERMANENT GRASS LINER IS SUITABLE.

∴ USE G1 TYPE DITCH FOR DITCHES FLOWING TO SEDIMENT TRAP ST4.

Table 8.03a
Runoff Coefficient
Rational Formula

Land Use	C	Land Use	C
Business:		Lawns:	
Downtown areas	0.70-0.95	Sandy soil, flat, 2%	0.05-0.10
Neighborhood areas	0.50-0.70	Sandy soil, ave., 2-7%	0.10-0.15
		Sandy soil, steep, 7%	0.15-0.20
Residential:		Heavy soil, flat, 2%	0.13-0.17
Single-family areas	0.30-0.50	Heavy soil, ave., 2-7%	0.18-0.22
Multi units, detached	0.40-0.60	Heavy soil, steep, 7%	0.25-0.35
Multi units, attached	0.60-0.75		
Suburban	0.25-0.40	Agricultural land:	
		Bare packed soil	
Industrial:		Smooth	0.30-0.60
Light areas	0.50-0.80	Rough	0.20-0.50
Heavy areas	0.60-0.90	Cultivated rows	
		Heavy soil no crop	0.30-0.60
Parks, cemeteries	0.10-0.25	Heavy soil with crop	0.20-0.50
		Sandy soil no crop	0.20-0.40
Playgrounds	0.20-0.35	Sandy soil with crop	0.10-0.25
		Pasture	
Railroad yard areas	0.20-0.40	Heavy soil	0.15-0.45
		Sandy soil	0.05-0.25
Unimproved areas	0.10-0.30	Woodlands	0.05-0.25
Streets:			
Asphalt	0.70-0.95		
Concrete	0.80-0.95		
Brick	0.70-0.85		
Drives and walks	0.75-0.85		
Roofs	0.75-0.85		

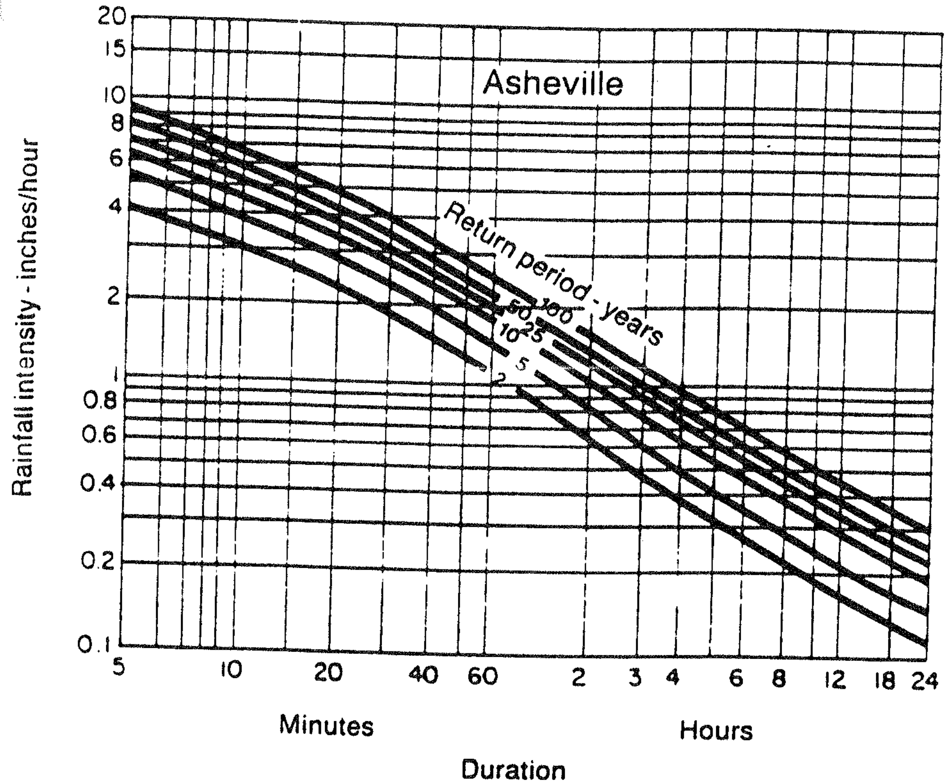
NOTE: The designer must use judgment to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

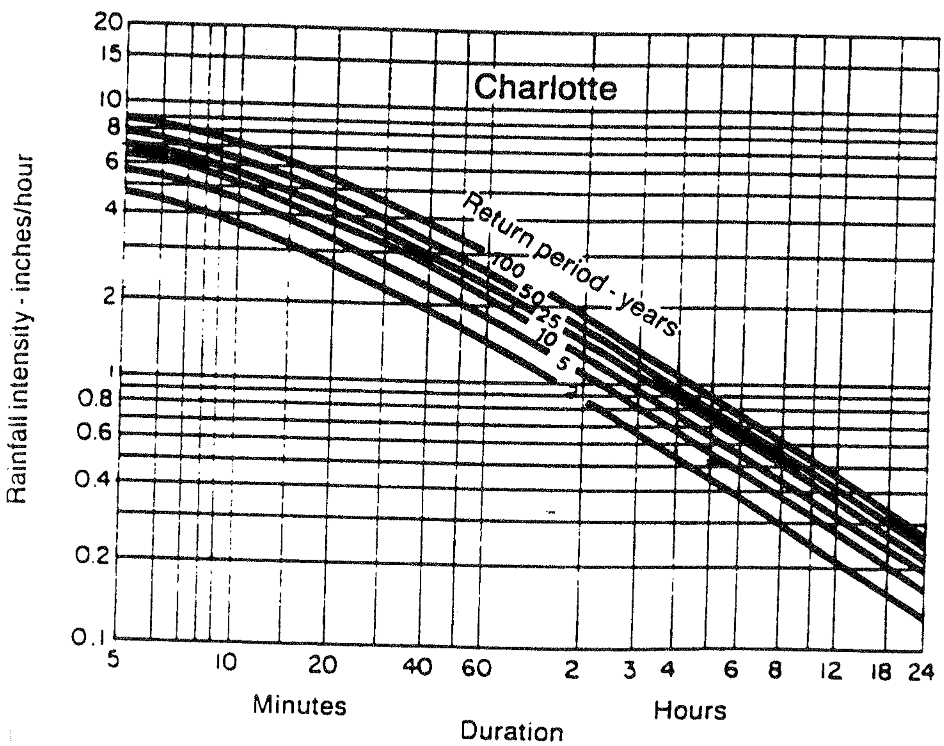
The overland flow portion of flow time may be determined from Figure 8.03a. The flow time (in minutes) in the channel can be estimated by calculating the average velocity in feet per minute and dividing the length (in feet) by the average velocity.

Step 4. Determine the rainfall intensity, frequency, and duration (Figures 8.03b through 8.03g—source: North Carolina State Highway Commission; Jan. 1973). Select the chart for the locality closest to your location. Enter the "duration" axis of the chart with the calculated time of concentration, Tc. Move vertically until you intersect the curve of the appropriate design storm, then move horizontally to read the rainfall intensity factor, i, in inches per hour.

Step 5. Determine peak discharge, Q (ft^3/sec), by multiplying the previously determined factors using the rational formula (Sample Problem 8.03a).



nfall intensity duration curves—Asheville.



fall intensity duration curves—Charlotte.

Design Procedure-Permissible Velocity

The following is a step-by-step procedure for designing a runoff conveyance channel using Manning's equation and the continuity equation:

Step 1. Determine the required flow capacity, Q, by estimating peak runoff rate for the design storm (*Appendix 8.03*).

Step 2. Determine the slope and select channel geometry and lining.

Step 3. Determine the permissible velocity for the lining selected, or the desired velocity, if paved.

Step 4. Make an initial estimate of channel size—divide the required Q by the permissible velocity to reach a "first try" estimate of channel flow area. Then select a geometry, depth, and top width to fit site conditions.

Step 5. Calculate the hydraulic radius, R, from channel geometry (Figure 8.05b).

Step 6. Determine roughness coefficient *n*.

Structural Linings—see Table 8.05b

Grass Lining:

a. Determine retardance class for vegetation from Table 8.05c. To meet stability requirement, use retardance for newly mowed condition (generally C or D). To determine channel capacity, use at least one retardance class higher.

b. Determine *n* from Figure 8.05c.

Step 7. Calculate the actual channel velocity, V, using Manning's equation (Figure 8.05a), and calculate channel capacity, Q, using the continuity equation.

Step 8. Check results against permissible velocity and required design capacity to determine if design is acceptable.

Step 9. If design is not acceptable, alter channel dimensions as appropriate. For trapezoidal channels, this adjustment is usually made by changing the bottom width.

Table 8.05b
Manning's *n* for Structural Channel Linings

Channel Lining	Recommended *n* values
Asphaltic concrete, machine placed	0.014
Asphalt, exposed prefabricated	0.015
Concrete	0.015
Metal, corrugated	0.024
Plastic	0.013
Shotcrete	0.017
Gabion	0.030
Earth	0.020

Source: American Society of Civil Engineers (modified)

Table 8.05d Maximum Permissible Velocities for Unprotected Soils in Existing Channels.

Materials	Maximum Permissible Velocities (fps)
Fine Sand (noncolloidal)	2.5
Sand Loam (noncolloidal)	2.5
Silt Loam (noncolloidal)	3.0
Ordinary Firm Loam	3.5
Fine Gravel	5.0
Stiff Clay (very colloidal)	5.0
Graded, Loam to Cobbles (noncolloidal)	5.0
Graded, Silt to Cobbles (colloidal)	5.5
Alluvial Silts (noncolloidal)	3.5
Alluvial Silts (colloidal)	5.0
Course Gravel (noncolloidal)	6.0
Cobbles and Shingles	5.5
Shales and Hard Pans	6.0

Sample Problem 8.05a Design of a grass-lined channel.

Given:

Design Q_{10} = 16.6 cfs

Proposed channel grade = 2%
Proposed vegetation: Tall fescue
Soil: Creedmoor (easily erodible)
Permissible velocity, V_p = 4.5 ft/s (Table 8.05a)
Retardance class: "B" uncut, "D" cut (Table 8.05c).
Trapezoidal channel dimensions:
designing for low retardance condition (retardance class D)
design to meet V_p.

Find:

Channel dimensions

Solution:

Make an initial estimate of channel size
$A = Q/V$; 16.6 cfs/4.5 ft/sec = 3.69 ft^2

Try bottom width = 3.0 ft

$Z = 3$
$A = bd + Zd^2$
$P = b + 2d\sqrt{Z^2 + 1}$

An iterative solution using Figure 8.05a to relate flow depth to Manning's *n* proceeds as follows: Manning's equation is used to check velocities

d (ft)	A (ft^2)	R (ft)	n	V (fps)	Q (cfs)	Comments
0.8	4.32	0.54	0.043	3.25	14.0	$V<V_p$ OK, $Q<Q_{10}$. (too small, try deeper channel)
0.9	5.13	0.59	0.042	3.53	18.10	$V<V_p$. OK, $Q>Q_{10}$. OK

Now design for high-retardance (class B):

Try d = 1.5 ft and trial velocity, V_t = 3.0 ft/sec

d (ft)	A (ft^2)	R (ft)	V_t (fps)	n	V (fps)	Q (cfs)	Comments
1.5	11.25	0.90	3.0	0.08	2.5		reduce Vt
			2.0	0.11	1.8		reduce V_t
			1.6	0.12	1.6	18	$Q>Q_{10}$ OK

Channel summary:

Trapezoidal shape, Z=3, b=3 ft, d=1.5 ft, grade = 2%

Table 8.05a
Maximum Allowable Design Velocities[1] for Vegetated Channels

Typical Channel Slope Application	Soil Characteristics[2]	Grass Lining	Permissible Velocity[3] for Established Grass Lining (ft/sec)
0-5%	Easily Erodible Non-plastic (Sands & Silts)	Bermudagrass	5.0
		Tall fescue	4.5 ✓
		Bahiagrass	4.5
		Kentucky bluegrass	4.5
		Grass-legume mixture	3.5
	Erosion Resistant Plastic (Clay mixes)	Bermudagrass	6.0
		Tall fescue	5.5
		Bahiagrass	5.5
		Kentucky bluegrass	5.5
		Grass-legume mixture	4.5
5-10%	Easily Erodible Non-plastic (Sands & Silts)	Bermudagrass	4.5
		Tall fescue	4.0 ✓
		Bahiagrass	4.0
		Kentucky bluegrass	4.0
		Grass-legume mixture	3.0
	Erosion Resistant Plastic (Clay Mixes)	Bermudagrass	5.5
		Tall fescue	5.0
		Bahiagrass	5.0
		Kentucky bluegrass	5.0
		Grass-legume mixture	3.5
>10%	Easily Erodible Non-plastic (Sands & Silts)	Bermudagrass	3.5
		Tall fescue	2.5
		Bahiagrass	2.5
		Kentucky bluegrass	2.5
	Erosion Resistant Plastic (Clay Mixes)	Bermudagrass	4.5
		Tall fescue	3.5
		Bahiagrass	3.5
		Kentucky bluegrass	3.5

Source: USDA-SCS Modified

NOTE: [1]Permissible Velocity based on 10-yr storm peak runoff
[2]Soil erodibility based on resistance to soil movement from concentrated flowing water.
[3]Before grass is established, permissible velocity is determined by the type of temporary liner used.

Selecting Channel Cross-Section Geometry

To calculate the required size of an open channel, assume the design flow is uniform and does not vary with time. Since actual flow conditions change throughout the length of a channel, subdivide the channel into design reaches, and design each reach to carry the appropriate capacity.

The three most commonly used channel cross-sections are "V"-shaped, parabolic, and trapezoidal. Figure 8.05b gives mathematical formulas for the area, hydraulic radius and top width of each of these shapes.

Table7

Maximum Flow Depth(Ft.)

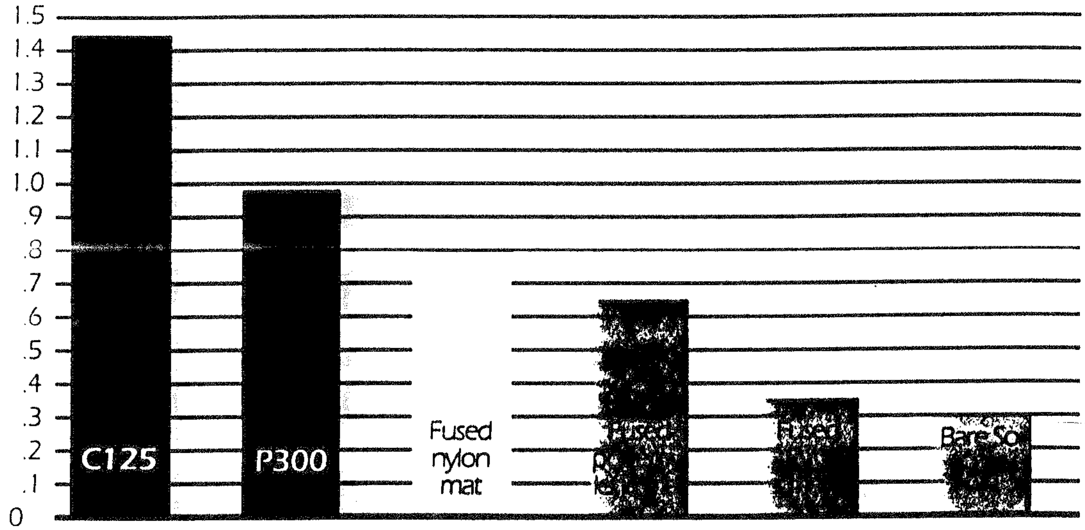


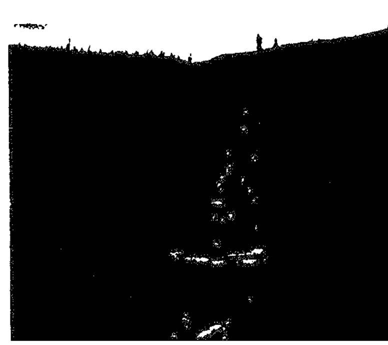
Table 8

Tractive Force Limits and Roughness Coefficients* - Unvegetated**

North American Green Blanket	Manning's "n" for Depth Range 0-.5 ft.	.5-2 ft.	>2.0 ft.	Max. Permissible Shear Stress (lbs/sq.ft.)
S75	.055	.028	.021	1.55
S150	.055	.028	.021	1.65
SC150	.050	.025	.018	1.80
C125	.022	.014	.014	2.25
P300	.024	.020	.020	2.00

*Recommended values based on above research, North American Green field studies and Published Federal Highway Administration research.

** Tractive force limits and roughness coefficients will increase dramatically when vegetation is established through the erosion control blanket.



C125 and P300 effectively protect a field test channel carrying high discharges over gradients approaching 17%.

Step 10. For grass-lined channels once the appropriate channel dimensions have been selected for low retardance conditions, repeat steps 6 through 8 using a higher retardance class, corresponding to tall grass. Adjust capacity of the channel by varying depth where site conditions permit.

> NOTE 1: If design velocity is greater than 2.0 ft/sec., a temporary lining may be required to stabilize the channel until vegetation is established. The temporary liner may be designed for peak flow from the 2-yr storm. If a channel requires temporary lining, the designer should analyze shear stresses in the channel to select the liner that provides protection and promotes establishment of vegetation. For the design of temporary liners, use tractive force procedure.

> NOTE 2: Design Tables—Vegetated Channels and Diversions at the end of this section may be used to design grass-lined channels with parabolic cross-sections.

Step 11. Check outlet for carrying capacity and stability. If discharge velocities exceed allowable velocities for the receiving stream, an outlet protection structure will be required (Table 8.05d).

Sample Problem 8.05a illustrates the design of a grass-lined channel.

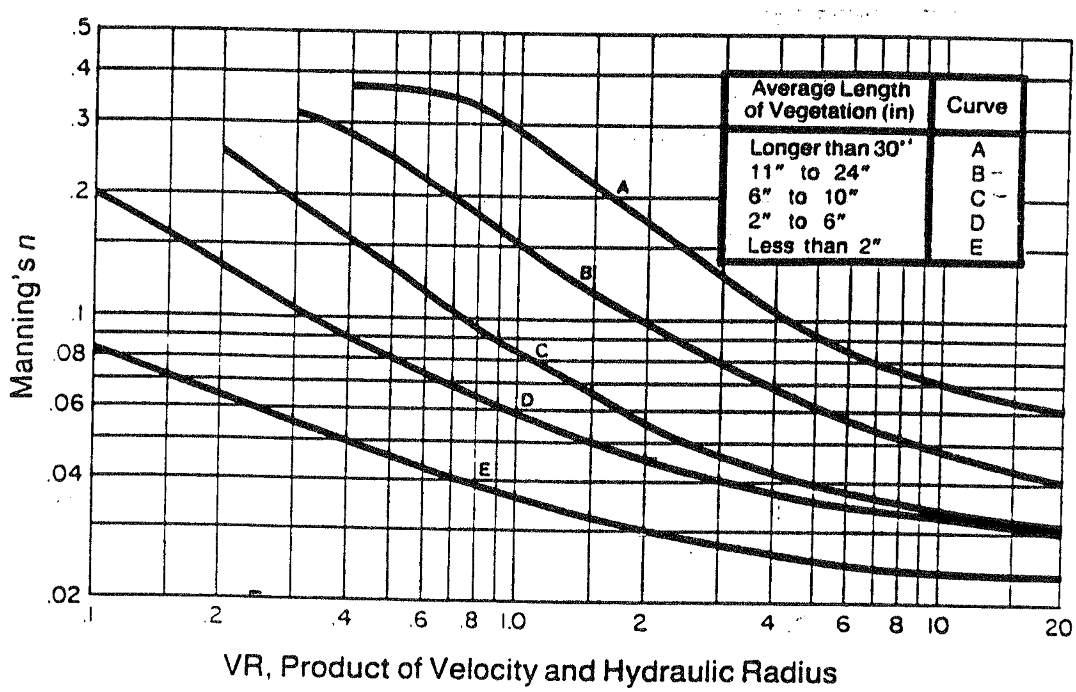


Figure 8.05c Manning's *n* related to velocity, hydraulic radius, and vegetal retardance.

Table 8.05c
Retardance Classification for Vegetal Covers

Retardance	Cover	Condition
A	Reed canarygrass	Excellent stand, tall (average 36")
	Weeping lovegrass	Excellent stand, tall (average 30")
B	Tall fescue	Good stand, uncut, (average 18")
	Bermudagrass	Good stand, tall (average 12")
	Grass-legume mixture (tall fescue, red fescue, sericea lespedeza)	Good stand, uncut
	Grass mixture (timothy, smooth bromegrass or orchardgrass)	Good stand, uncut (average 20")
	Sericea lespedeza	Good stand, not woody, tall (average 19")
	Reed canarygrass	Good stand, cut (average 12-15")
	Alfalfa	Good stand, uncut (average 11")
C	Tall fescue	Good stand (8-12")
	Bermudagrass	Good stand, cut (average 6")
	Bahiagrass	Good stand, uncut (6-8")
	Grass-legume mixture-- summer (orchardgrass, redtop and annual lespedeza)	Good stand, uncut (6-8")
	Centipedegrass	Very dense cover (average 6")
	Kentucky bluegrass	Good stand, headed (6-12")
	Redtop	Good stand, uncut (15-20")
D	Tall fescue	Good stand, cut (3-4")
	Bermudagrass	Good stand, cut (2.5")
	Bahiagrass	Good stand, cut (3-4")
	Grass-legume mixture-- fall-spring (orchard-grass, redtop, and annual lespedeza)	Good stand, uncut (4-5")
	Red fescue	Good stand, uncut (12-18")
	Centipedegrass	Good stand, cut (3-4")
	Kentucky bluegrass	Good stand, cut (3-4")
E	Bermudagrass	Good stand, cut (1.5")
	Bermudagrass	Burned stubble

Modified from: USDA-SCS, 1969. Engineering Field Manual.

Table 8.05g
Permissible Shear Stresses for Riprap and Temporary Liners

Lining Category	Lining Type	Permissible Unit Shear Stress, T_d (lb/ft^2)
Temporary	Woven Paper Net	0.15
	Jute Net	0.45
	Fiberglass Roving:	
	Single	0.60
	Double	0.85
	Straw with Net	1.45
	Curled Wood mat	1.55
	Synthetic Mat	2.00
	d_{50} Stone Size (inches)	
Gravel Riprap	1	0.40
	2	0.80
Rock Riprap	6	2.50
	9	3.80
	12	5.00
	15	6.30
	18	7.50
	21	8.80
	24	10.00

Design Procedure-Temporary Liners

The following is a step-by-step procedure for designing a temporary liner for a channel. Because temporary liners have a short period of service, the design Q may be reduced. For liners that are needed for six months or less, the 2-yr frequency storm is recommended.

Step 1. Select a liner material suitable for site conditions and application. Determine roughness coefficient from manufacturer's specifications or Table 8.05e.

Step 2. Calculate the normal flow depth using Manning's equation (Figure 8.05d). Check to see that depth is consistent with that assumed for selection of Manning's *n* in Figure 8.05d.

Step 3. Calculate shear stress at normal depth.

Step 4. Compare computed shear stress with the permissible shear stress for the liner.

Step 5. If computed shear is greater than permissible shear, adjust channel dimensions to reduce shear or select a more resistant lining and repeat steps 1 through 4.

Design of a channel with temporary lining is illustrated in Sample Problem 8.05b.

Table 8.05f
Manning's Roughness Coefficient for Riprap and Gravel

Material	d_{50} (inches)	*n* value for Depth Ranges 0-0.5 ft	0.5-1.0 ft	1.0-2.0 ft	> 2.0 ft
Gravel	1	0.033	0.028	0.026	0.025
	2	0.045	0.034	0.034	0.031
Riprap	6	0.106	0.054	0.044	0.041
	9	0.215	0.068	0.062	0.047
	12	0.797	0.084	0.060	0.053
	15	—	0.104	0.068	0.059
	18	—	0.127	0.076	0.064
	21	—	0.158	0.085	0.070
	24	—	0.199	0.095	0.076

DETERMINING SHEAR STRESS

Shear stress, T, at normal depth is computed for the lining by the following equation:

$$T = yds$$

where:

- T = shear stress in lb/ft^2
- y = unit weight of water, 62.4 lb/ft^3
- d = flow depth in ft
- s = channel gradient in ft/ft.

If the permissible shear stress, T_d, given in Table 8.05g is greater than the computed shear stress, the riprap or temporary lining is considered acceptable. If a lining is unacceptable, select a lining with a higher permissible shear stress and repeat the calculations for normal depth and shear stress. In some cases it may be necessary to alter channel dimensions to reduce the shear stress.

Computing tractive force around a channel bend requires special considerations because the change in flow direction imposes higher shear stress on the channel bottom and banks. The maximum shear stress in a bend, T_b, is given by the following equation:

$$T_b = K_b T$$

where:

- T_b = bend shear stress in lb/ft^2
- K_b = bend factor
- T = computed stress for straight channel in lb/ft^2

The value of K_b is related to the radius of curvature of the channel at its center line, R_c, and the bottom width of the channel, B, Figure 8.05e. The length of channel requiring protection downstream from a bend, L_p, is a function of the roughness of the lining material and the hydraulic radius as shown in Figure 8.05f.

S&ME

JOB NO. 1356-95-133
SHEET NO. 1
DATE 7/25/95

JOB NAME Fieldcrest Cannon
COMPUTED BY PGG
SUBJECT Erosion Control
CHECKED BY DWW

OBJECTIVE: SIZE ROCK DAM RD2.

PARAMETERS: SIZE FOR RUNOFF DURING GRADING OF BORROW AREA I

REFERENCE: NORTH CAROLINA EROSION & SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL (SEE CALCULATIONS FOR RD_1 FOR REFERENCE INFORMATION)

DURING GRADING OF BORROW AREA I, RUNOFF WILL BE DIVERTED ALONG THE EDGE OF THE ASH FILL AREA TO RD2. RD2 WILL ALSO RECEIVE RUNOFF FROM A PORTION OF THE EXISTING ASH FILL AND FROM OFF-SITE (CONVEYED BY THE WEST PERIMETER DITCH, THIS DITCH DESIGNED PREVIOUSLY).

TOTAL DRAINAGE AREA:

FROM BORROW AREA I = 3.0 AC. (DISTURBED AREA)

USE C=0.50

FROM ASH FILL ≈ 1.7 AC (UNDISTURBED)

USE C= 0.30 (GRASSED)

$$C_c = \frac{(0.5)(3.0) + (.3)(1.7)}{4.7} = 0.43$$

USE $I = 6.5$ in/hr (CONSERVATIVE)

$$Q_{10} = (0.43)(6.5)(5\text{AC}) = 14 \text{ cfs}$$

ADD Q FROM WEST SIDE PERIMETER DITCH, DURING CONSTRUCTION WEST SIDE PERIMETER DITCH ONLY CARRIES RUNOFF FROM OFFSITE DRAINAGE AREA. THEREFORE:

$$Q_{DITCH} = (0.3)(6.5)(1.45\text{AC}) = 2.8 \text{ cfs}$$

$$Q_{TOTAL} = 14 + 2.8 = 16.8 \text{ cfs}$$

S&ME

JOB NO. 1356-95-133

SHEET NO. 2

DATE 7/25/95

JOB NAME FIELDCREST CANNON

COMPUTED BY PGG

SUBJECT EROSION CONTROL

CHECKED BY DWW

SINCE THE AREA JUST SOUTH OF BORING B5 CURRENTLY COLLECTS STORMWATER, USE THIS AREA AS STORAGE AREA FOR ROCK DAM. BASED ON SITE VISITS, THE DEPTH AVAILABLE FOR STORAGE IS APPROXIMATELY 3 FT FROM THE TOP OF THE EXISTING BERM. (TOP OF BERM IS ≈ 732)

BERM CAN BE NOTCHED AND ROCK FILTER CAN BE CONSTRUCTED.

SET TOP OF ROCK FILTER WEIR AT ELEVATION 730.0.

STORAGE VOLUME BELOW ELEV. 730.0:

AREA AT 730 = 10,000 ft^2

AT ELEV. 727 AREA ≈ 20' x 10' = 200 ft^2

VOLUME = 5100 ft^2 x 3' = 15,300 ft^3

VOLUME REQUIRED = 1800 ft^3 x 3.0 AC = 5400 ft^3 < 15,300

∴ VOLUME PROVIDED IS OK

CHECK SURFACE AREA REQUIREMENT:

S.A. = 0.01 x 16.8 = 0.168 AC = 7318 ft^2

SINCE 10,000 ft^2 > 7318 ft^2
SURFACE AREA PROVIDED IS OK.

SUMMARY:

- USE EXISTING EMBANKMENT
- NOTCH EMBANKMENT TO CONSTRUCT ROCK FILTER
- WEIR ELEVATION = 730.0
- WEIR LENGTH = 12.0'

S&ME

JOB NO. 1356-95-133
SHEET NO. 1
DATE 7/25/95
JOB NAME FIELDCREST CANNON
COMPUTED BY PGG
SUBJECT EROSION CONTROL
CHECKED BY DNW

OBJECTIVE: SIZE SEDIMENT TRAP (ST 3) AND CULVERT C_1

PARAMETERS: DRAINAGE AREA = 2 AC

REFERENCE: NORTH CAROLINA EROSION & SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL

SINCE DISTURBED DRAINAGE AREA IS LESS THAN 5 AC, SEDIMENT TRAP IS OK.

REQUIRED TRAP CAPACITY = $1800\ ft^3 \times 2\ AC = 3600\ ft^3$

REQUIRED SURFACE AREA = $0.01 \times$ PEAK INFLOW IN cfs

$Q_{peak} = CIA$

LET $C = 0.5$ FOR DISTURBED CONDITIONS

$T_c = 5\,MIN \therefore I = 6.5\ in/hr$ (Charlotte IDF)

$Q = (0.5)(6.5)(2\,ac) = 6.5\ cfs$

SURFACE AREA = $0.01 \times 6.5 = 0.065\ AC \cong 2830\ ft^2$

PROVIDE TRAP WITH DIMENSIONS 57 ft × 50 ft $= 2850\ ft^2$

$2850 > 2830$ ok

CHECK VOLUME:

WITH DEPTH = 2.5' (ELEVATION 702.5 TO ELEVATION 700.0)

ELEV. 702.5 — ELEV. 700

$$VOLUME = \frac{(57 \times 50) + (40 \times 20)}{2} \times 2.5' = 4560\ ft^3$$

$4560\ ft^3 > 3600\ ft^3$ REQ.

ok

S&ME

JOB NO. 1356-95-133

SHEET NO. 2

DATE 7/25/95

JOB NAME FIELDCREST CANNON

COMPUTED BY PGG

SUBJECT EROSION CONTROL

CHECKED BY DWW

SUMMARY

TOP OF EMBANKMENT ELEVATION = 704.0
BOTTOM OF TRAP ELEV. = 700.0

PROVIDE AREA OF 57' x 50' AT ELEVATION 702.5
3H : 1V SIDE SLOPES

STONE OUTLET SECTION:

TOP ELEVATION = 702.5
WEIR LENGTH = 6.0' (REF: TABLE 6.60 a)

S&ME

JOB NO. 1356-95-133
SHEET NO. 1
DATE 7/26/95

JOB NAME FIELDCREST CANNON
SUBJECT EROSION CONTROL
COMPUTED BY PGG
CHECKED BY DWW

NOW SIZE CULVERT C_1 for $Q_{10} = 6.5$ cfs (SAME DRAINAGE AREA AS (ST3))

BASED ON SITE CONDITIONS SET PIPE INVERT IN = 702.0
& INVERT OUT = 701.0

LENGTH = 30'

$$SLOPE = \frac{702-701}{30} = 0.033 \text{ ft/ft}$$

TRY 18" DIA CULVERT:

FROM CHART 5 (INLET CONTROL), PROJECTING CONDITION

$\frac{HW}{D} = 1.1'$ ∴ $HW = 1.65'$

HEADWATER ELEVATION = 702' + 1.65' = 703.65

ACCEPTABLE HEADWATER ELEVATION ≈ 705

703.65 < 705 OK

CHECK FOR TAILWATER CONDITIONS:

MAX TAILWATER = ELEVATION - 702.5 (SEDIMENT TRAP WEIR ELEVATION)
TOP OF PIPE AT INVERT = 702.5

∴ USE $H_W = H + h_o - LS_o$

FIND H from chart 11.

H = 0.7

$h_o = T_W$ for submerged pipe ∴ $h_o = 702.5 - 701 = 1.5'$

S&ME

JOB NO. 1356-95-133
SHEET NO. 2
DATE 7/26/95

JOB NAME Fieldcrest Cannon
SUBJECT Erosion Control
COMPUTED BY PGG
CHECKED BY DWW

$$H_W = 0.7 + 1.5' - (30)(0.033) = 1.2'$$

HEADWATER ELEVATION = 702+1.2 = 703.2'

SINCE H_W FOR OUTLET CONTROL < H_W FOR INLET CONTROL

INLET CONTROL GOVERNS.

SUMMARY

18" DIA CMP PIPE

INVERT IN = 702.0

INVERT OUT = 701

SLOPE = 0.033 ft/ft

6.60 TEMPORARY SEDIMENT TRAP

Definition

A small, temporary ponding basin formed by an embankment or excavation to capture sediment.

Purpose

To detain sediment-laden runoff and trap the sediment to protect receiving streams, lakes, drainage systems, and protect adjacent property.

Conditions Where Practice Applies

At the outlets of diversions, channels, slope drains, or other runoff conveyances that discharge sediment-laden water.

Below areas that are 5 acres or less.

Where access can be maintained for sediment removal and proper disposal.

In the approach to a storm water inlet located below a disturbed area as part of an inlet protection system.

Structure life limited to 2 years.

Planning Considerations

Select locations for sediment traps during site evaluation. Note natural drainage divides and select trap sites so that runoff from potential sediment- producing areas can easily be diverted into the traps. Ensure the drainage areas for each trap does not exceed 5 acres.

Make traps readily accessible for periodic sediment removal and other necessary maintenance. Plan locations for sediment disposal as part of trap site selection. Clearly designate all disposal areas on the plans.

In preparing plans for sediment traps, it is important to consider provisions to protect the embankment from failure from storm runoff that exceeds the design capacity. Consider nonerosive emergency bypass areas, particularly if there could be severe consequences from failure. If a bypass is not possible and failure would have severe consequences, consider alternative sites.

Sediment trapping is achieved primarily by settling within a pool formed by an embankment. The sediment pool may also be formed by excavation, or by a combination of excavation and embankment. Sediment-trapping efficiency is a function of surface area and inflow rate (Practice 6.61, *Sediment Basin*). Therefore, maximize the surface area in the design. Installations that provide pools with large length to width ratios reduce short circuiting and allow more of the pool surface area for settling. This optimizes efficiency.

Because well-planned sediment traps are key measures to preventing off-site sedimentation, they should be installed in the first stages of project development.

Design Criteria

Ensure drainage area for a sedimentation trap does not exceed 5 acres.

Storage capacity—Keep the minimum volume of the sediment trap at 1800 ft^3/acre based on disturbed area draining into the basin. Measure volume below the crest elevation of the outlet. The volume of a natural sediment trap may be satisfactorily approximated by the equation:

$$\text{volume } (ft^3) = 0.4 \times \text{surface area } (ft^2) \times \text{maximum pool depth } (ft)$$

Trap cleanout—Remove sediment from the trap and restore the capacity to original trap dimensions when sediment has accumulated to one-half the design depth.

Trap efficiency—Keep the surface area at peak flow as large as possible. Research by Barfield and Clar (1985) indicates that use of the following equation will give trap efficiency of 75% for most Coastal Plain and Piedmont soils:

$$\text{surface area at design flow (acres)} = (0.01) \text{ peak inflow rate (cfs)}$$

Embankment—Ensure that embankments for temporary sediment traps do not exceed 5 ft in height measured at the center line from the original ground surface to the top of the embankment. Additional freeboard may be added to the embankment height to allow flow through a designated bypass location. Construct embankments with a minimum top width of 5 ft and side slopes of 2:1 or flatter. Machine compact embankments.

Excavation—Where sediment pools are formed or enlarged by excavation, keep side slopes at 2:1 or flatter for safety.

Outlet section—Construct the sediment trap outlet using a stone section of embankment located at the low point in the basin. The stone section serves two purposes: (1) the top section serves as a nonerosive spillway outlet for flood flows, and (2) the bottom section provides a means of dewatering the basin between runoff events.

Stone size—Construct the outlet using well-graded stones with a d_{50} size of 9 inches (class B erosion control stone is recommended,) and a maximum stone size of 14 inches. A 1-ft thick layer of 1/2 - 3/4-inch aggregate (N.C. DOT #57 washed stone is recommended) should be placed on the inside face to reduce drainage flow rate.

Side slopes—Keep the side slopes of the spillway section at 2:1 or flatter. To protect the embankment, keep the sides of the spillway at least 21 inches thick.

Depth—Keep the crest of the spillway outlet a minimum of 1.5 ft below the settled top of the embankment.

Protection from piping—Place filter cloth on the foundation below the riprap to prevent piping. An alternative would be to excavate a keyway trench across the riprap foundation and up the sides to the height of the dam.

Weir length and depth—Keep the spillway weir at least 4 ft long and sized to pass the peak discharge of the 10-yr storm (Figure 6.60a). A maximum flow depth of 1 ft, a minimum freeboard of 0.5 ft, and maximum side slopes of 2:1 are recommended. Weir length may be selected from Table 6.60a shown for most site locations in North Carolina.

Table 6.60a
Design of Spillways

Drainage Area (acres)	Weir Length[1] (ft)
1	4.0
2	6.0
3	8.0
4	10.0
5	12.0

[1]Dimensions shown are minimum

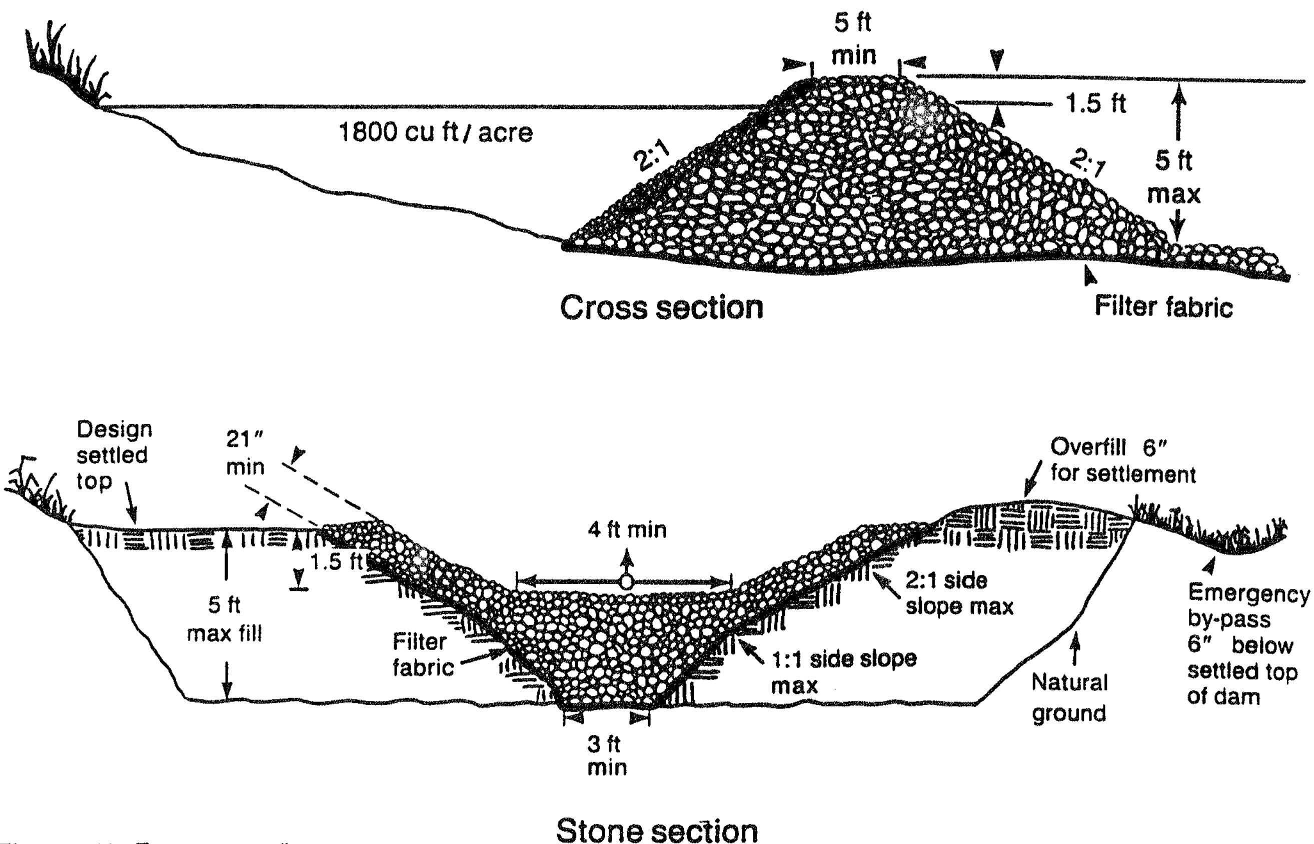


Figure 6.60a Temporary sediment trap.

Construction Specifications

1. Clear, grub, and strip the area under the embankment of all vegetation and root mat. Remove all surface soil containing high amounts of organic matter and stockpile or dispose of it properly. Haul all objectionable material to the designated disposal area.

2. Ensure that fill material for the embankment is free of roots, woody vegetation, organic matter, and other objectionable material. Place the fill in lifts not to exceed 9 inches and machine compact it. Over fill the embankment 6 inches to allow for settlement.

3. Construct the outlet section in the embankment. Protect the connection between the riprap and the soil from piping by using filter fabric or a keyway cutoff trench between the riprap structure and the soil.

- Place the filter fabric between the riprap and soil. Extend the fabric across the spillway foundation and sides to the top of the dam; or
- excavate a keyway trench along the centerline of the spillway foundation extending up the sides to the height of the dam. The trench should be at least 2 ft deep and 2 ft wide with 1:1 side slopes.

4. Clear the pond area below the elevation of the crest of the spillway to facilitate sediment cleanout.

5. All cut and fill slopes should be 2:1 or flatter.

6. Ensure that the stone (drainage) section of the embankment has a minimum bottom width of 3 ft and maximum side slopes of 1:1 that extend to the bottom of the spillway section.

7. Construct the minimum finished stone spillway bottom width, as shown on the plans, with 2:1 side slopes extending to the top of the over filled embankment. Keep the thickness of the sides of the spillway outlet structure at a minimum of 21 inches. **The weir must be level and constructed to grade to assure design capacity.**

8. Material used in the stone section should be a well-graded mixture of stone with a d_{50} size of 9 inches (class B erosion control stone is recommended) and a maximum stone size of 14 inches. The stone may be machine placed and the smaller stones worked into the voids of the larger stones. The stone should be hard, angular, and highly weather-resistant.

9. Ensure that the stone spillway outlet section extends downstream past the toe of the embankment until stable conditions are reached and outlet velocity is acceptable for the receiving stream. Keep the edges of the stone outlet section flush with the surrounding ground and shape the center to confine the outflow stream (*References: Outlet Protection*).

10. Direct emergency bypass to natural, stable areas. Locate bypass outlets so that flow will not damage the embankment.

11. Stabilize the embankment and all disturbed areas above the sediment pool and downstream from the trap immediately after construction (*References: Surface Stabilization*).

12. Show the distance from the top of the spillway to the sediment cleanout level (one-half the design depth) on the plans and mark it in the field.

Maintenance

Inspect temporary sediment traps after each period of significant rainfall. Remove sediment and restore the trap to its original dimensions when the sediment has accumulated to one-half the design depth of the trap. Place the sediment that is removed in the designated disposal area and replace the contaminated part of the gravel facing.

Check the structure for damage from erosion or piping. Periodically check the depth of the spillway to ensure it is a minimum of 1.5 ft below the low point of the embankment. Immediately fill any settlement of the embankment to slightly above design grade. **Any riprap displaced from the spillway must be replaced immediately.**

After all sediment-producing areas have been permanently stabilized, remove the structure and all unstable sediment. Smooth the area to blend with the adjoining areas and stabilize properly (*References: Surface Stabilization*).

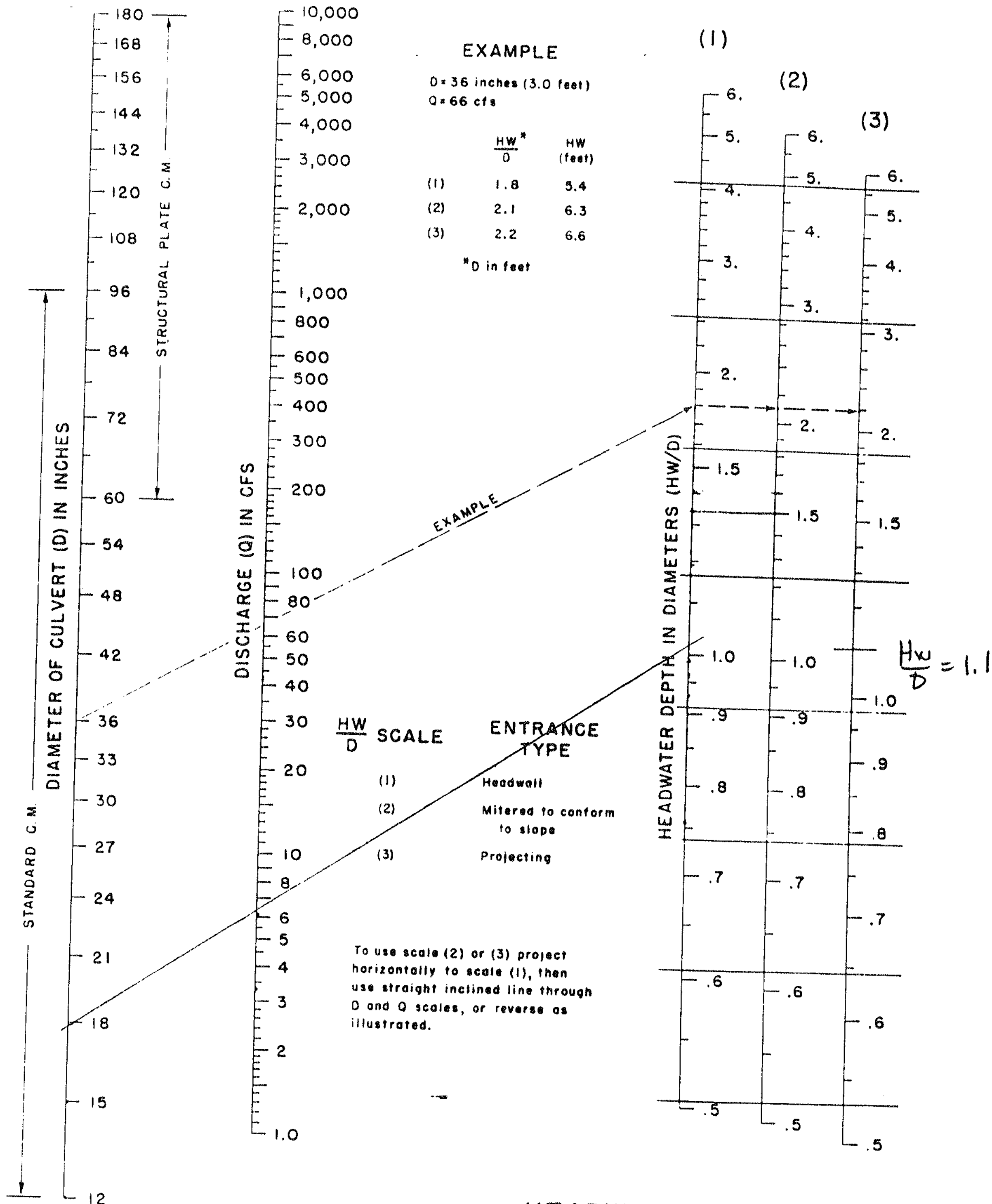
References

Outlet Protection
6.41, Outlet Stabilization Structure

Surface Stabilization
6.10, Temporary Seeding
6.11, Permanent Seeding
6.15, Riprap

North Carolina Department of Transportation
Standard Specifications for Roads and Structures

CHART 5



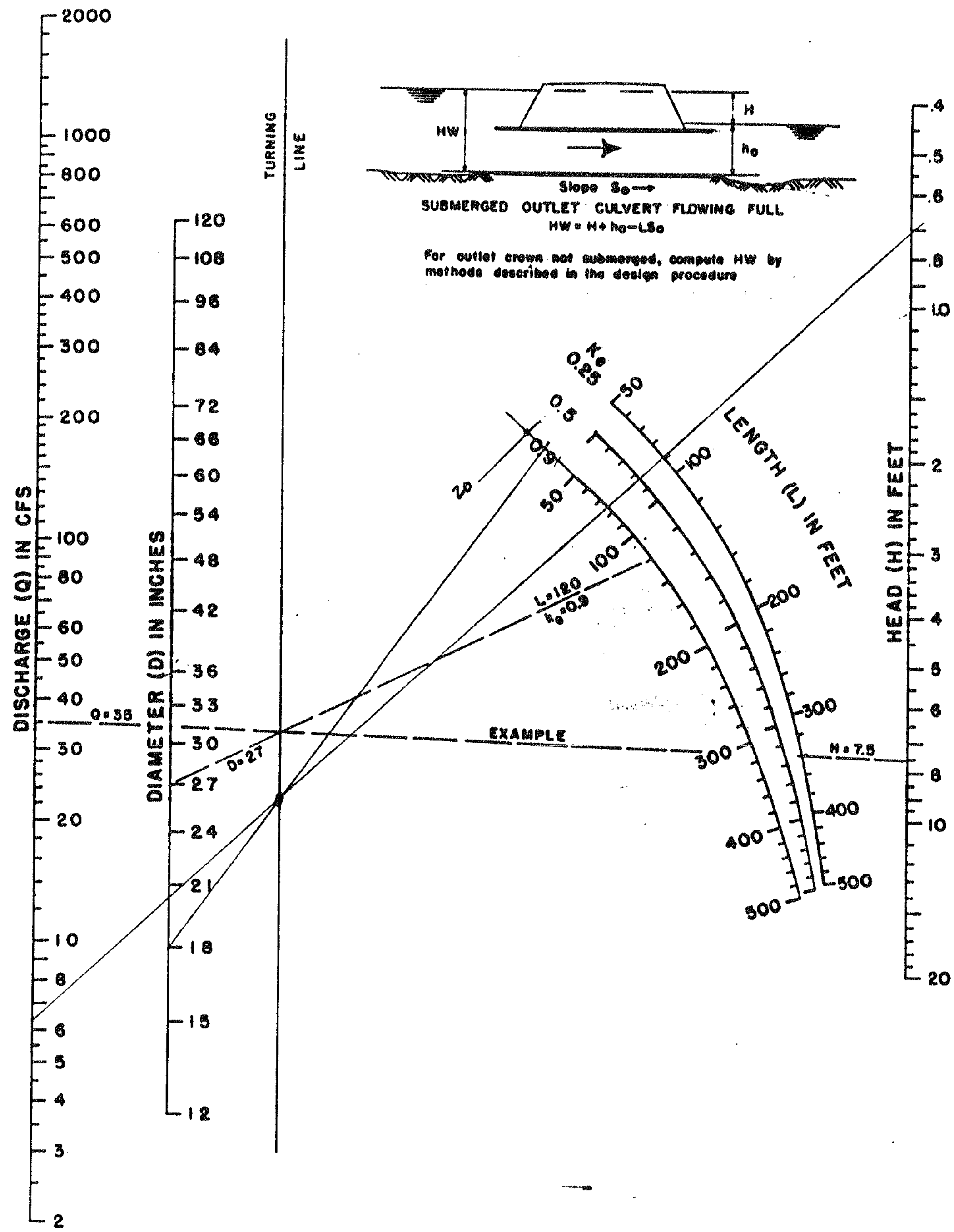
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

H = [1 + Ke + ――――] ―― WP Q=AV
R^1.33   2g

For L=20', Q=35cfs, D=27 IN ∴ H=3.16

CHART 11



HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

BUREAU OF PUBLIC ROADS JAN. 1963

S&ME

JOB NO. 1356-95-133

SHEET NO. 1

DATE 7/26/95

JOB NAME FIELDCREST CANNON

COMPUTED BY PGG

SUBJECT EROSION CONTROL

CHECKED BY DNW

OBJECTIVE: SIZE SEDIMENT TRAP (ST4) AND CULVERT C_2.

BY INSPECTION, ST_4 HAS SAME SIZE DRAINAGE AREA AS ST_3. THEREFORE,

$Q = 6.5 cfs$

REQUIRED VOLUME = 3600 FT^3

REQUIRED SURFACE AREA = 2830 ft^2

SET TOP OF EMBANKMENT = ELEV. 702.0

TOP OF WEIR = ELEVATION 700.5

DIMENSION AT 700.5 = 95' x 30' = 2850 > 2830 ok

VOLUME = $\frac{(95 \times 30) + (50 \times 10)}{2}$ x 2.5' = 4188 ft^3 > 3600 ft^3 ok

(50 x 10 – BOTTOM)

SUMMARY:

TOP OF EMBANKMENT = 702.0

TOP OF WEIR = 700.5

WEIR LENGTH = 6.0' (TABLE 6.60a, SEE ST_3 CALCULATIONS)

DIMENSION OF BASIN AT WEIR = 95' x 30'

S&ME

JOB NO. 1356-95-133

SHEET NO. 1

DATE 7/27/95

JOB NAME FIELDCREST CANNON

COMPUTED BY PGG

SUBJECT EROSION CONTROL

CHECKED BY DWW

SIZE CULVERT C_2. BASED ON PREVIOUS CALCULATIONS FOR CULVERT C_1, 18-IN DIA CMP SHOULD BE OK.

BASED ON SITE CONDITIONS:

SET INVERT IN = 700.0
SET INVERT OUT = 699.0

LENGTH = 30'
SLOPE = 700.0-699.0/30' = 0.033 FT/FT
DRAINAGE AREA = 2 AC
Q_p = 6.5 cfs

] SAME AS CULVERT C_1 (SEE S&ME CALCS. DATED 7/26/95)

THEREFORE, CHOOSE 18-IN DIA CMP

S&ME

JOB NO. 1356-95-133

SHEET NO. 1

DATE 8/23/95

JOB NAME FIELDCREST CANNON

COMPUTED BY PGG

SUBJECT EROSION CONTROL CALCS.

CHECKED BY DEB

OBJECTIVE: SIZE PERMANENT INLET / OUTLET CULVERT PROTECTION

PARAMETERS: SIZE FOR Q_{10} USED TO DESIGN CULVERTS

REFERENCE: NORTH CAROLINA EROSION & SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL

TWO CULVERTS WERE PREVIOUSLY DESIGNED TO CARRY $Q_{10} = 6.5$ cfs

USE Fig. 7.45 (ATTACHED), DIAMETER = 18"

$L_a = 2'$

$W_d = 3.5'$

RIPRAP SIZE = 0.3 ft = 3.6" USE $d_{50} = 6"$

WIDTH AT PIPE OUTLET = 4.5'

TO MAINTAIN GEOMETRY OF STRUCTURE, SET THE FOLLOWING DIMENSIONS FOR OUTLET STABILIZATION STRUCTURE FOR CULVERTS C1 & C2

WIDTH OF APRON AT PIPE OUTLET = 4.5

$L_a = 3'$

$W_d = 7.5'$

RIPRAP $d_{50} = 6"$

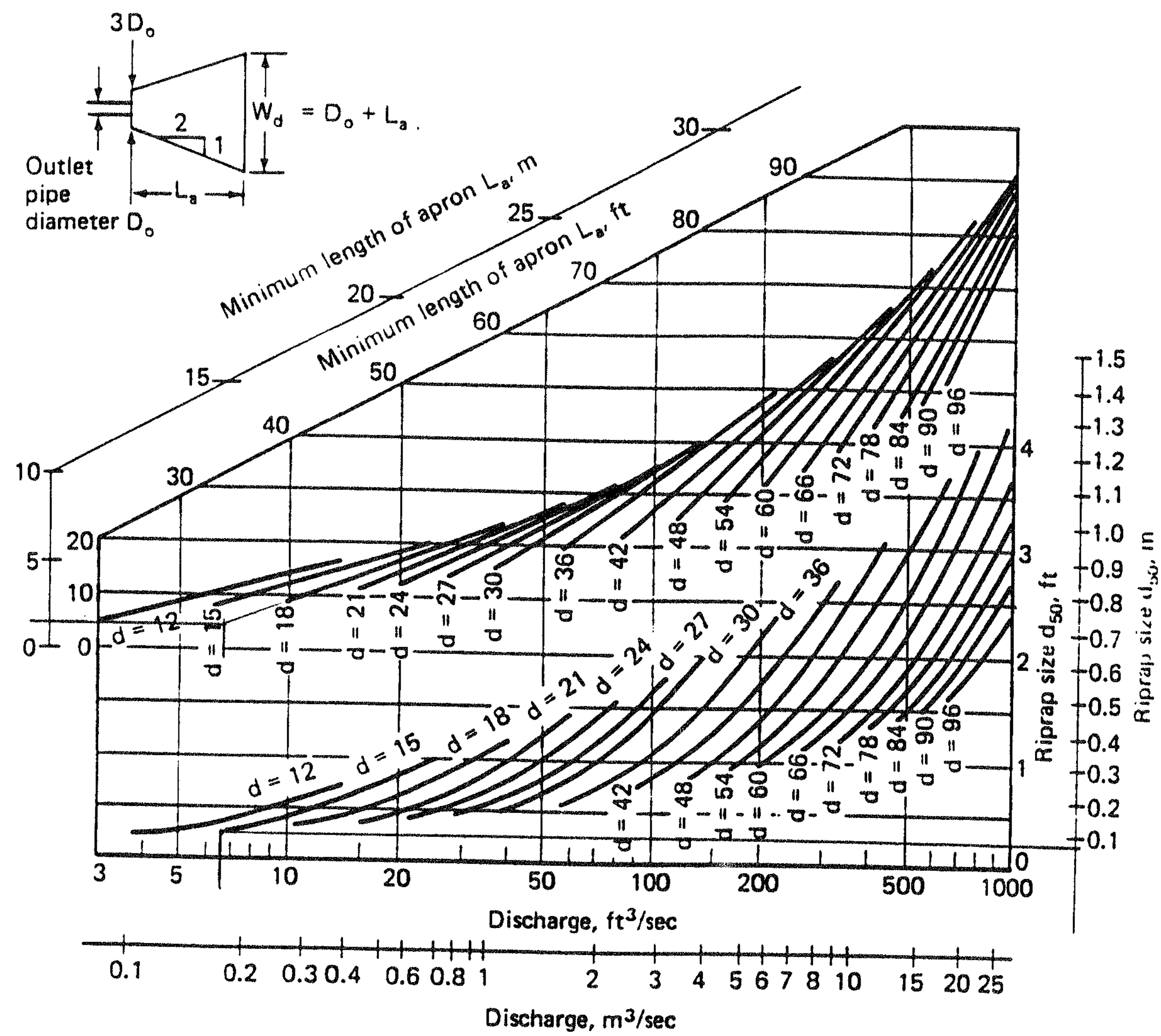


Fig. 7.45 Design of riprap outlet protection from a round pipe flowing full; minimum tailwater conditions. (6, 14)