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Engineered Trench
Long-Term Waste Stability
Low-Level Waste Disposal

Retention:
Permanent

LONG-TERM WASTE STABILIZATION PARAMETER ESTIMATION, SAVANNAH RIVER SITE, AIKEN, SOUTH CAROLINA (U)

William E. Jones
Savannah River Technology Center

William T. Li
Site Geotechnical Services

SEPTEMBER 2001

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U.S. Department of Energy Under Contract Number DE-AC09-96SR18500

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LIST OF ACRONYMS

ASTM	American Society for Testing and Material
bls	below land surface
°C	degrees centigrade
cm	centimeter(s)
D&D	Decontamination and Decommissioning
DOE	United States Department of Energy
DWPF	Defense Waste Processing Facility
EPA	United States Environmental Protection Agency
ERD	Environmental Restoration Department
ET	Engineered Trench #1
°F	degrees Fahrenheit
FML	Flexible Membrane Liner
ft	foot/feet
FY	fiscal year
g	gram(s)
GCL	Geosynthetic Clay Liner
in.	inch
INEEL	Idaho National Engineering and Environmental Laboratory
kg	kilogram
km	kilometer
LAWV	Low Activity Waste Vault
lb	pound
LLW	Low-level waste
m	meter(s)
mg	milligram
mi	mile
MMI	Modified Mercalli Index
msl	mean sea level
MWMF	Mixed Waste Management Facility
NASA	United States National Aeronautics and Space Administration
psi	pounds per square inch
RWMC	Radioactive Waste Management Complex
SCF	Supercompaction Facility
SRS	Savannah River Site
SRTC	Savannah River Technology Center
SWD	Solid Waste Division
TSA	Temporary Storage Area
USCS	Unified Soil Classification System
WAC	Waste Acceptance Criteria
WSF	Waste Sorting Facility
WSRC	Westinghouse Savannah River Company

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1.0 EXECUTIVE SUMMARY

Department of Energy Order 435.1, Radioactive Waste Management, requires that certain Performance Objectives be met over a 1,000-year post-closure period, in order to protect the public, environment, and workers. This objective is realized by specific requirements designed to minimize radionuclide transport from the disposal facilities. The requirement to achieve long-term stability, minimize subsidence, and minimize the need for long-term maintenance for long-term cover systems is one such requirement.

Engineered Trench #1 (ET) is a low-level radioactive waste disposal trench located in E-Area, Savannah River Site. The first phase of the ET has been constructed and steel B-25 waste containers are currently being placed. This fiscal year, and over the next two fiscal years, TTP SR11SS29, will use the ET as a case study to evaluate long-term waste stabilization design for long-term cover systems. The case study will include:

- Finite element modeling of waste container (B-25) behavior
- Corrosion study to evaluate B-25 long-term structural stability
- Cost evaluation and impact on long-term maintenance for stabilization methods modeled
- Risk-based evaluation of the structural finite element model results by integration with the Performance Assessment
- Production of a generic, risk-based design methodology for evaluating and selecting physical stabilization options for long-term cover systems

This report summarizes parameters to be incorporated in the finite element model, and includes some parameters related to the corrosion study. Parameters include ET configuration, soil, container, waste, seismic, and climate characteristics. Information related to the currently planned stabilization method (dynamic compaction) is included, as is information related to a potential new disposal method, the use of soft-sided bags rather than B-25s.

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2.0 INTRODUCTION

2.1 BACKGROUND

A May 2001 report by the U.S. Department of Energy (DOE) Office of Inspector General estimates the DOE has disposed nearly 69 million ft^3 (1.95 million m^3) of low-level radioactive waste at its facilities (DOE, 2001). To put this in perspective, 3.5 million ft^3 (100,000 m^3) is similar in volume to a 7-story building covering the area of a football field (DOE, 1998). So, the nearly 69 million ft^3 (1.95 million m^3) disposed to date is about the volume of 20 football-field-size, 7-story buildings. Over the next 70 years, DOE plans to dispose an additional 358 million ft^3 (10.14 million m^3), a volume roughly equivalent to 102 football-field-size, 7-story buildings. Most of this material will be generated over the next two decades as part of DOE's environmental restoration activities (DOE, 1998). According to DOE Orders 5820.2A and 435.1, the preferred locations for disposing low-level materials (in order of priority) are: at the site of origin, at other DOE sites (i.e., Nevada Test Site or Hanford Site), and at commercial facilities (DOE, 2001).

The limited availability of disposal alternatives is the principal factor influencing DOE decisions about the treatment, storage, and disposal of the low-level and mixed wastes from its 20 major waste-generating sites. Four of DOE's six disposal sites – Idaho National Engineering and Environmental Laboratory; Los Alamos National Laboratory, New Mexico; Oak Ridge Reservation, Tennessee; and Savannah River Site (SRS), South Carolina – are restricted to disposing almost exclusively of their own low-level wastes (and no mixed wastes) because of limits on their remaining disposal capacity and/or unfavorable site conditions, such as proximity to groundwater or relatively wet climates. The two other disposal sites – the Hanford Site in Washington State and the Nevada Test Site – have relatively dry climates and enough capacity to dispose of nearly all the low-level and mixed wastes generated at DOE's nuclear facilities nationwide (GAO, 2000). A summary of the various DOE waste-generating and disposal sites is presented in Section 3.0.

The Savannah River Site (SRS) is a DOE facility that was set aside in 1950 as a controlled area for production of nuclear materials for national defense. The DOE and its contractors are responsible for the operation of the SRS. Westinghouse Savannah River Company (WSRC) currently manages and operates the site. SRS and other DOE sites use shallow land burial facilities (i.e., trenches) to dispose some low-level radioactive waste.

DOE Order 435.1 (DOE, 1999), Radioactive Waste Management, and its companion manual and guidance require that certain Performance Objectives be met over a 1,000 year post-closure period, in order to protect the public, environment, and workers. This objective is realized by specific requirements designed to minimize radionuclide transport from the disposal facilities. The requirement to achieve long-term stability, minimize subsidence, and minimize the need for long-term maintenance for long-term cover systems is one such requirement.

Buried materials can experience settlement due to consolidation of underlying materials by several processes. These processes include compression of materials under their own weight and the weight of any overlying materials or loads, chemical and biological degradation, and other mechanisms. The magnitude, distribution, and rate of settlement are governed by factors such as material age, type, density and thickness, loading, and moisture (EPA, 2001).

At SRS and other DOE sites, waste containers (called B-25 containers), with from approximately 10 percent to as much as 90 percent void space, are placed in the disposal trenches. Dames and Moore (1987) estimated the typical B-25 contained 70 percent void space and 30 percent waste material. Corrosion and degradation of these carbon-steel containers can result in significant subsidence over time. Subsidence can compromise the structural integrity of the long-term cover system, resulting in increased radionuclide transport into the environment. The selection of cost effective and appropriate stabilization of both containerized and bulk waste is required in order to maintain long-term cover system stability and stakeholder acceptance of long-term disposal practices.

Current SRS disposal of low-level radioactive waste contained in stacked B-25 containers within Engineered Trench is anticipated to continue for the foreseeable future. The current SRS baseline option for waste physical stabilization is dynamic compaction immediately prior to construction of the final cover at closure. However, the cost of dynamic compaction is approximately $200,000 per acre and DOE’s low-level radioactive waste sites constitute hundreds of acres. Additionally, the dynamic compaction conducted to date at DOE facilities has not eliminated future subsidence potential, but has only reduced it by less than 50%. Therefore, significant future maintenance activities are likely to be required at these facilities.

2.2 OBJECTIVE AND APPROACH

Fiscal Year (FY) 2001 tasks under Technical Task Plan SR11SS29 encompass developing a better understanding of the structural stability of B-25 container disposal using Engineered Trench #1 as a case study.

- Task 1 is a finite element parametric study to determine the parameters that have the most impact upon long-term structural stability and subsidence of the cover system.
- Task 2 is a corrosion evaluation using a B-25 container exhumed near the Engineered Trench (ET).
- Task 3 is this technical report.

This report summarizes parameter estimations for use in the structural finite-element modeling of a selected ET waste physical-stabilization option, to be performed in FY 2002. The SRS ET case study will be completed in time to allow modification of current disposal practices and/or the baseline stabilization, as appropriate, prior to facility closure.

2.3 DESCRIPTION OF STUDY AREA

The SRS comprises approximately 300 square miles (mi^2) within Aiken, Barnwell, and Allendale counties in southwestern South Carolina. The center of the SRS is 22.5 miles (mi; 36.2 kilometers (km)) southeast of Augusta, Georgia, approximately 100 miles from the Atlantic Coast within the Upper Atlantic Coastal Plain Physiographic Province. The Savannah River forms the southwest boundary of the SRS. The SRS lies on the Aiken Plateau of the Atlantic Coastal Plain at an average elevation of 300 feet above mean sea level (ft msl; 91 meters above mean sea level (m msl)). The Aiken Plateau is well drained, although many poorly-drained sinks and depressions exist, especially in upland areas. Overall, the Aiken Plateau displays highly dissected topography, characterized by broad inter-fluvial areas separated by narrow, steep-sided valleys. Local relief can attain 280 ft (85 m; Siple, 1967). E-Area is located near the SRS geographic center (Figure 1).

2.3.1 Engineered Trench Area Geology

The geology of the SRS includes sediments of the Atlantic Coastal Plain. The Atlantic Coastal Plain consists of southeast-dipping, unconsolidated and semi-consolidated strata that extend from the Piedmont Province at the Fall Line to the edge of the continental shelf. Strata range from Late Cretaceous to Miocene in age and rest unconformably on crystalline and sedimentary basement rock. The sediment comprises interbedded sand, muddy sand, and mud (clay and silt), with a subordinate amount of calcareous sediment. The sedimentology of these strata indicates deposition in deltaic and near-shore environments that experienced considerable fluvial influence (Fallaw and Price, 1995). Several recent reports describe the geology and lithostratigraphy of the SRS (Fallaw and Sargent, 1982; Colquhoun et al., 1983; Logan and Euler, 1989; Fallaw et al., 1990; Aadland et al., 1991; Fallaw and Price, 1992; and Aadland et al., 1995).

The ET will be constructed primarily within the “Upland Unit”, with the trench bottom near the “Upland Unit”/Tobacco Road Formation contact. The “Upland Unit” is an informal stratigraphic term applied to terrestrial, probably fluvial, deposits that occur at higher elevations in some places in the southwestern South Carolina Coastal Plain. This unit overlies the Barnwell Group’s Tobacco Road Formation in the South Carolina Upper Coastal Plain, where SRS is located. The unit occurs at the surface at higher elevations in many places around and within the SRS, but it is not present at all higher elevations. The sediments are poorly sorted, clayey-to-silty sands, with lenses and layers of conglomerates, pebbly sands, and clays. Clay casts are abundant. Weathered feldspar is abundant in places. Color is variable and facies changes are abrupt. The “Upland Unit” is up to 69 ft (21 m) thick in areas at SRS. Abrupt thickness changes are due to channeling of the underlying Tobacco Road Formation during “Upland” deposition and subsequent erosion of the “Upland” unit itself. Much of this unit corresponds to the Miocene Hawthorne and Formation, and the Tertiary alluvial gravels identified in previous publications (WSRC, 1997; WSRC, 2000b).

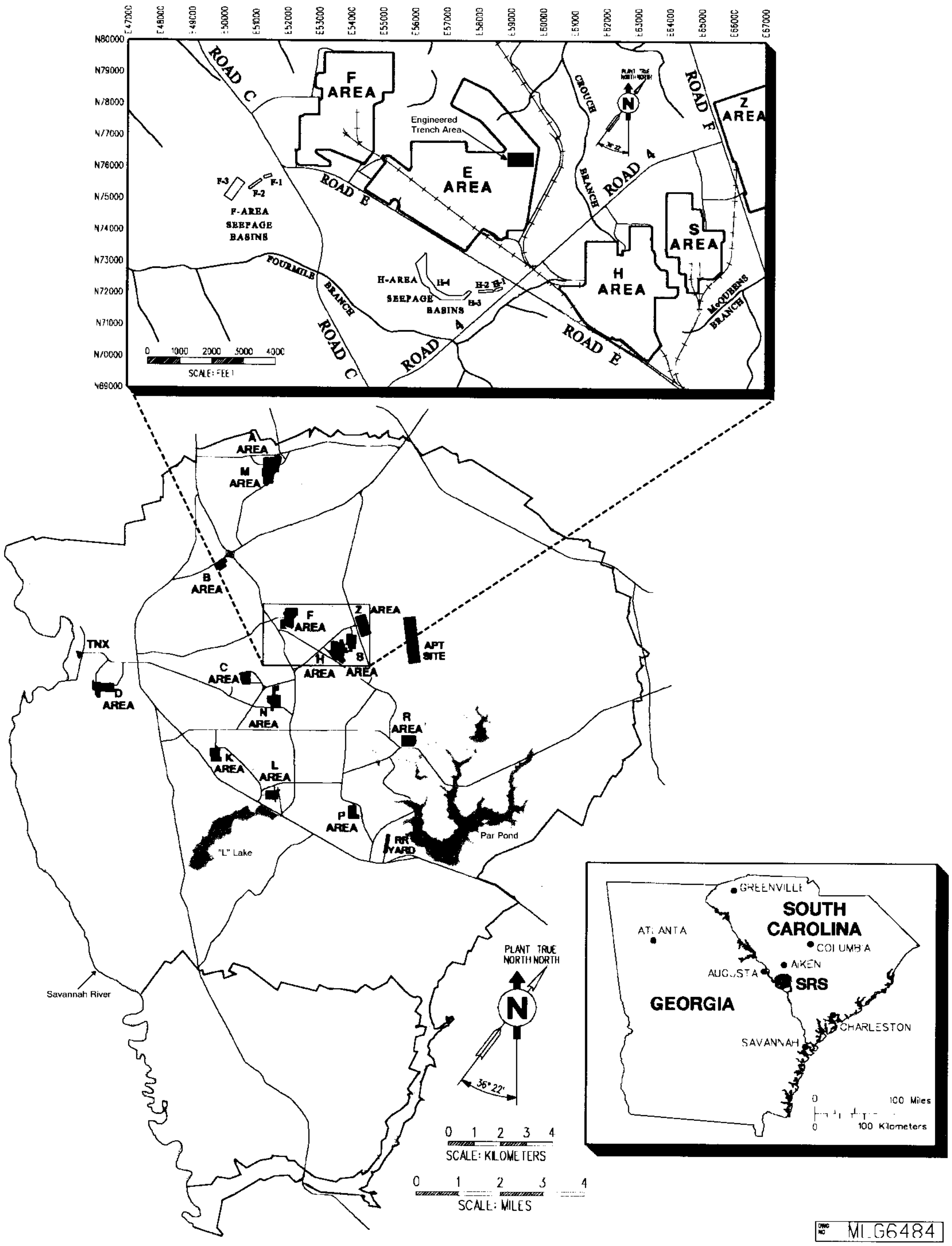

Figure 1. Savannah River Site, E Area, and Engineered Trench Area Location Map (modified from WSRC, 2000b)

The Late Eocene Tobacco Road Formation consists of moderately to poorly sorted, red, brown, tan, purple, orange, and yellow, fine to coarse, clayey quartz sand. Pebble layers are common, as are clay laminae and beds. Ophiomorpha burrows are abundant in parts of the formation. The sediments have the characteristics of lower Delta plain to shallow marine deposits. The top of the Tobacco Road Formation is characterized by the change from a comparatively well sorted sand to the more poorly sorted sand, pebbly sand, and clay of the overlying “Upland” unit. Contact between the units constitutes the “Upland” unconformity. The unconformity is very irregular due to fluvial incision that accompanied deposition of the overlying “Upland” unit and later erosion, as mentioned in the previous paragraph. Thickness is variable as a result of erosive processes, but is at least 50 ft (15 m) in places (WSRC, 2000b; WSRC, 1997).

Subsurface characterization associated with the E-Area Vadose Zone Monitoring System was performed in 1999. The vadose zone underlying E Area extends to a depth of about 69 ft (21 m). E-Area disposal trenches, including the ET, are typically constructed within the uppermost 26 ft (8 m). Split-spoon sampling, Shelby-tube sampling and laboratory testing, and PiezoCone Penetrometer Testing were used to develop a geological model for determining optimum monitoring instrument locations. The model indicates three three major lithologic strata are located beneath the E-Area. The A-stratum dominates the vadose zone’s upper 23 ft (7 m), and is a predominantly clay layer (“Upland” unit). The B-stratum, characterized by higher sand content than either the overlying A-stratum or underlying C-stratum, begins at about the 23 ft (7 m) depth and extends to approximately 59 ft (18 m) depth (Tobacco Road Formation). Within the underlying C-stratum’s predominantly silty sands (Dry Branch Formation) is where the water table is located, just above the locally termed “Tan Clay” (WSRC, 2000b).

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3.0 PARAMETERS

3.1 ENGINEERED TRENCH LOCATION AND CONFIGURATION

The ET is located in E Area (see Figure 1). It will have a capacity of approximately 9,100 cubic meters in the first phase, with additional sections to be constructed as required. The ET is sized to allow stacking B-25s four-high. Trench depth is approximately 17 to 20 ft (6 m) below ground surface. First phase trench-bottom dimensions are approximately 150 ft (45 m) x 210 ft (64 m). First phase ground surface dimensions are approximately 200 ft (61 m) x 260 ft (79m), at a typical elevation of 280 ft (84.8 m) msl.

The trench bottom is compacted using a minimum of five passes of a vibratory roller having a dynamic force of 30,000 lbs per drum. The ET bottom is constructed with a geotextile filter underlying a crusher run layer. The geotextile is non-woven, spun-bonded, continuous filament of 100 percent polypropylene, and providing a minimum puncture resistance of 70 lbs, a minimum Mullen Burst pressure of 140 psi., and equivalent apparent opening of 70 to 140 size sieve. A granite gravel (Georgia Department of Transportation Standard Specifications Section 815-01, also known as Georgia #25 Crusher Run) layer approximately 6 in. thick is placed atop the geotextile layer. The gravel size gradation is:

Sieve Size	**Percent Passing by Weight**
2 in.	100
1.5 in.	97-100
0.75 in.	60-90
#10	25-45
#60	5-30
#200	0-15

Once the trench is filled with B-25s, the B-25s will be covered in the same manner as the slit trenches [i.e., minimum 4 ft (1.2 m) soil thickness, consolidated by the bulldozer pushing soil over the tops of the B-25s]. The ET is being constructed using standard heavy-construction equipment (e.g., backhoe and dump truck). Construction details for the Engineered Trench (formerly called the Mega Trench) are presented in Appendix A, which includes Design Change Package C-DCP-E-00001.

The ET design allows extending the next trench section while operation continues in the previous section. A roadway leading into the ET is about 30 ft (9.1 m) wide, with a five-percent grade, and designed to AASHTO HS-20 loads. A flat-bed truck, fork lift, or crane may be used for disposing B-25s. A 35-ft-minimum (10.6-m-minimum) interior turning radius for heavy equipment is allowed on the ET base. The base is sloped to move water runoff to a low-point sump for collection and pumping (using a portable pump on an elevated surface). The Performance Category is PC-1, designed per the SRS Engineering Standards No. 01110.

The ET bottom is constructed with a sump to collect any runoff for analysis prior to disposal. Elevation for the first phase is 261 ft (79.1 m) msl along the trench-bottom perimeter, sloping downward toward the sump perimeter at 260 ft (78.8 m) msl. Sump-bottom minimum elevation (top of Geoweb/concrete) is 243 ft (73.6 m) msl, with maximum depth 17 ft (5.2 m). Sump-top dimensions are approximately 60 ft (18.2 m) x 70 ft (21.3 m). Sump-bottom dimensions are approximately 30 ft (9.1 m) x 40 ft (12.2 m). The sump is designed to accommodate rainfall from a 6 hr.-25 year storm event for one-third of the ET area.

The ET floor is used to accommodate the difference between the design storm event (24 hr. - 500 year return period) and the 6 hr.-25 year storm event. Water depth within the ET will not be allowed to exceed 2 ft (0.61 m), to prevent B-25s from floating. The sump design allows the sump to be pumped out in 4 hrs. A rigid pipe is located near the sump to move water away from the sump and direct the water, at the top of the slope, toward the existing drainage ditch.

The ET also has a small submersible non-clogging industrial pump, to feed a sample station above the sump walls. The sample station allows an operator to sample the small pump's discharge. The existing performance assessment requires a minimum 25 ft (7.6 m) of undisturbed soil between the trench floor and the underlying water table. Sump sides have designed slopes at 1:1. Side-slopes are stabilized using 8 oz. minimum, geotextile fabric overlain by 4-in. (0.1 m)-deep GW20V Geoweb (manufactured by Presto Products Co., Appleton, WI) with 4,000 psi. concrete infill. Six TK-89 tendons per Geoweb section are typical for all sump sides (SRS Engineering, 2000).

The ET walls are sloped to allow personnel to work safely at the trench base. Typical elevation at the top of the trench side-slope is 278 ft msl (84.2 m msl). Minimum side-slope is 1:1. The side-slope is designed with a safety factor of 1.5 against slope stability failure where site-specific strength data are not available. Erosion control features for keeping the walls intact include erosion control matting and seeding of slopes. Life expectancy of the entire trench is at least 20 years.

3.2 SOIL CHARACTERISTICS

3.2.1 Vadose Zone Soil Moisture Content

E-Area Vadose Zone Monitoring System time domain reflectometer sensor data indicate that water content is very consistent over time. Average water contents are 0.284 m^3/m^3, from a depth of about 18-20 ft bls in the Upland Formation; 0.181 m^3/m^3, from a depth of about 40 to 42 ft bls in the Tobacco Road Formation, and 0.266 m^3/m^3, from a depth of about 58 to 60 ft bls in the Dry Branch Formation. Advanced tensiometer measurements indicate soil tension is relatively constant, ranging between -100 cm (wetter) to -200 cm (dryer), and is consistent with expected tensions for SRS soils. Water potential appears unaffected by daily or yearly infiltration events at the depths measured [approximately 18 ft (5.5 m) to about 60 ft (18.2 m)]. The total variation in water potential was less than 100 cm. in all tensiometers over a 3.5 month study period (WSRC, 2000b).

3.2.2 Soil Chemical Characteristics

3.2.2.1 pH

SRS shallow soil chemical and physical properties from areas not impacted by DOE activities are summarized in Looney, et al. (1990). Overall, pH values are indicated from 4.15 to 6.22 for shallow (6 to 120 inches deep) samples obtained for their study. Looney, et al. (1990) also cites a previous study that indicates pH values from 4.09 to 7.17 for shallow (surface to 30 inches deep) clayey soils and 4.69 to 5.68 for sandy soils. The Looney, et al. (1990) sampling depths are shallower than the ET total depth (up to 10 ft deep, rather than 20 ft deep). However, the values do give an indication of the general pH range to be expected for SRS soils - from just over 4 to just over 7.

Soil pH measurements obtained from backfill material (depth 9.5 ft) during the B-25 excavation on May 2 and 3, 2001, ranged from 5.3 to 5.7. These measurements were made using a Cole-Parmer Model 5992-62 soil pH electrode, consistent with American Society for Testing and Materials (ASTM) designation G 51-95 (Reapproved 2000) Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing (ASTM, 2000). Measurements were also made with pHydrion Vivid 1-11 pH color indication paper, made by Micro Essential Laboratory, Brooklyn, New York. Paper color indicated soil pH in the range of 5 to 6. These field values are generally consistent with the values used in the Dames and Moore (1987) B-25 corrosion study based on literature values for pH and resistivity. SRS soils were assumed to be acidic, with pH values ranging from 4.5 to 5.5.

3.2.2.2 Metals and Inorganic Compounds

SRS and E-Area background soil total metals values are summarized in Table 1. SRS values are from Looney, et al. (1990). E-Area values are from samples obtained at approximately 20 ft to 24 ft below land surface (bls) in the Burial Ground Complex (EPD, 1995).

Chloride	Chloride is commonly detected in SRS soils. Concentrations ranging from 0.7 mg/kg to approximately 118 mg/kg are reported by Looney et al. (1990).
Nitrate	Looney, et al. (1990) report nitrate in 70 percent of their 168 shallow soil samples. Concentrations range from below detection to 44.4 mg/kg.
Nitrite	Nitrite is reported below the nominal detection limit for all samples (Looney, et al., 1990).
Phosphate	Phosphate is not commonly detected in SRS soils - Looney et al. (1990) report detection in less than 10 percent of samples analyzed. Concentrations ranged from below detection to 13.7 mg/kg.
Sulfate	Looney, et al. (1990) report sulfate detected in approximately 70 percent of 168 samples. Concentrations ranged from below detection to approximately 25.1 mg/kg.

Table 1. Savannah River Site and Burial Ground Complex (E Area) Soils Total Metals Concentrations

Constituent	**SRS Shallow Soils* Concentration (mg/kg)**	**BGC Soils (20 ft bls)** Concentration (mg/kg)**
Copper	ND to 14	ND to 9.3
Iron	886 to 79,600	5,300 to 35,000
Lead	ND to 16.7	ND to 14
Magnesium	12.9 to 759	33 to 1,600
Manganese	ND to 498	11 to 110
Mercury	ND to 0.89	ND to 0.23
Nickel	ND to 17.9	ND to 230
Potassium	ND to 1,118	ND to 960
Selenium	ND to 1.66	ND to 11
Silver	ND to 1.8	ND to 3.7
Sodium	ND to 760	ND to 110
Thallium	ND	5.5 to 7.4
Vanadium	ND to 72.1	13 to 98
Zinc	1.8 to 267	ND to 15

ND = Not Detected
*Looney, et al. (1990)
**EPD (1995)

3.2.2.3 B-25 Exhumation Soil Analytical Results

On May 2-3, 2001, a B-25 was exhumed in E Area as part of a corrosion study (see section 2.4.1). A soil sample obtained adjacent to the B-25 on May 2, from a depth of 9.5 ft bls, was shipped to Law-Gibb Engineering, Inc. (Law-Gibb) for analysis. A summary of the analytical results (Law-Gibb, 2001) is presented in Table 2.

The moisture content measurement reported in Table 2 is lower than would be expected based on field observations during sampling and available reflectometer and Shelby tube data from nearby sampling of similar material and depths (see Section 2.2.1 and Appendix B). Shelby tube sample moisture measurements from depths similar to that from which the B-25 was exhumed range from 11.4 to 27.0 percent by weight (Appendix B).

Table 2. B-25 Exhumation Soil Sample Analytical Results (Law-Gibb, 2001)

Analytical Method	Parameter	Analytical Results
ASTM D854	Specific Gravity	2.67
ASTM D2216	Moisture Content (as received)	1.9 percent by weight
ASTM D4972	pH	4.57
ASTM D516-90	Sulfate Ion	<100 mg/kg
ASTM D512-90	Chloride Ion	<21 mg/kg
ASTM G57	Resistivity (as received)	5.8×10^6 ohm-cm
ASTM G57	Resistivity (minimum)	3.0×10^4 ohm-cm

Additional resistivity and moisture measurement details were obtained by phone conversation and fax from Law-Gibb (personal communication, Harry Johnson to William E. Jones, October 16, 2001). After discussing the reported Law-Gibb moisture content value, it is concluded that the reported value does not reflect field conditions. Soil moisture content values representing field conditions are included in Section 3.2.3 and Appendix B. The additional resistivity and moisture measurements provided by Law-Gibb are listed below.

Resistivity (ohm-cm)	Moisture Content (percent by weight)
5.829×10^6	2.4
7.63×10^5	0.9
3.01×10^4	31.1
3.04×10^4	53.5

These resistivity and moisture content values suggest a resistivity of approximately 1×10^4 ohm-cm would be expected in typical ET area field moisture conditions. This resistivity value is also consistent with Dames and Moore (1987), a corrosion study wherein a resistivity value of 1.0×10^4 ohm-cm is taken to be representative of soils to which B-25 would be exposed (see Section 2.4.1). Based on resistivity and field and laboratory-reported pH measurements, the soil encountered around the exhumed B-25 would be classified as slightly corrosive according to United States Department of Agriculture Guide for Interpreting Soils (USDA, 1971).

3.2.3 Trench Area Geotechnical Characteristics

At least 10 piezocone penetration tests have been performed and 10 geotechnical boreholes drilled in the ET area. Piezocone penetration test data include sleeve friction, tip resistance, pore pressure, friction ratio, and resistivity. Borehole data include standard penetration testing blow counts, field classification, and soil descriptions. Laboratory soil tests include sieve analyses, Atterberg limits, moisture contents, density, and strength tests. Results from these tests are summarized in a letter report from William T. Li, Site Geotechnical Services. The report is included as Appendix B.

The geotechnical data indicate four general soil layers above the water table. These layers are defined primarily by geotechnical properties measured by piezocone penetration testing (e.g., tip stress and friction ratio), and are not necessarily the same as geologically or hydrologically defined strata. The ET will be constructed largely within the upper two layers. The surficial geotechnical layer, Layer A, is predominantly clayey sands with intermittent sandy clay lenses, and ranges from about 5 to 15 ft (1.5 to 4.5 m) thick. Underlying Layer A is Layer B, predominantly clayey sands and sandy clays ranging from about 7 to 10 ft (2.1 to 3.0 m) thick. Layer C underlies Layer B. Layer C is about 25 ft (7.6 m) thick, comprising predominantly clayey sands. The lowermost few feet of some portions of the ET may encounter the uppermost Layer C. Most of the ET sump is within Layer C. Underlying Layer C, and including the water table in most areas of the ET, is Layer D. Layer D is predominantly silty sand, and about 6 to 9 ft (1.8 to 2.7 m) thick.

Layer A characteristics from soil samples EMTUD1-ST1 [Unified Soil Classification System (USCS) soil classification SC] and EMTUD2-ST1 (USCS classification CH) include moisture contents from 27.0 to 11.4 percent. Atterberg limits for these two samples are LL 53 to 90 percent, PL 25 to 35 percent, and PI 28 to 55 percent.

Layer B characteristics from soil samples EMTUD1-ST2 (USCS classification SC) and EMTUD3-ST1 (USCS classification SC) include moisture contents from 15.0 to 15.8 percent. Atterberg limits for these two samples are LL 44 to 49 percent, PL 26 percent, and PI 18 to 23 percent.

Layer C characteristics from soil samples EMTUD2-ST2 (USCS classification SC) and EMTUD4-ST1 (USCS classification SC) include moisture contents from 14.8 to 16.3 percent. Atterberg limits for these two samples are LL 40 to 44 percent, PL 23 to 24 percent, and PI 16 to 21 percent. Additional geotechnical characteristics such as grain-size distribution and triaxial compression tests for all soil samples are included in the letter report presented in Appendix B. A generalized geotechnical conceptual model is presented in Figure 2.

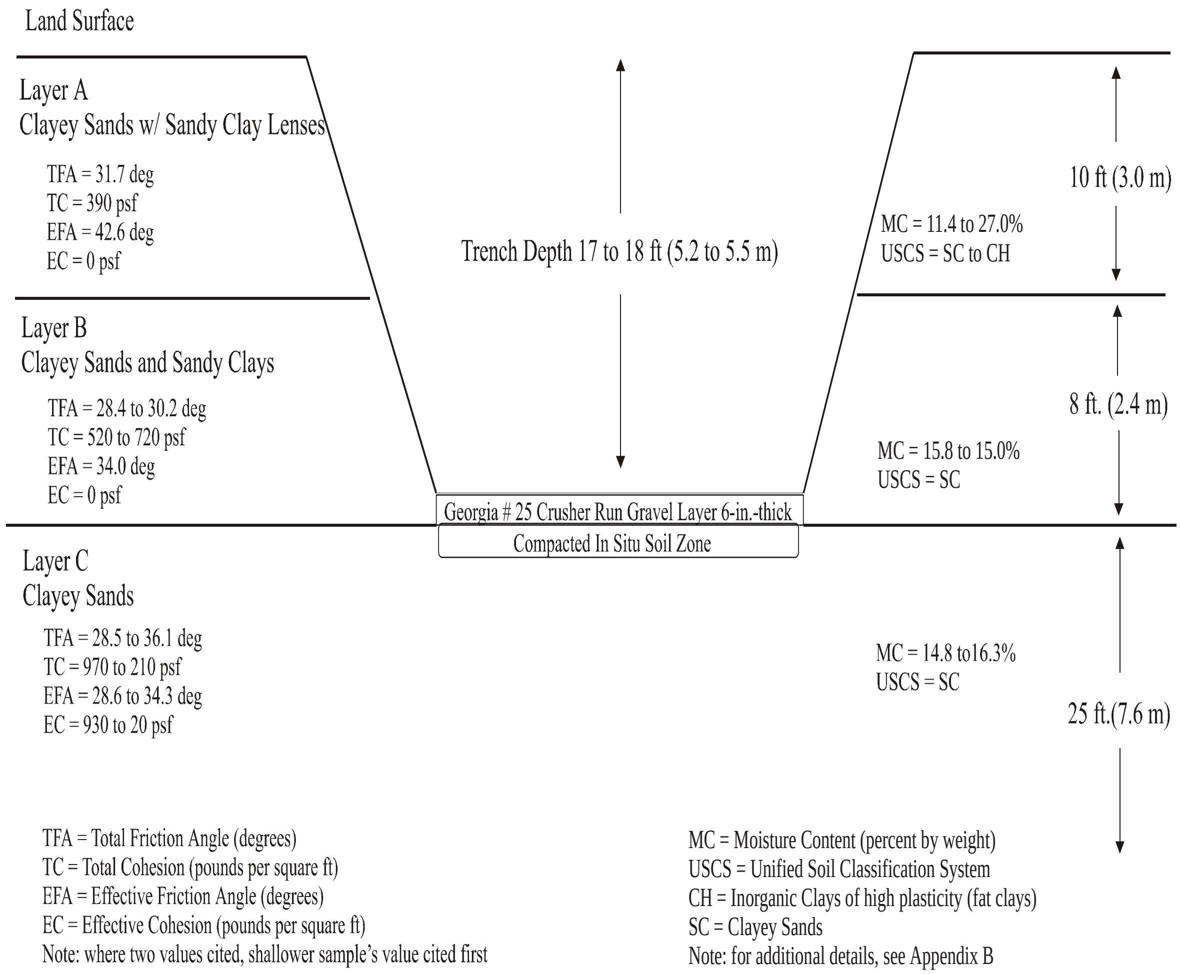

Figure 2. Engineered Trench Geotechnical Conceptual Model (not to scale)

3.3 DYNAMIC COMPACTION

Dynamic compaction is simply dropping a heavy weight repeatedly to compact underlying materials. A dynamic compaction test for the Mixed Waste Management Facility (MWMF) was performed in 1988 (Main, 1988 and 1989a; Phifer, 1991). This testing was performed in trenches with and without randomly dumped B-25s. Therefore, it is of limited relevance to dynamic compaction for a trench containing only stacked B-25s. The testing showed that dynamic compaction can be performed safely in both low-level and intermediate-level waste trenches.

A large-scale E-Area dynamic compaction evaluation is described in McMullin and Dendler (1994), McMullin (1994), and McMullin (1992). The primary evaluation objective was to determine if dynamic compaction of buried low-level waste trench materials would cause damage or failure to the adjacent MWMF closure system. Vibrations from dynamic compaction were observed to potentially damage the kaolin clay cap, although cap hydraulic conductivity was not affected. Recommendations were to use a 50-ft buffer between dynamic compaction locations and the MWMF cap.

A second objective was to quantify the success of dynamic compaction in consolidating buried B-25 containers containing low-level waste. A full-scale model of an engineered low-level waste trench with 168 B-25s stacked 4-high, 7-long, and 6-wide, containing simulated waste was constructed adjacent to a 3-ft-thick kaolin clay cap similar to that of the MWMF. An 8-ft-dia., 42,000 lb. weight was dropped from a height of 42 ft for either 20 drops or a 6-ft-displacement, which ever came first (Drop Zone A), or until displacement appeared to be negligible (Drop Zone B).

Following the dynamic compaction, B-25s were exhumed and the degree of compaction quantified. In general, the upper B-25s were more compacted than the bottom B-25s. The upper B-25s formed a fused layer by lateral spread and interlocking, which may inhibit further dynamic compaction effectiveness. Some B-25s were breached. Failed B-25s and simulated waste materials were overlying each other so tightly that, in some cases, the cranes extracting the containers tore metal rather than separating the containers. The outside edges of the B-25 matrix were not effectively consolidated.

Figure 3 shows the westerly edge of excavated B-25s (Area A compacted with traditional success criterion; Area B over- compacted). McMullin and Dendler (1994) indicates compaction in drop Area B was about 30 percent greater than drop Area A. Bottom B-25s in Drop Zone A particularly showed little compaction, while those in Zone B showed more consolidation. In particular, the bottom B-25 tier was not compacted in Area A. The overall results were that while some B-25s were significantly compressed, others were not.

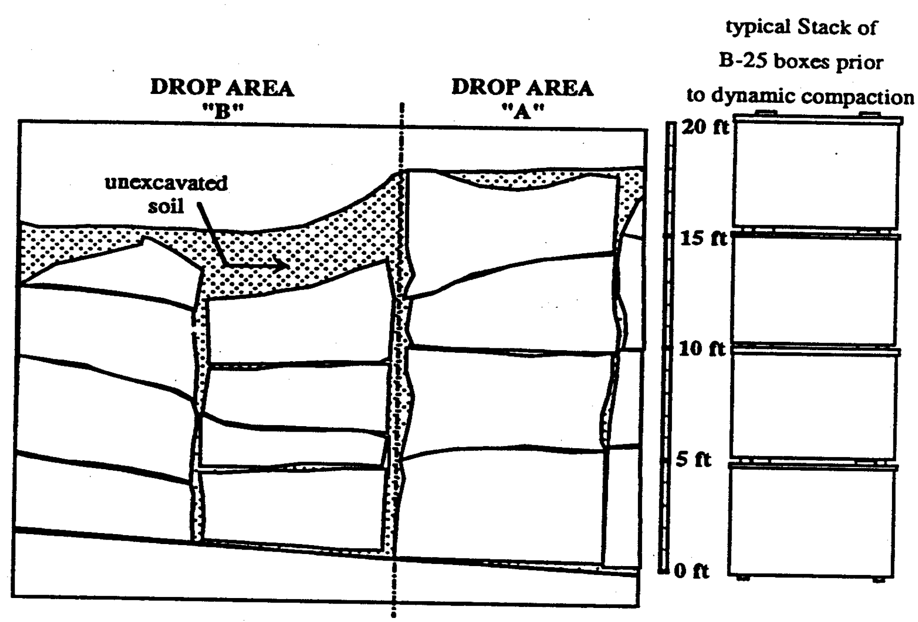

Figure 3. View of 1993 Dynamic Compaction Test Results (McMullin and Dendler, 1994)

The SRS Project Management Department performed dynamic compaction of 58 acres of the Mixed Waste Management Facility in 1989. The 1.5-acre trench (containing stacked B-25 containers) had previously received a 25-ft-thick static surcharge of soil over a one-year period. Dynamic compaction of this trench resulted in "…5 to 6 foot craters with an average of 12 drops and final displacements between drops of less than ½-foot." (Phifer, 1991).

Phifer and Serrato (2000) estimate SRS dynamic compaction costs at \$100,000 for mobilization/demobilization, and \$200,000 per acre. They go on to recommend evaluation of the following:

- Biodegradable waste minimization
- Use of low-density, high-strength, durable material to fill B-25 void space
- B-25 corrosion study
- Replacement of carbon steel with non-corroding material
- Placement of waste and soil in layers which are individually compacted
- Use of grout or lean fill to fill void spaces between containers

3.4 SUBSIDENCE

An early E-Area trench subsidence study is documented in Dames and Moore (1987). The study evaluated subsidence related to trench disposal (including Engineered Low-Level Trench Number 1) using B-25s in the Mixed Waste Management Facility, near the ET. At the time of the study, typical B-25 void space was estimated at 70 percent. Waste material was assumed to be rubber materials (30 percent), paper materials (30 percent), cloth articles (20 percent), plastic articles (18 percent), and tools (2 percent). Failure modes analyzed by plate-and-shell theory to estimate potential subsidence included:

- Elastic shortening or deformation of containers due to weight of soil cap and overlying containers with waste
- Buckling potential of the metal containers as construction of the soil cap commences
- Total collapse of the metal containers with complete closure of the void space and consolidation of the waste contents
- Effect of corrosion on the long-term subsidence

Subsidence due to linear elastic B-25 deformation or shortening was determined to be insignificant. Buckling analysis (not including increased resistance from neighboring B-25s, contents, B-25 lid and base, or inherent rigidity) indicated the B25s would begin to crush before the soil cap was completed. With 1 ft to 10 ft of soil loading, the bottom B-25 in a stack of 4 would begin to collapse, and the top B-25 would show signs of distress and begin to buckle. The uncertainty inherent in the buckling analysis was estimated as a factor of 2 to 5, with results that agreed closely with an SRS load test (to failure) of a B-25. A summary of that load test, simulating loading that the lid of the uppermost B-25 would experience under uniform loading from the fill material, is presented in Table 3.

Table 3. Load Test Results (Dames and Moore, 1987)

Load (lbs)	Observations	Equivalent Height of Soil* (ft)
7,300	Lid began to buckle, breach of containment	3.3
12,000	Failure of corner	5.5
26,000	Continued wall buckling, lid pulled away from container	11.8
34,000	Risers and lower perimeter began to deform	10.1
41,000	Continued deformation	12.2
46,000	Total lower perimeter failure, containment breached	13.7

Based on estimated soil unit wt. 120 pounds per cubic ft.

Dames and Moore (1987) concludes that B-25 buckling would occur in a random manner over a long time period throughout the ELLT-1 trench, partly due to restraint provided by surrounding B-25s. Collapse would first occur under the soil cap crown, where stress is greatest. An estimated 25 to 33 percent of the total void space in the four stacked B-25s would be lost due to initial random failure [approximately 2.5 to 3.5 ft (8.3 to 1.1 m) of subsidence]. Over time, uneven corrosion effects would cause additional collapse, inducing additional random failures.

Maximum subsidence where B-25s were stacked 4-high in ELLT-1 was expected to be approximately 14.5 ft (4.4 m), or a reduction in total height of 83 percent. A 75 percent reduction in waste material thickness (50 percent of the waste was expected to decompose) was expected. The 14.5 ft (4.4 m) of ultimate subsidence was expected to occur regardless of the amount of fill placed above the B-25s, since it represents closing of void space and waste compression. Overall, subsidence was expected to progress as an initial settlement during construction, followed by progressive, somewhat erratic settlement over a long time (Dames and Moore, 1987).

The actual height of soil anticipated to be placed over ET B-25s is in the order of 4 to 6 feet (1.2 to 1.8 m). So, initial collapse might be expected to be less that this model suggests. However, the May 3, 2001, exhumation of a B-25 that had been buried in March 1993 showed that the lid had been forced into the B-25 by the overlying 8 ft (2.4 m) of soil. This indicates a possible initial collapse of about 1 to 2 feet

Yau (1986) describes the B-25 structural response to burial as occurring from two different loading patterns. The uppermost containers are subjected to distributed soil pressure on the lid plates. All underlying B-25s are subjected to compression of the wall plates because the bottom plate of each B-25 is stiffened by girders that transmit the soil pressure from the top to the wall plates rather than the lid plates of the B-25 layers underlying the uppermost B-25 layer. Table 4 summarizes B-25 deformation characteristics described in Yau (1986).

Table 4. B-25 Deformation With Applied Weight (Yau, 1986)

B-25 Lid Plate Deformation (uppermost B-25s directly overlain by soil)				
PSI	**Lbs**	**Lbs/ft^2**	**Equivalent Height of Soil (ft)***	**Occurrence**
0.2	660	28	0.27	inelastic lid deformation begins
1.3	4,500	190	1.8	bent rim starts to unbend
3.6	12,000	505	4.8	lid starts to slip
7.8	26,000	1,095	10.5	lid starts to cave into container
Side Plate Deformation (B-25s underlying the uppermost B-25 layer)				
PSI	**Lbs**	**Lbs/ft^2**	**Equivalent Height of Soil (ft)***	**Occurrence**
8.5	29,000	1,220	11.7	buckling of sides begins
11.7	40,000	1,685	16.2	complete B-25 collapse
*Assumes soil weight 90 lbs/ft^3 dry density (104 lbs/ft^3 wet density). Test results describe behavior of single B-25 stack, and does not include side plate support provided by adjacent stacked B-25s. Actual B-25s in trench would require greater loading to produce deformation due to side support provided by adjacent B-25s.				

Performance of a kaolin cap as the result of subsidence was evaluated by Dr. Richard C. Warner in a 1988 field demonstration. The demonstration concluded that a 2-ft compacted kaolin clay layer can span a 3 to 3.5-ft-wide cavity without subsiding. A 4-ft-wide cavity would eventually cause the layer to fail and subside. Warner's study also demonstrated that saturated soil conditions reduce the cavity-width that a kaolin layer can span (Phifer and Wilhite, 2001).

The SRS Environmental Restoration Department performed a clayey sand and Flexible Membrane Liner (FML) / Geosynthetic Clay Liner (GCL) cap subsidence field demonstration during 1992 and 1993. Table 5 provides a summary of the demonstration results along with a comparison to Warner's kaolin clay cap subsidence field demonstration. Other observations made during this demonstration include the following (Phifer and Wilhite, 2001):

- Failure began at the center of the cavity for both the clayey sand and FML/GCL caps.
- Significant surface loading (i.e. 7500 lbs/ft^2) on the clayey sand and FML/GCL caps with underlying cavities could cause failure in a very short duration.
- Clayey sand and FML/GCL caps with underlying cavities and no surface loading could span the cavities for significant periods prior to failure (i.e. 3 months).

Table 5. Closure Cap Subsidence Demonstration Summary Results (Phifer and Wilhite, 2001)

Parameter	Kaolin Cap [1]	Clayey Sand Cap [2]	FML/GCL Cap [3]
Span at Failure (ft), Unsaturated Conditions	4	6	7
Span at Failure (ft), Saturated Conditions	2.5	5	7
Hydraulic Conductivity (cm/s)	1.2E-08	2E-06	1E-10
Underlying Cavity Impact on Hydraulic Conductivity	Increased prior to collapse	Remained constant until collapse	Remained constant with strain until tensile failure occurred (i.e. tearing)
Mode of Failure	Catastrophically	Catastrophically	Incremental subsidence until tensile failure

[1] 2-foot thick kaolin clay layer (>90% passing #200 sieve)
[2] 2-foot thick clayey sand layer [SC material based on the Unified Soil Classification System (USCS)]
[3] A 40-mil thick, high density polyethylene (HDPE), flexible membrane liner (FML) over a geosynthetic clay liner (GCL) containing bentonite over a 2-foot thick clayey sand layer (USCS SC material) (Serrato, 1994)

An examination of long-term waste subsidence potential for the ET is documented in Phifer and Wilhite (2001). Their study evaluates subsidence associated with B-25 disposal with and without dynamic compaction after placement within the ET, and with and without super compaction of waste prior to placement within B-25s. Their recommendations are that the following options receive further consideration along with other options that may be more technically effective and cost efficient:

- Use of tertiary dynamic compaction
- Combined use of the Waste Sort Facility/Supercompaction Facility and tertiary dynamic compaction

Use of B-25 containers results in a large inherent subsidence potential which cannot be totally eliminated by any of the methods evaluated. Changing to a disposal container with less structural integrity or waiting until the B-25 containers have degraded before performing dynamic compaction might reduce the subsidence potential more than the cases evaluated.

Phifer and Wilhite (2001) recommend that the use of B-25 containers for waste disposal in Engineered Trenches be reconsidered. B-25 container usage results in a large inherent subsidence potential, and is assumed to require an extended period requiring post-closure maintenance. Both of these conditions result in high long-term maintenance costs. If it is determined that B-25 containers will continue to be used, they recommend that an evaluation be conducted to optimize subsidence treatment, capping, and long-term maintenance strategies. Phifer and Wilhite (2001) recommend the SRS Solid Waste Division take an integrated approach that considers the implications of and interactions between disposal operations, subsidence treatments, closure methodology, and long-term maintenance requirements. Such an approach would produce an overall strategy which is both technically effective and cost efficient.

3.4.1 Static Surcharge

A monitoring program to investigate the effects of applying a static load, or surcharge, on stacked B-25s in an SRS trench is described in a letter report by Chas. T. Main, Inc. (Main, 1989b). The one-year program evaluated the potential of large overburdens [25 ft (7.6 m) soil thickness] to induce subsidence on stacked B-25s in Engineered Low Level Trench Number 1 (ELLT #1). The report concludes that surcharging yields 2 to 3 ft (0.6 to 0.9 m) of settlement, and is not an acceptable method of waste densification for trenches containing stacked B-25s. These results appear consistent with observations in the preceding paragraph that indicate greater loading is required to produce deformation when B-25s are stacked side-by-side than a load placed on a single B-25 stack.

3.4.2 Subsidence Potential and Subsidence-Potential Reduction

Phifer and Wilhite (2001) present an evaluation of ET subsidence potential and subsidence-potential reduction. Their in-depth study uses the most recent and complete information regarding the ET B-25 configuration and subsidence-reduction measures that are presently being considered by Solid Waste. The basic B-25 configuration is presented in Figure 4.

The subsidence-reduction measures evaluated by Phifer and Wilhite (2001) assume the waste bulk density will eventually become 1.5 g/cm^3. This density is both a typical bulk density for soil and within the range of bulk density measured for exhumed buried waste at the SRS Sanitary Landfill. Another starting-point assumption is the base relative subsidence potential against which the subsidence treatment methods are evaluated: 15.1 ft (4.6 m) for a stack of four uncompacted B-25 containers prior to placement of the interim soil cover.

The first subsidence-reduction method is placement of the interim soil cover over the uncompacted B-25s. This likely results in pushing the uppermost B-25's lid into the container, resulting in elimination of about 1.5 ft (0.46 m; 9.9 percent reduction) of subsidence potential.

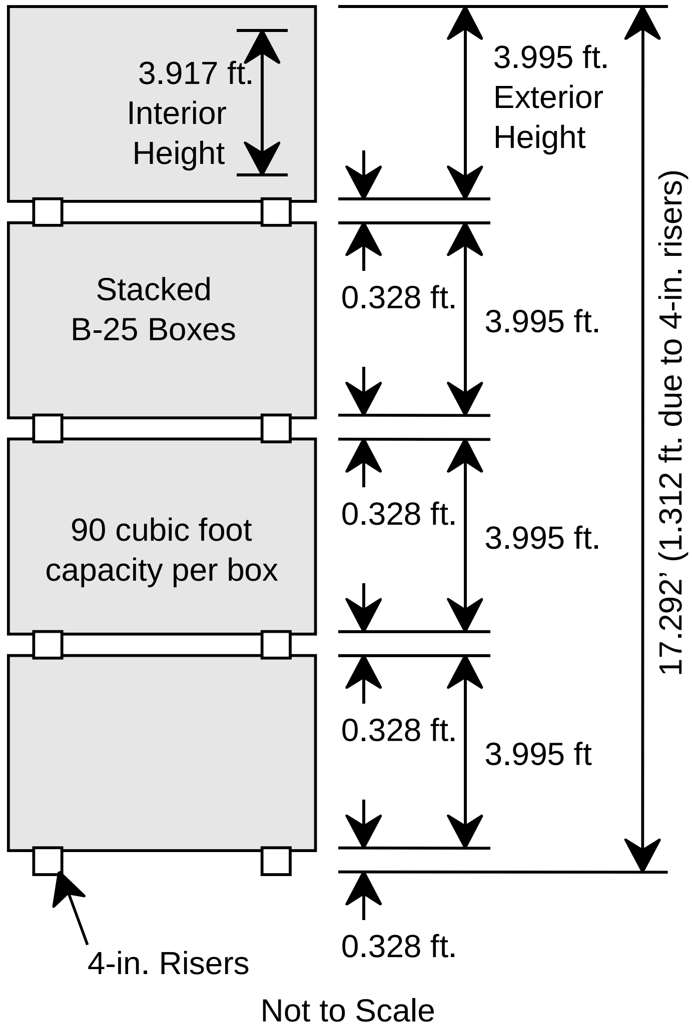

Figure 4. B-25 Containers Stacked Four-High (Phifer and Wilhite, 2001)

Processing the waste through the WSF/SCF prior to disposal and placement of the interim soil cover likely results in a relative subsidence potential of 11.7 ft (3.57 m; 22.5 percent reduction). The subsidence potential for standard dynamic compaction (treats about 50 percent of trench surface area) of B-25s containing waste that has not been processed through the WSF/SCF is 10.4 ft (3.16 m; 31.9 percent reduction). The subsidence potential for tertiary dynamic compaction (treats 100 percent of trench surface area) of B-25s containing waste that has not been processed through the WSF/SCF is 7.2 ft (2.18 m; 52.5 percent reduction).

Standard dynamic compaction of B-25s containing waste that has been processed through the WSF/SCF has a subsidence potential of 9.2 ft (2.79 m; 39.4 percent reduction). Tertiary dynamic compaction of B-25s containing waste that has been processed through the WSF/SCF has a subsidence potential of 6.6 ft (2.01 m; 56.3 percent reduction). A summary of subsidence-reduction methods, subsidence potential, and percent subsidence potential reduction is presented in Table 6.

Table 6. Relative Subsidence Potential and Relative Subsidence Potential Reduction (Phifer and Wilhite, 2001)

Subsidence Treatment Method	Relative Subsidence Potential (ft)	Relative Subsidence Potential Reduction (%)
Base Subsidence Potential [1]	15.1	0.0
ISC	13.6	9.9
ISC and WSF/SCF	11.7	22.6
ISC and SDC	10.4	31.2
ISC and TDC	7.2	52.4
ISC, WSF/SCF, and SDC	9.2	39.5
ISC, WSF/SCF, and TDC	6.6	56.3

[1] Subsidence Potential of a stack of four uncompacted B-25 boxes prior to the placement of the interim soil cover
ISC = Interim Soil Cover; WSF/SCF = Waste Sort Facility / Super Compactor Facility; SDC = Standard Dynamic Compaction; TDC = Tertiary Dynamic Compaction

3.4.3 Corrosion

McMullin and Dendler (1994) point out that the B-25 design purpose is to contain low-level waste at the generation point, to protect workers, and to facilitate transportation to the burial site. B-25s were not intended to provide waste containment within a burial location. They do, by default, help minimize waste migration. The B-25 containers used in the dynamic compaction testing revealed that dynamic compaction accelerated the B-25 corrosion rate by bending and tearing the metal and by breaking the protective paint bonds. As part of an earlier corrosion study, 3 B-25 containers were buried uncompacted at a location near the dynamic compaction test location. When those B-25s were exhumed after four years, they showed no observable corrosion. After being in the ground for 6 months, the dynamically compacted B-25s demonstrated accelerated corrosion and degradation (McMullin and Dendler, 1994).

A detailed corrosion evaluation based upon an exhumed E-Area B-25 is in preparation. The B-25 was exhumed on May 3, 2001, from a depth of about 8 to 12 ft bls. Soil samples were obtained for corrosion related laboratory analyses. The corrosion evaluation is being led by Kerry Dunn, Savannah River Technology Center (SRTC). Conclusions from the corrosion evaluation, including a paradigm for corrosion rates and B-25 stability through time, will be used in the future for predicting subsidence rates. A description of the excavation and photographs of the B-25 prior to burial and during exhumation are included in Appendix C.

The B-25 exhumed for corrosion evaluation was one of those used for the dynamic compaction test. The B-25 was somewhat flexed in some areas when buried, but in overall structurally sound shape. Photographs of the B-25 prior to burial are included in Appendix C. The exhumed B-25 showed a fairly consistent covering of blistered outer paint layer underlain by either primer or pitted steel (Appendix C). This suggests that corrosion becomes apparent on painted, relatively undamaged portions somewhere between 4 and 8 years after burial for uncompacted B-25s. The dynamic compaction test results indicate that if corrosion minimization is important, dynamic compaction should not be used.

Corrosion was evaluated in the Dames and Moore (1987) study based on literature values for pH and resistivity. SRS soils were assumed to be moderately to strongly acid, with pH values ranging from 4.5 to 5.5. These values are consistent with those measured by soil pH probe (5.4 to 5.7) and pH indicator paper (5 to 6 range) during the May 3, 2001, B-25 exhumation. Electrical resistivity values ranging from 3.0×10^3 ohm-cm to 3.5×10^4 ohm-cm were cited for F- and H-Area soils by Dames and Moore (1987), with a value of 1.0×10^4 ohm-cm taken to be representative.

Resistivity values ranging 5.8×10^6 ohm-cm (as received) to 3.0×10^4 ohm-cm (resistivity minimum), depending on soil moisture, are reported for the soil sample obtained during the May 2001 B-25 exhumation (see Section 3.2.2). Based on these measurements, a value of 1×10^4 ohm-cm is believed to represent typical field moisture conditions, substantiating the Dames and Moore (1987) assumption. Overall, Dames and Moore (1987) considered the soil moderately to mildly corrosive. Assuming a pH of 4.5 and soil resistivity of 1.0×10^4 ohm-cm, Dames and Moore (1987) estimated 30 years would be required to perforate 14-gauge carbon steel.

Maximum subsidence where B-25s were stacked 4-high in ELLT-1 was expected to be approximately 14.5 ft (4.42 m), or a reduction in total height of 83 percent. A 75 percent reduction in waste material thickness (50 percent of the waste was expected to decompose) was expected. The 14.5 ft (4.42 m) of ultimate subsidence was expected to occur regardless of the amount of fill placed above the B-25s, since it represents closing of void space and waste compression. Overall, subsidence was expected to progress as an initial settlement during construction, followed by progressive, somewhat erratic settlement over a long time (Dames and Moore, 1987).

3.5 CONTAINER CHARACTERISTICS AND CONFIGURATION

As described in Phifer and Wilhite (2001), data from the SRS Waste Information Tracking System (WITS) on about 6,900 waste containers meeting Waste Acceptance Criteria (WAC) for the Engineered Trench are presented in Table 7. The containers are those located in the Low Activity Waste Vault (LAWV) and temporary storage areas associated with the LAWV (i.e., TRAN1, TRAN2, TRAN5, TRAN6, and TRAN7) and containers located in the Engineered Trench and associated temporary storage areas (i.e., ET-TSA). The information presented, for each type of container, includes the container description, the number of containers, and the average density for that container type. Statistics (i.e., average, standard deviation, minimum, maximum, and median) on the density of containers are also presented.

Table 7. Waste Containers meeting Engineered Trench Waste Acceptance Criteria (Phifer and Wilhite, 2001)

Container Description	Number of Boxes	Average Density, g/cc	Standard deviation	Minimum Density	Maximum Density	Median Density
SRS Uncompacted B-25 Boxes:						
Pass WSF Screening Criteria						
B-25 (YELLOW)-LIGHT	818	1.853E-01	1.616E-01	1.779E-02	1.119E+00	1.387E-01
B-25 (6,000# CAP) 672#	25	1.281E-01	5.011E-02	5.623E-02	2.354E-01	1.103E-01
B-25 (YELLOW) 575#	1042	1.965E-01	1.745E-01	3.024E-03	1.183E+00	1.424E-01
B-25 (YELLOW) 625#	1777	1.427E-01	6.265E-02	1.832E-02	3.549E-01	1.291E-01
B-25 OVERPACK - UNRESTRICTED	5	1.926E-01	3.188E-02	1.576E-01	2.411E-01	1.865E-01
B-25(YELLOW) 440 LBS	87	1.734E-01	6.499E-02	6.589E-02	3.456E-01	1.654E-01
Super Compactor B-25 (575#) not compacted	1	1.658E-01	NA			
B-25P (Purple Compactor B-25) not compacted	12	9.391E-02	5.204E-02	2.633E-02	1.713E-01	8.681E-02
Total SRS uncompacted B-25s meeting WSF Screening Criteria	**3767**	**1.673E-01**	1.291E-01	3.024E-03	1.183E+00	1.357E-01
Fail WSF Screening Criteria						
B-25 (YELLOW)-LIGHT	156	1.865E-01	1.475E-01	3.273E-02	6.790E-01	1.248E-01
B-25 (YELLOW) 575#	244	2.284E-01	1.908E-01	1.512E-02	8.405E-01	1.424E-01
B-25 (YELLOW) 625#	288	2.088E-01	1.695E-01	4.145E-02	8.627E-01	1.251E-01
B-25 OVERPACK - UNRESTRICTED	10	1.774E-01	4.375E-02	1.068E-01	2.545E-01	1.775E-01
B-25(YELLOW) 440 LBS	18	3.205E-01	1.744E-01	4.678E-02	5.950E-01	3.779E-01
B-25P (Purple Compactor B-25) not compacted	27	1.962E-01	9.140E-02	3.842E-02	3.132E-01	2.209E-01
Total SRS uncompacted B-25s not meeting WSF Screening Criteria	**743**	**2.124E-01**	1.707E-01	1.512E-02	8.627E-01	1.359E-01
SRS B-25 Boxes containing supercompacted waste	**779**	**7.201E-01**	9.854E-02	4.468E-01	1.341E+00	7.089E-01
SRS B-25P (Purple Compactor B-25) compacted	183	4.371E-01	8.379E-02	2.448E-01	7.208E-01	4.470E-01
SRS B-12	434	4.763E-01	3.288E-01	1.107E-02	1.726E+00	4.134E-01
Non SRS Boxes:						
BETTIS 12,500 CAPACITY B-25	128	1.036E+00	2.399E-01	1.116E-01	1.326E+00	1.085E+00
B-25(BETTIS)	284	4.298E-01	2.163E-01	3.735E-02	1.039E+00	3.949E-01
B-25, KAPL, Stng Tight, Unres.	211	4.050E-01	1.863E-01	1.270E-01	9.360E-01	3.691E-01
B-25 TYPE A (KNOLL-KAPL)	10	2.972E-01	1.678E-01	1.387E-01	5.657E-01	2.259E-01
B-25 PINELLAS	1	5.424E-02	NA	NA	NA	NA
B-12(BETTIS)	17	1.270E+00	3.222E-01	1.506E-01	1.669E+00	1.290E+00
B-12, KAPL, Stng Tight, Unrest	66	8.4541E-01	4.661E-01	2.470E-01	2.694E+00	7.699E-01
B-12 STRONG TIGHT (KNOLL)	5	1.368E+00	1.354E-01	1.227E+00	1.553E+00	1.317E+00
B-12 Type A (Knolls)	1	1.705E-01	NA	NA	NA	NA
Total non-SRS boxes	723					
Miscellaneous Containers						
55-Gal Drum (A,7A)	12	NA	NA	NA	NA	NA
Box for Jumper P-PJ-H-7878	1	NA	NA	NA	NA	NA
Empty 30-Gallon SS Drum	2	NA	NA	NA	NA	NA
NMSS Container for PVV	3	NA	NA	NA	NA	NA
B-1000 AGNS	2	NA	NA	NA	NA	NA
55 Gal Drum (UN1A2)	41	NA	NA	NA	NA	NA
55 Gal Drum (17H Bettis)	9	NA	NA	NA	NA	NA
Bettis DOT 7A Type A	7	NA	NA	NA	NA	NA
KAPL-Windsor (B-82)	49	NA	NA	NA	NA	NA
KAPL-Windsor (B-87)	2	NA	NA	NA	NA	NA
KAPL-Knolls 55-gal drum	9	NA	NA	NA	NA	NA
KAPL-Kesselring 01-2800	25	NA	NA	NA	NA	NA
BAPL-Mixed Fission Products	4	NA	NA	NA	NA	NA
BAPL-Unirradiated Alpha	1	NA	NA	NA	NA	NA
KWD-Low Specific Activity	1	NA	NA	NA	NA	NA
SEG OP45(Retired Do Not Use)	34	NA	NA	NA	NA	NA
SRTC One-Time Shielded Cell	1	NA	NA	NA	NA	NA
SEG OP45	7	NA	NA	NA	NA	NA
KAPL-Windsor Steam Gen Un-Res	5	NA	NA	NA	NA	NA
SRTC Box – 16,000 LB. Capacity	1	NA	NA	NA	NA	NA
SRTC Box – 2000 LB. Capacity	1	NA	NA	NA	NA	NA
55-Gallon Drum, Carolina Metal	4	NA	NA	NA	NA	NA
85-Gallon, Stain. Steel Drum	15	NA	NA	NA	NA	NA
85-Gal Carbon Steel Drum, SW	3	NA	NA	NA	NA	NA
Empty Bung Hole 55-Gallon Drum	1	NA	NA	NA	NA	NA
Total Miscellaneous	240					
Total Number of Containers	6869					

The data are subdivided into several categories, SRS containers, non-SRS containers, and miscellaneous containers. The SRS containers are further subdivided into the following categories:

- B-25 containers containing non-compacted waste that pass the Waste Sort Facility (WSF) screening criteria
- B-25 containers containing non-compacted waste that fail the WSF screening criteria
- B-25 containers containing supercompacted waste
- B-25 containers containing compacted waste from the 253-H compactor (purple containers)
- B-12 containers

The non-SRS containers are subdivided into two categories: B-25 containers and B-12 containers.

To facilitate projection of waste subsidence and consequent trench cap disruption, only the SRS B-25 containers containing non-compacted and supercompacted waste were considered by Phifer and Wilhite (2001). These containers represented 77% of the total number of containers. The B-25 containers containing compacted waste from the 253-H compactor were not included because that compactor is no longer operational.

The inside dimensions of B-25 containers are 1.83 meters long, 1.17 meters wide and 1.19 meters high (6 feet long, 3.83 feet wide, and 3.917 feet high). The outside dimensions are 1.85 meters long, 1.19 meters wide and 1.32 meters high (6.078 feet long, 3.911 feet wide, and 4.323 feet high). The interior volume of a B-25 is 2.55 m^3 (90 ft^3) (Phifer and Wilhite, 2001).

Waste received for potential supercompaction was considered by Phifer and Wilhite (2001) to be processed in one of the following two ways:

- Waste received from the generators in B-25 Containers is processed through the WSF, if it passes the WSF screening criteria, and it is supercompacted in the Super Compactor Facility (SCF), if it passes the SCF compaction criteria.
- Pre-sorted compactable waste is also received at the SCF from the generators in 55-gallon drums. This waste is ready for supercompaction and does not require processing through the WSF.

Approximately 30% of the B-25 containers received, on the average, do not pass the WSF screening criteria. Of the B-25 containers sent to the WSF/SCF, about 15% are rejected because the contents were unacceptable for supercompaction. Therefore, Phifer and Wilhite (2001) assume that 60% of the SRS B-25 containers received by SWD can be supercompacted.

These B-25 containers which can be supercompacted, are supercompacted by removing the waste from the B-25 containers and placing it in 55-gallon drums. The drums are then supercompacted. The supercompacted drums are then loaded into a B-25 container prior to emplacement in the Engineered Trench.

The 779 supercompacted SRS B-25 containers listed in Table 7 contained 6,095 compacted 55-gallon drums of waste that were received directly from the generators at the SCF ready for compaction and therefore were not processed through the WSF. Phifer and Wilhite (2001) assume that the split between compacted 55-gallon drums of waste both processed through the WSF and received directly from the generators at SCF is accurately represented by the fraction of each type of drum in the supercompacted SRS B-25 containers. On the average, 40 supercompacted drums are contained in a B-25 container. The median number of drums is 39, the maximum is 68, the minimum is 24, and the standard deviation is 7.5 drums. Empty 55-gallon drums weigh 36 ± 7.2 pounds (1.633E04 ± 3.266E03 grams).

From Table 7, the average density of uncompacted B-25 containers that pass the WSF screening criteria is 0.1673 grams per cubic centimeter (g/cm^3). The average density of uncompacted B-25 containers that do not pass the WSF screening criteria is 0.2124 g/cm^3 (see Table 7). The average density of B-25 containers containing supercompacted waste is 0.7201 g/cm^3 (Table 7). The average weight of B-25 containers, including the container itself, that pass the WSF screening criteria but fail the SCF compaction criteria is 748,430 g.

Based upon the above data, Phifer and Wilhite (2001) have determined the following:

- Using the SCF facility, both uncompacted and supercompacted B-25s would be disposed in the Engineered Trench. Figure 5 provides the WSF/SCF B-25 process flow diagram based upon the receipt of 100 B-25 boxes by SWD. As shown in Figure 5, every 100 B-25 boxes received by SWD that meet the WAC for the Engineered Trench result in the following for disposal in the Engineered Trench:
  - Approximately 40 uncompacted B-25 boxes with an average waste density of 0.2067 g/cm^3 would be produced.
  - Approximately 21 supercompacted B-25 boxes with an average waste density of 0.7201 g/cm^3 would be produced due to processing through the WSF.
  - Approximately 5 supercompacted B-25 boxes with an average waste density of 0.7201 g/cm^3 would be produced due to pre-sorted compactable waste received from the generators in 55-gallon drums.
  - A total of approximately 66 B-25 boxes with an average waste density of 0.4088 g/cm^3, of which approximately 39% are supercompacted and 61% are uncompacted, would be disposed in the Engineered Trench.

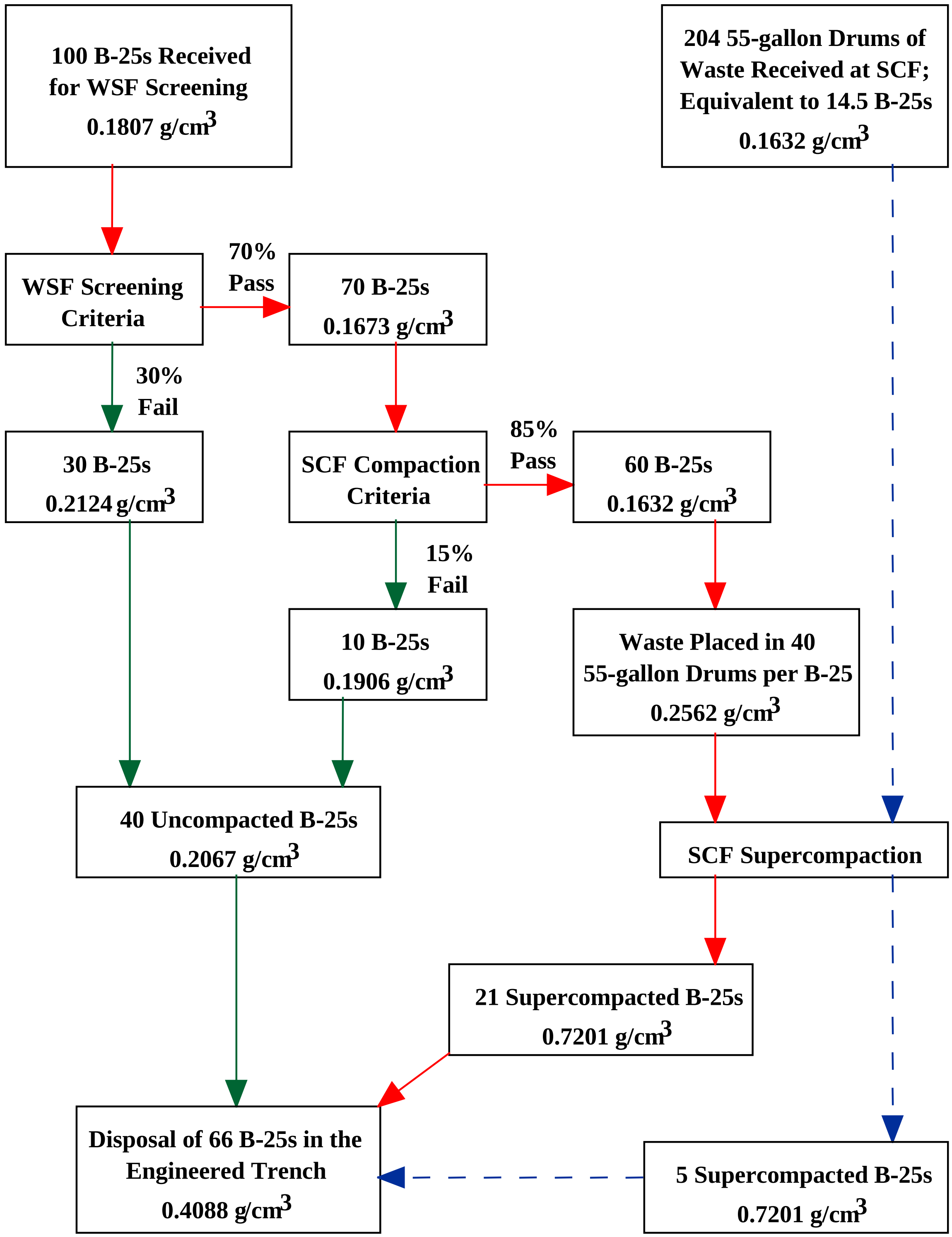

Figure 5. Waste Sort Facility/Super Compactor Facility B-25 Process Flow Diagram (Phifer and Wilhite, 2001)

- If the B-25 containers meeting the Waste Acceptance Criteria (WAC) were not processed through the WSF/SCF prior to disposal in the Engineered Trench, and if the waste received directly from the generators in 55-gallon drums was instead received in B-25 containers, the average density of the waste within the uncompacted B-25s would be 0.1785 g/cm^3.
- The average B-25 container in an Engineered Trench containing B-25s which have been processed through the WSF/SCF is equivalent to 1.72 average B-25 boxes in an Engineered Trench containing only uncompacted B-25s on a mass equivalent basis. Processing through the WSF/SCF results in disposal of a mixture of supercompacted and uncompacted B-25 boxes.

The majority of waste containers to be placed in the ET will be 90 cubic ft B-25 containers. B-25s are made of hot-rolled, 12-gauge carbon steel (ASTM-A569-93). Some older documents refer to 14-gauge low-carbon steel construction (Dames and Moore, 1987; Yau, 1986). Both interior and exterior are painted. Both an older (1986) B-25 procurement specification referring to 14-gauge steel and a more recent (2000) B-25 procurement specification referring to 12-gauge steel are included in Appendix D.

According to Yau (1986), mechanical properties like tensile and yield strength are not published by steel producers, because the steel in thin sheet form is not suitable for consideration of structural resistances. Yau (1986) cites personal communication with Bethlehem Steel, Inc., indicating minimum yield strength of Y = 35 ksi, and tensile strength of U = 43 ksi. Because of its high ductility with a maximum strain of 35 percent, the sheet metal is generally used for deformable containers. The side plates are stiffened by V-shaped crimps, and the bottom plate is stiffened by three channel risers (also called girders). Only the lid plate is not stiffened. The lid plate has a turned-down rim, which folds over the side like a shoe container cover. When the container is ready for burial, up to 12 angled steel pegs approximately 3 in. wide are driven into the buckles on the side walls to secure the lid.

3.6 SOFT-SIDED CONTAINERS

Another containerization method under consideration for ET application is soft-sided disposable containers. Two vendors have demonstrated this technology at SRS. For information purposes, the available vendor’s product is described here.

The Transport Plastics, Inc., Lift-Liner™ soft-sided waste packaging system includes a 25-ml. woven outer polypropylene fabric shell with a 2-ml. Water-resistant coating and a 45-ml. double layer polypropylene inner liner. The outer shell is equipped with 18 lifting straps made of 2 in. polyester seat belt webbing material. The containers meet the U.S. Department of Transportation (DOT) requirements for transport of low specific activity and surface contaminated objects.

The system includes a loading frame used to support the shell and inner liner during loading and a lifting/spreader bar. The lifting/spreader bar attaches to the lifting straps for hoisting the container from the loading frame onto a transport vehicle. A small forklift can move the empty loading frame and lifting/spreader bar. The empty bags are light and compact enough to move by hand. Each container has a capacity of 260 cubic ft and holds up to 24,000 lbs. This is almost three times the weight and capacity of a B-25. There is a one-time cost of about $7,000 for the loading frame and lifting/spreader bar. The soft-sided containers cost about $380 per bag. This results in a savings of about $1,800 in container cost for each bag filled versus filling three B-25s. Smaller size bags equivalent in size to a B-25 are also being developed and tested.

Soft-sided containers are currently being evaluated at SRTC by B.T. Butcher and co-workers, as replacements for some B-25s at SRS. One obvious advantage over B-25s is the very significant reduction in void space, with concomitant reduction in subsidence and increase in long-term stability. Soft-sided containers might be placed similarly to sanitary waste, with a layer of soil between layers of containers. Even with layers of soil, compaction could result in a total waste/compacted soil thickness only half the height of the current 4-high B-25 height.

One disposal method (conceived by Mark Phifer) that could be considered for finite element modeling is placement of soft-sided containers in a “pillow” configuration. The “pillow” could be covered by a bentonite or high-density polyethylene (HDPE) “cap,” and possibly underlain by a bentonite or HDPE seal and/or a gravel capillary break. The “pillow” could also be overlain by 10 to 12 ft of native soil (providing static surcharge, compaction, and isolation from intruders). The native soil could be covered at the surface by climax vegetation. Such a configuration could provide truly long-term stability with minimal subsidence and maintenance.

3.7 WASTE CHARACTERISTICS

The ET will contain low-level radioactive waste (LLW). LLW is radioactive waste that is not classified as high-level waste, transuranic waste, spent fuel, or by-product material as defined in DOE Order 435.1, and does not contain Resource Conservation and Recovery Act-regulated hazardous waste (WSRC, 2000d). It consists of radioactively-contaminated materials such as miscellaneous job control waste, small equipment, plastic sheeting, gloves, wood, debris, and soil.

SRS operations classify LLW as long-lived, intermediate-level waste, and low-activity waste. Long-lived waste has higher quantities of long-lived isotopes (such as carbon-14). Intermediate-level waste consists of waste material that radiates greater than 200 millirem per hour from an unshielded engineered metal container at 5 cm. Intermediate-level waste is further differentiated by the presence of tritium. Low-activity waste consists of waste material that radiates less than 200 millirem per hour from an unshielded, engineered metal container at 5 cm. The LLW Program does not currently accept liquid waste, wastes containing transuranic radionuclides greater than 100 nCi/g, or mixed waste for storage and disposal. The primary isotopes of concern are tritium, iodine-129, cesium-137, strontium-90, plutonium-238, and plutonium-239 (WSRC, 2000d).

SRS has 13 LLW streams (treatability groups) in a wide range of physical forms. At present, the LLW facilities (including nine onsite storage facilities, vault disposal units, and trenches, including the ET) are forecast to receive about 6,000 cubic meters of LLW for disposition per year. This amount is predicted to gradually decrease in the future. Currently, compactable LLW is segregated from non-compactable LLW in the WSF, and is processed in the SCF before disposal in order to maximize disposal space. The remainder is being stored pending processing in the on-site segregation/supercompaction facilities. LLW system operations include shallow land disposal for suitable waste forms (soil, debris, wood, components in grout, boxed LLW); storage of naval reactor components and contaminated large equipment pending disposal; continued disposal of LLW in the Low-Activity Waste Vaults; and continued disposal of intermediate-level waste in the Intermediate Level Non-Tritiated Vault and the Intermediate Level Tritiated Vault. The following treatability groups may be placed in the ET (WSRC, 2000d).

SRS-LLW-1, No Treatment Low-Level Bulk Waste

This treatability group consists of boxed Low-Level Bulk Waste received from Naval Reactor facilities and onsite generators. This waste requires no treatment and is packaged for direct disposal. As much as 60 percent of this waste will qualify for disposal in the ET, with the remainder disposed in the E-Area Vaults.

SRS-LLW-2, Low-Level Waste Direct to Compactor

This treatability group includes three separate known waste streams: Low-Level Alpha Waste, compactable waste packaged in drums by generators for compaction, and, for planning purposes, a portion of the projected waste from the Tritium Extraction Facility (FY06). It is estimated that 60 percent of this treatability group will be disposed in the ET, with the remainder disposed in the E-Area Vaults.

SRS-LLW-3, Low Activity Bulk Waste

This treatability group consists of legacy waste stored in B-25s and newly generated Low Activity Waste. The waste is primarily paper, plastic, rubber, and cloth job control waste. Some wood and small amounts of metal may also be present. About 90 percent of the legacy waste will be compactable. Newly generated waste will be packaged directly for compaction/direct disposal. Once treated (compacted), about 60 percent of the waste will be disposed in the ET, with the remainder disposed in the E-Area Vaults.

SRS-LLW-4, Bulk Metal to Direct Disposal

This stream consists of facility 232-F equipment (legacy), and future job control, scrap, and components. A small quantity of LLW from the mixed LLW program (but not mixed LLW) will be disposed. Most of this material is not considered a candidate for decontamination and will be segregated by the generator for direct disposal. The preferred disposal option for most of this waste is direct disposal in the ET. The 232-F equipment has a preferred disposal option of the DOE-Nevada Test Site, due to high tritium levels.

SRS-LLW-5, Incinerable Low Activity Liquid Waste	This waste is primarily oil, oil and water, or water, with some chemical waste. Some of the liquids have high tritium levels that make them unsuitable for onsite or commercial treatment. Options for treatment include commercial treatment through combustion, stabilization, or detritiation (technology still in development). The Toxic Substances Control Act Incinerator at Oak Ridge Reservation (not currently available) may become available. The preferred treatment option, the SRS Consolidated Incineration Facility, is not currently available. The preferred disposal option after treatment for the majority of this group is the ET, with the remainder disposed in the E-Area Vaults.
SRS-LLW-6, Bulk Metal to Survey/ Decontamination	This stream will consist of newly generated scrap and components which have been segregated at the generator for survey and decontamination. Following survey and/or decontamination, about 75 percent of this stream will be disposed through free release/sanitary landfill. The portion not suitable for free-release/sanitary landfill disposal may be disposed in an E-Area slit-trench if it cannot be containerized, or in the ET if it can be containerized**.**
SRS-LLW-7, Contaminated Large Equipment to Survey/Decontamination	This stream consists of material or components that are too large for disposal in a standard container. These types of material include pumps, jumpers, scaffolding, trailers, process equipment, etc., presently in storage and expected to be generated by future Environmental Restoration Department (ERD) and Decontamination and Decommissioning (D&D) activities. The preferred option is decontamination and free release. A second option is disposition by vendor. The least preferred option is trench disposal within a grout/stabilizing matrix (called components-in-grout), probably in a slit-trench or, possibly, in the ET, which would require approval for expanded trench use and possible regulatory exemptions.
SRS-LLW-9, Contaminated Large Equipment to Size Reduction	For this stream, large equipment is material or components, such as reactor process water heat exchangers, that are too large to fit in a standard waste container. The heat exchangers make up the majority of the volume. The majority of this stream will require extensive decontamination prior to treatment/disposal. Disposition is anticipated to be 50 percent to beneficial re-use, and 50 percent to an E-Area trench. Components with higher contamination levels will be disposed in a grout/stabilizing matrix, most likely within a slit-trench or, possibly, the ET.

SRS-TRU-1, TRU Waste Less Than 100nCi/g Alpha Contaminated (Non-Mixed) Drums

This waste group is alpha contaminated low-level waste currently classified and being managed as transuranic (TRU) waste. The waste is packaged in Type 7A or 17C drums with 90-mil polyethylene liners, for which the inventory records report 0 grams of Pu-238. The drums contain low-density job control waste: hydrogenous materials (plastics, wipes, etc.), metal tools, inner containers, polyvinyl chloride bags, tape, gloves, shoecovers, celite, swipes, paper, glass, hut plastic, motors, metal, scales, valves, adsorbed liquids, etc. Solid Waste's preferred treatment option is supercompaction at SRS, with disposal in E-Area trenches, possibly including the ET (WSRC, 2000d).

3.8 SEISMIC CHARACTERISTICS

The largest known earthquake to affect the site region was the Charleston earthquake of 1886. This Modified Mercalli Index (MMI) X earthquake struck Charleston, South Carolina, on August 31, 1886. The greatest intensity felt at SRS has been estimated at MMI VI-VII (felt by all; everyone runs outdoors; damage negligible in buildings of good structure, but considerable in poorly built structures) as a result of the Charleston earthquake. Minor tremors from aftershocks of the 1886 Charleston event were also felt in the area where SRS is now located. Intensities of these tremors were estimated to be equal to or less than MMI IV (WSRC, 2000a).

Seismic-activity producing earthquakes of estimated MMI up to V to VII have occurred in the Bowman, South Carolina, area (about 95 km northeast of SRS) over the last 200 years. These earthquakes produced acceleration at SRS of less than 0.1 times the earth's gravitational acceleration. An earthquake (MMI VIII) that struck Union County, South Carolina, about 160 km north-northeast of SRS, in 1913 was felt at Aiken (6 km north-northwest of SRS) with an MMI of II to III (vibration indoors like a passing truck).

SRS has been operating a continuous recording seismic network onsite since the mid-1970s. The network was developed to monitor SRS and regional seismic activity that may potentially impact the safety of existing or planned structures and systems. Three earthquakes of MMI III or less have occurred with epicentral locations within the boundaries of SRS.

- An MMI III earthquake occurred on June 9, 1985, with local duration magnitude of 2.6. The mean annual probability of an intensity III event at SRS is about 10^{-1}, according to Stephenson et al. (1985).
- An MMI I-II earthquake occurred on August 5, 1988, with local duration magnitude of 2.0. On May 17, 1997, an earthquake with duration magnitude of about 2.3 occurred near GunSite 51 (about 16 km south of A Area).
- On October 8, 2001, an earthquake of estimated duration magnitude 2.5 occurred about 2.5 miles northeast of F Area, according to Donald Stevenson, with ERD's Site Geotechnical Services group (personal communication, Donald Stevenson to Mike Lewis, October 8, 2001).

None of the earthquakes triggered the seismic alarms at SRS facilities, which are triggered when ground acceleration equals or exceeds 0.002 times the earth's gravitational acceleration. The epicenters of these earthquakes appear to be located within about 10 km. of the intersection of a northwest-trending fault and the northeast-trending border fault at the northern edge of the Dunbarton Triassic basin. The epicenters are relatively shallow (1 to 3 km below ground surface) (WSRC, 2000a; WSRC, 2000b).

The recurrence interval for a Charleston-sized shock (MMI X) for the Charleston area and for the Coastal Plain is on the order of 1,000 years, at the 95 percent confidence level. A recurrence of the 1886 Charleston earthquake would result in an intensity of MMI VII at SRS. Recurrence of earthquakes associated with other known seismic zones in the region are not expected to be of greater intensity nor cause greater shaking at SRS (WSRC, 2000a).

A geotechnical seismic assessment was performed in 1995 for the Defense Waste Processing Facility (DWPF) in S-Area, located less than 1 km north of the ET (WSRC, 1995). The assessment concludes that neither geologic nor geotechnical hazards exist based on the design basis earthquake that would adversely affect the DWPF. Static and dynamic structure settlements were within tolerable limits, and liquefaction susceptibility was negligible for the seismic events analyzed. Although this study was not performed at the ET itself, the area is close enough to indicate the soils within and above which the ET will be emplaced are relatively sound, and not predisposed to weaken significantly due to seismic activity.

Another liquefaction probability assessment was performed for H Area, located across Road 4 from E Area (WSRC, 2000c). This assessment particularly evaluates Tobacco Road Formation soil strength properties using cone penetrometer data. The bottom of the ET will likely be at, or just above, the contact between the Tobacco Road Formation and the overlying Upland Formation. The H-Area liquefaction study concludes that the H-Area Tobacco Road Formation met liquefaction-potential requirements. This indicates the Tobacco Road Formation at the nearby ET should not be predisposed to liquefaction due to seismic activity.

In summary, the recurrence interval for a Charleston-sized shock (MMI X) for the Charleston area and for the Coastal Plain is on the order of 1,000 years. A recurrence of the 1886 Charleston earthquake would result in an intensity of MMI VII at SRS. The soils surrounding the ET are not predisposed to liquefaction. Although unobserved to date, given B-25 structural degradation through time, the behavior of disposed materials within the ET may include consolidation and subsidence associated with future seismic events.

3.9 CLIMATE CHARACTERISTICS

The southeastern United States has a humid, subtropical climate characterized by relatively short, mild winters and long, warm, and humid summers. Summer-like weather typically lasts from May through September, when the area is subject to the persistent presence of the Atlantic subtropical anticyclone (i.e., the “Bermuda” high). The humid conditions often result in scattered afternoon thunderstorms. Average seasonal rainfall is usually lowest during the fall (Cook et al., 2000).

The weather is changeable during the winter as mid-latitude low-pressure systems and fronts migrate through the region. Measurable snowfall is rare. Spring is characterized by a higher frequency of tornadoes and severe thunderstorms than the other seasons. During spring, temperatures are mild and the humidity is relatively low (Cook et al., 2000).

The average annual temperature at SRS is 64.7 °F. July is the warmest month of the year, with an average daily maximum of 92 °F and an average daily minimum near 72 °F. January is the coldest month, with an average daily high around 56 °F and an average daily low of 36 °F. Temperature extremes recorded at SRS since 1961 are 107 °F in July 1986 and –3 °F in January 1985 (Cook et al., 2000).

Annual precipitation averages 49.5 in. Summer is the wettest season of the year with an average monthly rainfall of 5.2 in. Fall is the driest season with an average monthly rainfall of 3.3 in. Relative humidity averages 70 percent annually with an average daily maximum of 91 percent and an average daily minimum of 45 percent (Cook et al., 2000).

Winds are most frequently from the northeast and southwest sectors. Measurements of turbulence are used to determine whether the atmosphere has relatively high, moderate, or low potential to disperse airborne pollutants (commonly identified as unstable, neutral, or stable atmospheric conditions, respectively). Generally, SRS atmospheric conditions were categorized as unstable 56 percent of the time (Cook, et al., 2000).

U.S. Environmental Protection Agency (EPA) and National Aeronautic and Space Administration (NASA) studies indicate human activities have changed the atmosphere’s chemical composition (EPA, 1997; EPA, 1998; NASA, 2001). Carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons, the primary “greenhouse gases,” have increased. These gases have undisputed heat-trapping properties. Though the specific climatic response is uncertain, meteorological data indicate detectable changes. Likely responses include increases in temperature and changes in precipitation, soil moisture, and sea level, which could have adverse effects on ecological and groundwater systems, human health, and the economy.

Long-term climate changes may affect long-term cover system stability. Changes in precipitation may enhance erosion rates. Changes in temperature and rainfall can result in floral and faunal suite changes, particularly by making conditions intolerable to already marginal species. Interestingly, EPA (1998) makes the following statement regarding the effect of increased rainfall on buried hazardous waste at SRS:

> The effect of buried hazardous wastes on groundwater quality, particularly in Barnwell County and near the Savannah River Plant, is a concern in South Carolina. Although the effects of climate change on the movement of pollutants are not well understood, changes in infiltration rates could affect the rate at which pollutants migrate through an aquifer. Increased precipitation could contribute to groundwater contamination by increasing the inflow of contaminants into nearby aquifers.

Global mean surface temperatures have increased 0.6 – 1.2 °F between 1890 and 1996. The average temperature in Columbia, South Carolina, has increased 1.3 °F over the last century, while precipitation has increased by up to 20 percent in many parts of the state (EPA, 1998). Regional climate change calculations are much less reliable than global ones. Regional climate may become more variable, with increased frequency and intensity of some extreme weather critical to ecological systems (droughts, floods, frosts, cloudiness, hot or cold spells, and associated fire and pest outbreaks; EPA 1998).

Based on projections made by the Intergovernmental Panel on Climate Change and results from the United Kingdom Hadley Centre's climate model (HadCM2), EPA (1998) cites temperatures in South Carolina could increase by 3 °F (a range of 1-5 °F) over the next 100 years (slightly less in winter and summer, slightly more in spring and fall). Precipitation increase is estimated at 15 percent (range 5-30 percent) in spring, slightly more in summer and fall, and slightly less in winter. Near the Aiken County, South Carolina area, precipitation increase is estimated around 10 percent over the next century. Near the Richmond and Columbia County, Georgia area, across the Savannah River from SRS, precipitation increase is also estimated around 10 percent over the next century (EPA, 1997). Ironically, though increased precipitation is predicted, decreased soil moisture is also predicted, due to increased temperatures.

The EPA (1998) predictions are consistent with preliminary regional projections for the southeastern U.S. cited in NASA (2001). Southeastern region temperatures are predicted to increase by about 4.1 °F (2.3 °C) by the year 2090. The increase occurrence is projected in a slightly nonlinear manner, with about a 1.8 °F (1 °C) increase over the next 30 years. Precipitation is projected to increase 3 percent over the next 30 years and by about 20 percent by the end of the century (NASA, 2001).

In summary, SRS climate change predictions are available for the next century. Predictions indicate subtropical conditions continue, with temperatures and precipitation increasing.

4.0 DOE-SITE DISPOSAL METHODS AND VOLUMES

To provide perspective on the enormity of the DOE complex low-level waste volume, past and future disposal volumes for DOE's 20 major waste-generating sites are summarized in Table 8.

Table 8. Past and Future Low-Level Waste Volumes for DOE's 20 Major Waste-Generating Sites (GAO, 2000)

DOE Site	Disposal Completed (m^3)	Disposal Planned (m^3)	Total (m^3)
Argonne National Laboratory, East, IL	886	623	1,509
Bettis Atomic Power Laboratory, PA	12,254	3,642	15,896
Brookhaven National Laboratory, NY	1,403	not available	1,403
Fernald Environmental Management Project, OH	439,017	2,173,271	2,612,288
Hanford Site, WA	495,049	128,707	623,756
Idaho National Engr. and Environ. Laboratory, ID	98,5000	26,000	124,500
Knolls Atomic Power Laboratory, NY	5,763	6,267	12,030
Lawrence Livermore National Laboratory, CA	5,641	6,350	11,991
Los Alamos National Laboratory, NM	223,400	273,000	496,400
Mound Plant, OH	54,798	103,321	158,119
Nevada Test Site, NV	243,000	119,983	362,983
Oak Ridge Reservation, TN	4,253	579,191	583,444
Paducah Gaseous Diffusion Plant, KY	not available	11,000	11,000
Pantex Plant, TX	3,070	not available	3,070
Portsmouth Gaseous Diffusion Plant, OH	978	14,387	15,365
RMI Titanium Company, OH	44	10,477	10,521
Rocky Flats Environmental Technology Site, CO	9,424	157,436	166,860
Sandia National Laboratories, NM	2,047	4,220	6,267
Savannah River Site, SC	353,911	407,000	760,911
West Valley Demonstration Project, NY	11,988	56,634	68,622
Total	**1,965,426**	**4,081,509**	**6,046,935**

Six DOE sites have active disposal facilities for low-level and/or mixed wastes (GAO, 2000). All six sites are located where DOE and its predecessor agencies generated low-level and mixed wastes through a variety of activities, from producing nuclear weapons, to operating nuclear reactors, to conducting nuclear research. The Sites have historically disposed low-level wastes in burial grounds, many of which are currently undergoing environmental remediation. Table 9 (from GAO, 2000) presents the six sites, the volumes of low-level waste disposed, and capacity for additional waste.

Table 9. DOE's Active Waste Management Disposal Facilities' Waste Disposal Volumes and Remaining Capacity (GAO, 2000)

Disposal Facility	DOE Site	Disposed Low-Level Waste Volume (m^3)	Remaining Capacity (m^3)
Hanford 200 Area Low-Level Burial Grounds	Hanford Site	380,500	934,000
Radioactive Waste Management Complex	INEEL	98,500	64,300
Area G of Technical Area-54 Material Disposal Area	LANL	223,400	273,000
Radioactive Waste Management Sites Areas 3 and 5	Nevada Test Site	551,000	2,400,000
Interim Waste Management Facility	ORNL	3,640	1,760
E-Area LLW and Saltstone Disposal Facility	SRS	29,911	133,300
Total		**1,286,951**	**3,806,360**

The following brief descriptions of site disposal methods (other than SRS) are from GAO (2000). Although the specific purpose of the present report is to provide site-specific parametric information for the ET case study, the greater purpose for this overall task is to provide a risk- and cost-based methodology for evaluating long-term disposal options. This methodology should be adaptable to all DOE long-term, low-level radioactive waste disposal facilities. Therefore, summarizing this DOE complex-wide information here provides perspective for the scope and variety of DOE's low-level disposal.

Hanford Site Active Low-Level Burial Grounds cover about 1 mi^2 (2.6 km^2) in the middle of the site. Each burial ground comprises a number of trenches, which will be filled with wastes contained, for the most part, in wooden containers or drums. Most of the trenches are used to dispose of DOE's wastes, but one is reserved for contaminated reactors from naval vessels operated by the Department of Defense. These reactors will be buried 1 to 20 ft bls (0.3 to 6.1 m). The Hanford Low-Level Burial Grounds can accept virtually all types of low-level wastes. The site has developed performance assessments that demonstrate its disposal operations are protective of human health and the environment. The eight active low-level burial grounds are located on a plateau approximately 200 ft (60.6 m) above the water table. The site's annual rainfall (about 6 in.; 0.15 m) is less than the amount of evaporation, thus limiting the downward migration of contaminants.

INEEL Radioactive Waste Management Complex (RWMC) occupies about 890 mi^2 (2,305 km^2) of dry, cool desert in southeastern Idaho. The site once had 52 active nuclear reactors, and reprocessed spent nuclear fuel for decades. Currently, the site's primary missions include storing spent nuclear fuel and treating and eventually disposing transuranic wastes offsite. The site's Radioactive Waste Management Complex (RWMC) covers roughly 144 acres (58.3 hectares), and is used for interim transuranic waste storage and low-level waste disposal. The four active, conjoined low-level waste disposal pits cover about 6 acres (2.4 hectares) adjacent to the transuranic waste storage areas. The pits are also adjacent to previously-filled waste burial grounds managed by the INEEL ER program. The site is fairly remote and dry. Average annual rainfall is 9 in. (0.23 m). Groundwater is about 700 ft (212.1 m) bls.

RWMC primarily disposes of low-level wastes in containers such as large (4- x 4- x 8-ft; 1.2- x 1.2 x 2.4 m) wood and metal containers, which are stacked 20 ft (6.1 m) high in unlined pits. To conserve disposal capacity and increase long-term stability, low-level wastes are sized and compacted at the site's Waste Experimental Reduction Facility prior to disposal. Smaller quantities of remote-handled low-level wastes are disposed in special concrete vaults in one area within the disposal pits. All low-level wastes disposed at RWMC are from INEEL. In FY 99, the facility disposed about 6,000 cubic meters of waste, almost eliminating the site's backlog of stored low-level waste. Current DOE plans assume the disposal facility will accept contact-handled low-level waste through 2006 and remote-handled waste through 2008.

Los Alamos National Laboratory Area G of Technical Area-54 Material Disposal Area began accepting wastes in about 1959. This area occupies approximately 64 acres (25.9 hectares) on top of a mesa adjacent to the highway between the laboratory and the nearby community of White Rock. The relatively dry climate [average annual rainfall 14 in. (0.35 m) in Area G] and volcanic bedrock combine to limit potential contaminant migration from the facility. The water table lies 800 ft (242.4 m) below the mesa surface. The mesa edges ultimately limit the disposal facility's expansion potential, but additional acreage could be developed beyond the area currently used.

The facility disposes low-level waste using shallow land disposal in either pits or shafts. Approximately 40 disposal pits have been used in Area G, four of which are currently active. The unlined pits, which are no more than 65 ft deep, are filled with an average of 10 to 12 tiers of tightly stacked wastes. The layers of waste are covered with backfill to build the tiers. During waste emplacement, pipes are installed for environmental sampling during operations and after closure. To optimize its disposal capacity, Los Alamos uses a compactor to reduce the volumes of some low-level wastes by as much as 8 to 1. Metal waste containers are used.

Most of Los Alamos' low-level wastes come to Technical Area-54 from over 2,000 onsite generators, with a limited amount from offsite. Because Los Alamos expects to continue its current missions into the foreseeable future, it is attempting to conserve the site's limited disposal capacity for anticipated onsite wastes.

Nevada Test Site Area 3 and Area 5 Radioactive Waste Management Sites are located in southeastern Nevada, about 65 mi. (104.6 km) northwest of Las Vegas. From 1951 through 1992, DOE and its predecessor agencies conducted 928 nuclear tests at the site, 100 atmospheric and 828 underground. Many of the testing areas will require long-term institutional controls to prevent inadvertent exposure to residual contamination. Area 3 and Area 5 are well within the site boundaries. Both areas are arid, receiving 4 to 6 in. of rain annually. There is no nearby surface water, and the water table is approximately 1,600 ft (484.8 m) below Area 3 and 800 ft (242.4 m) below Area 5.

The Area 3 site covers about 120 acres (48.6 hectares) and currently disposes low-level wastes in seven subsidence craters that resulted from underground nuclear tests. The seven craters make up five disposal units. In two cases, the area between craters was excavated to make two craters into a single disposal unit. The subsidence craters require little excavation before being used for disposal (in contrast to the engineered trenches in Area 5 and at other DOE sites). Low-level bulk wastes arrive in large cargo containers or soft containers, some of which can be rolled off hydraulic truck beds, reducing necessary handling.

The Area 5 site comprises 732 acres (296.2 hectares), 92 acres (37.2 hectares) of which are currently used for shallow land disposal. The wastes are accepted in containers, drums, or soft packages and are stacked in a stair-step manner within 22 engineered and excavated disposal trenches. As the trenches fill, the wastes are covered with clean soil until the facility can be permanently closed.

The Nevada Test Site has been disposing low-level waste from other sites since the 1960s, with larger quantities accepted since the mid-1970s. Offsite wastes comprised approximately 57 percent of the total volume of low-level waste disposed from 1974 through 1997. During the last five years of this period, offsite wastes accounted for approximately 95 percent of the total volume of low-level waste disposed at the site. In fact, the Nevada Test Site accepted more than 41 percent of all low-level waste disposed in DOE's shallow land disposal facilities from 1987 through 1996.

Oak Ridge Reservation Interim Waste Management Facility - Oak Ridge Reservation, established in 1942, occupies approximately 55 mi^2 (142.5 km^2) in eastern Tennessee, near Knoxville. The site has included uranium enrichment, isotope separation, and plutonium production facilities, among others. Hydrologic conditions make the site unsuitable for shallow land disposal of radioactive wastes. The Oak Ridge climate is humid, with annual average rainfall of 55 in. (1.4 m) Depth to groundwater is shallow [less than 20 ft (6.1 m) in some areas and averaging 20 to 50 ft (6.1 to 15.2 m)]. Groundwater is discharged to the surface in some areas, to onsite streams and springs. The Clinch River and six tributaries run through the reservation, and a major aquifer underlies the site.

Because of this wet environment, Oak Ridge's only low-level waste disposal facility, the Interim Waste Management Facility (IWMF), is an aboveground, high-cost engineered facility. Modular concrete vaults are filled with low-level wastes encapsulated in concrete. The vaults are placed on concrete pads, and grout is used to fill void spaces within the vaults. A concrete lid with a seal is place on each vault following the grouting operation. IWMF has a total of six 18 m x 27 m concrete pads, a leachate collection system, and a monitoring capability. The facility is expensive, and its use for long-term disposal has been questioned.

No significant amount of waste was disposed in IWMF during FY99 due to costs and the re-evaluation of the facility's performance assessment and waste acceptance criteria. The site will eventually load vaults onto the already-constructed pads. These vaults will be filled primarily with waste containing high-activity, short-lived isotopes like cesium and strontium. The facility cannot accept much of the low-level waste generated at the site, and its disposal capacity is limited to 5,400 m^3.

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5.0 CONCLUSIONS

This report details parameters to be used in FY02 finite element modeling related to long-term waste stability. Parameters related to B-25 corrosion evaluation are also included. Work performed in FY01 has indicated a number of additional details that may be considered for this finite element modeling. One would be the response of the uppermost B-25 to soil loading. The placement of a minimum 4-ft-thick soil cover may be sufficient to push the top of the uppermost B-25 down inside the container. This would change the response of the stack to dynamic compaction, possibly transferring the greatest energy to the second and third B-25 from the top.

Another detail is the discovery during the B-25 exhumation that the uppermost B-25 was full of water and soil, and that the underlying B-25 was half-full of water. This suggests additional study of the dynamics of moisture accumulation within buried B-25s should be performed. It also suggests the performance of B-25s in isolating waste (previously considered not to take place) should be evaluated.

Another detail that should be considered is that most of the B-25s in the ET will not necessarily be in contact with soil over large portions of their surface area. Most of the B-25s will be in close proximity to other B-25s, and would provide some degree of lateral support to adjacent containers. The effect of lateral support/incomplete soil contact on corrosion rate and physical stability should be considered.

FY02 structural modeling will focus on the most likely ET waste stabilization method to be implemented. This will begin by discussing all the possible stabilization methods with SRS SWD and SWD-funded scientists and engineers who are evaluating disposal alternatives. The most likely alternatives will be used for structural finite element modeling. Later, in FY03, the modeled method will be incorporated into the ET performance assessment. The methodology for evaluating choices for long-term stabilization will be incorporated into a guidance document for DOE complex-wide distribution. The methodology should be adaptable to long-term disposal facilities using various disposal methods and in various climate zones.

One method under consideration is the use of soft-sided containers. A general conceptual model for this method might be to place the same waste volume (same radioactivity content) in a mounded configuration of layers of soft-sided bags. The bag layers might be separated by soil layers, with each soil/bag layer compacted. The bag mound might be underlain and/or overlain by a low-permeability layer. The mound could then be covered with a thick soil layer and planted with naturally occurring vegetation designed as closely as possible to that of the area’s natural climax vegetation. Such a design would substantially reduce future subsidence compared to disposal using B-25 containers (whether or not the B-25s are dynamically compacted or contain supercompacted waste). Reduced subsidence should yield lower long-term maintenance cost.

Another method might be to allow the B-25s to naturally weaken by corrosion prior to applying dynamic compaction and construction of a new cap. This concept would assume that after the B-25s have structurally degraded, dynamic compaction would yield greater consolidation (and less subsidence) than when performed while the B-25s are relatively pristine.

An additional method under consideration is the use of static surcharge rather than dynamic compaction. With this method, the thick mound of soil providing the surcharge also provides sufficient soil to fill in subsidence while still providing a cover. Whichever method is selected, cost and operational requirements (such as health and safety) must be met.

As DOE looks toward long-term stewardship, the overall goal for all long-term disposal facilities should be, "…to develop disposal systems that will change in harmony with the landscape in which it is sited" (Caldwell and Reith, 1993). This should include planning for the eventual development of a "climax" vegetated cover and anticipating subsidence. Caldwell and Reith (1993) state, "Our obligation is to free subsequent generations of the responsibility for caretaking our hazardous residues, not to saddle them with housekeeping chores which, if neglected, will result in the re-pollution of the environment that we worked so hard to clean." Selecting the best long-term waste stabilization method and providing the best possible input for a disposal site's performance assessment are steps toward fulfilling this obligation.

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APPENDIX A

C-DCP-E-00001

SWMF LOW LEVEL WASTE MEGA-TRENCH (U)

Rev. 0

July 20, 2000

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OSR 19-201# (Rev 12-21-97)
Stores: 26-13562.99

Design Change Package Cover Sheet
Design Change Package

DCP No.	Rev No.	Organization	Security Classification
C-DCP-E-00001	0	SFSD	☒ U ☐ UCNI ☐ Other

DCP Title
SWMF LOW LEVEL WASTE MEGA-TRENCH (U)

Description

A shallow land burial site is required to dispose of Low Level Waste (LLW). This DCP provides the design requirements for a shallow land burial site known as the Mega-Trench which will be utilized for disposal of LLW. The new Mega-Trench will be located in the eastern third of the future LAW vault # 11.

ENGINEERING DOC. CONTROL – SRS
00562849

UNCLASSIFIED
DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
ADC & Reviewing Official (Name and Title)
Date: 7/20/00

Functional Classification ☐ SC ☐ SS ☐ PS ☒ GS

ALARA Required ☐ Yes ☒ No ☐ N/A

Authorizing Document and Project/Task No.
U-PMT-E-00149

	Signature	Phone No.	Date
Prepared By (Lead Engineer) (Print Name): David J. Huizenga		7-3085	7/20/00
Concurrence By (Design Agency Cognizant Quality Function) (Print Name): N/A	N/A	N/A	N/A
Approved By (Design Agency Manager) (Print Name): Mark Gober	For M. Gober	7-3469	7/21/00
Approved By (Design Authority) (Print Name): Don Sink		2-4846	7/20/00
Additional Approvals (Optional) (Print Name): Mike Lewis	M.K. Lewis	2-6847	7/21/00

USQ-SWE-2000-0036 7/20/00

OSR 19-202# (2-5-92)

Design Change Package Revision Summary Sheet

DCP No.	Sheet Revision	
C-DCP-E-00001	0	Sheet 1 of 1

Rev No.	Description	Date
0	ISSUED FOR CONSTRUCTION	7-21-00

OSR 19-203# (10-29-93)

Design Change Package Documentation List

DCP No./Rev: C-DCP-E-00001 / REV. 0

Sheet 1 of 2

Documents Associated With Change					In DCP			
Complete Document No. (If Vendor—Incl Sub + AC)	Rev	Affected Document No.	Rev	Title	Yes	No	Remarks	Closure Action (If none, enter N/A)
DCP Cover Sheet	0	N/A	N/A	DCP Cover Sheet	X			N/A
DCP Revision Summary Sheet	0	N/A	N/A	DCP Revsion Summary Sheet	X			N/A
DCP Documentation List	0	N/A	N/A	DCP Documentation List	X			N/A
DCP Installation Instructions	0	N/A	N/A	DCP Installation Instructions	X			N/A
C-CV-E-0125	A	Interim Drawing	N/A	E-Area Low Level Waste Mega-Trench Site Plan	X			ISSUE TO DCC
C-CV-E-0126	A	Interim Drawing	N/A	E-Area Low Level Waste Mega-Trench Sections/Details	X			ISSUE TO DCC
C-CV-E-0127	A	Interim Drawing	N/A	E-Area Low Level Waste Mega-Trench Sections/Details	X			ISSUE TO DCC
C-CV-E-0128	A	Interim Drawing	N/A	E-Area Low Level Waste Mega-Trench General Notes	X			ISSUE TO DCC
C-CV-E-0129	A	Interim Drawing	N/A	E-Area Low Level Waste Mega-Trench Erosion Details	X			ISSUE TO DCC
U-PMT-E-00149	2	N/A	N/A	Soilid Waste Plant Modification Traveler	X			N/A
Attachment "B"	N/A	N/A	N/A	Vendor Calculation, Sump Liner	X			N/A
Attachment "C"	0	N/A	N/A	Type II Calculation, Priming Pump & Piping	X			N/A
W2017860	1	N/A	N/A	Burial Ground Expansion Master Plan Civil	X			N/A
Topographic Map	0	N/A	N/A	Topographic Survey Prepared by BSRI Layout (#E000202)		X		N/A
SRS-02111-C	0	N/A	N/A	SRS Commercial Specification for Site Clearing		X		N/A
SRS-02222-C	0	N/A	N/A	SRS Commercial Specification for Earthwork		X		N/A
Attachment "E"	0	N/A	N/A	Environmental Checklist	X			N/A
Attachment "F"	N/A	N/A	N/A	Pump Data Sheet	X			N/A

OSR 19-203# (10-29-93)

Design Change Package Documentation List

DCP No./Rev
C-DCP-E-00001/REV. 0

Sheet 2 of 2

Documents Associated With Change					In DCP			
Complete Document No. (If Vendor—Incl Sub + AC)	Rev	Affected Document No.	Rev	Title	Yes	No	Remarks	Closure Action (If none, enter N/A)
K-CLC-E-00022	0	N/A	N/A	Static Slope Stability Analysis for the Mega-Trench		X		N/A
DCP Materials List	0	N/A	N/A	DCP Materials List	X			N/A
M-M6-E-0076	A	Interim Drawing	N/A	E-Area Low Level Waste Mega-Trench P&ID	X			ISSUE TO DCC
SRS Eng. Guide 15060-G, PS101	2	N/A	N/A	Piping Specification PS-101 (A, B, C, D)	X			N/A
SRS Eng. Guide 15060-G, PS500	1	N/A	N/A	Piping Specification PS-500	X			N/A
SRS Eng. Guide 15060-G, Valve Selection Guide	N/A	N/A	N/A	Valve Selection Guide	X			N/A
M-CLC-E-00023	0	N/A	N/A	E-Area LLW Mega-Trench Sump Pump Evalaution		X		N/A
SRS Eng. Requirements 01110	3	N/A	N/A	Civil Site Design Criteria	X			N/A
SRS Eng. Guide 02224-G	0	N/A	N/A	Excavation,Backfill, and Grading	X			N/A
Attachment "G"	N/A	N/A	N/A	GeoWeb Cellular Confinement System Material Specification	X			N/A

C-DCP-E-00001
Rev No. 0
Page 1 of 2

INSTALLATION INSTRUCTIONS

Personnel Performing Work Shall

- STOP WORK AND OBTAIN GUIDANCE FROM EITHER THE SYSTEM ENGINEER OR THE DCP ORIGINATOR PRIOR TO PERFORMING ANY TASK WHICH IS NOT FULLY UNDERSTOOD.
- STOP WORK AND OBTAIN A RESOLUTION FOR ANY "AS FOUND" CONDITION WITHIN THE WORK SCOPE OF THIS DCP THAT IS NOT CORRECTLY DEPICITED WITHIN THE DCP. RESOLUTIONS THAT REQUIRE A CHANGE TO THE DCP WILL BE IN WRITING (DCF).
- THE REFERENCED ENGINEERING GUIDES ARE REQUIREMENTS AND THE WORD "SHOULD" WHEN USED SHALL BE UNDERSTOOD TO MEAN "SHALL".

Codes & Standards

1997 Edition of the Uniform Building Code
29 CFR 1926 Subpart P
SRS Engineering Guide 15060-G, Application of ASME B31.3
WSRC 3Q Environmental Compliance Manual, Procedure 12.2 (Stormwater Management and Sedimentation Reduction)
WSRC 8Q Employee Safety Manual, Procedure 34 (Excavations and Trenches)
SRS Engineering Standard 01110 R/4 (SRS Civil Site Design Criteria)
Solid Waste Plant Modification Traveler, U-PMT-E-00149 R/2

General Notes

1. The existing performance assessment requires a minimum of 25 feet of undisturbed soil between the bottom of the trench and the ground water table. This design is based on an assumed maximum water table elevation of 231.5 feet. Measurements taken from surrounding ground water wells BGO-3DR, BGO-4D, BGX-10D and BGX-11D indicate that the water table elevation could range from 230.7 feet to 240.1 feet. The actual water table elevation where the new mega-trench will be located shall be determined prior to construction. Design Engineering shall be notified if actual water table elevation is higher than the assumed value of 231.5 feet.
2. Prepare a Stormwater Management & Sediment Reduction Plan (SMSRP) in coordination with EPD/Environmental Support Section and U.S. Dept. of Agriculture/Natural Resources Conservation Service (EPD/ESS and USDA/NRCS). The requirements of SC Regulation 72-300, the General Permit, and the NPDES General Permit (land disturbances greater than 5 acres) must be met for plan approval by EPD/ESS (ref. WSRC 3Q, Procedure 12.2).
3. Obtain an authorized Site Clearance Permit (OSR 3-121), as required, prior to start of construction (ref WSRC 8Q, Procedure 34).
4. Stock piling of excavated materials shall be performed only in areas designated by WSRC.

Sump Liner

1. The sump liner detailed in this DCP will not prevent liquids from passing through the bottom or sides of the sump. It is assumed that the operator of this facility will utilize other means to contain and dispose of contaminated liquids which may enter the sump.
2. Excavate and shape foundation soils so top of installed Geoweb section is flush with or slightly lower than the final grade as indicated on the drawings.
3. Install a 8-oz nonwoven geotextile underlayer on prepared surfaces. Ensure required overlaps are maintained and outer edges of geotextile are buried a minimum of 6 inches below grade.
4. Feed precut lengths of tendon material through aligned holes in cell walls of Geoweb section before expanding individual sections into position. Tie off end of tendons with a knot that cannot pass

INSTALLATION INSTRUCTIONS

through hole in cell walls. Tie knots to provide full tendon strength and not slip under tensioning of tendon.

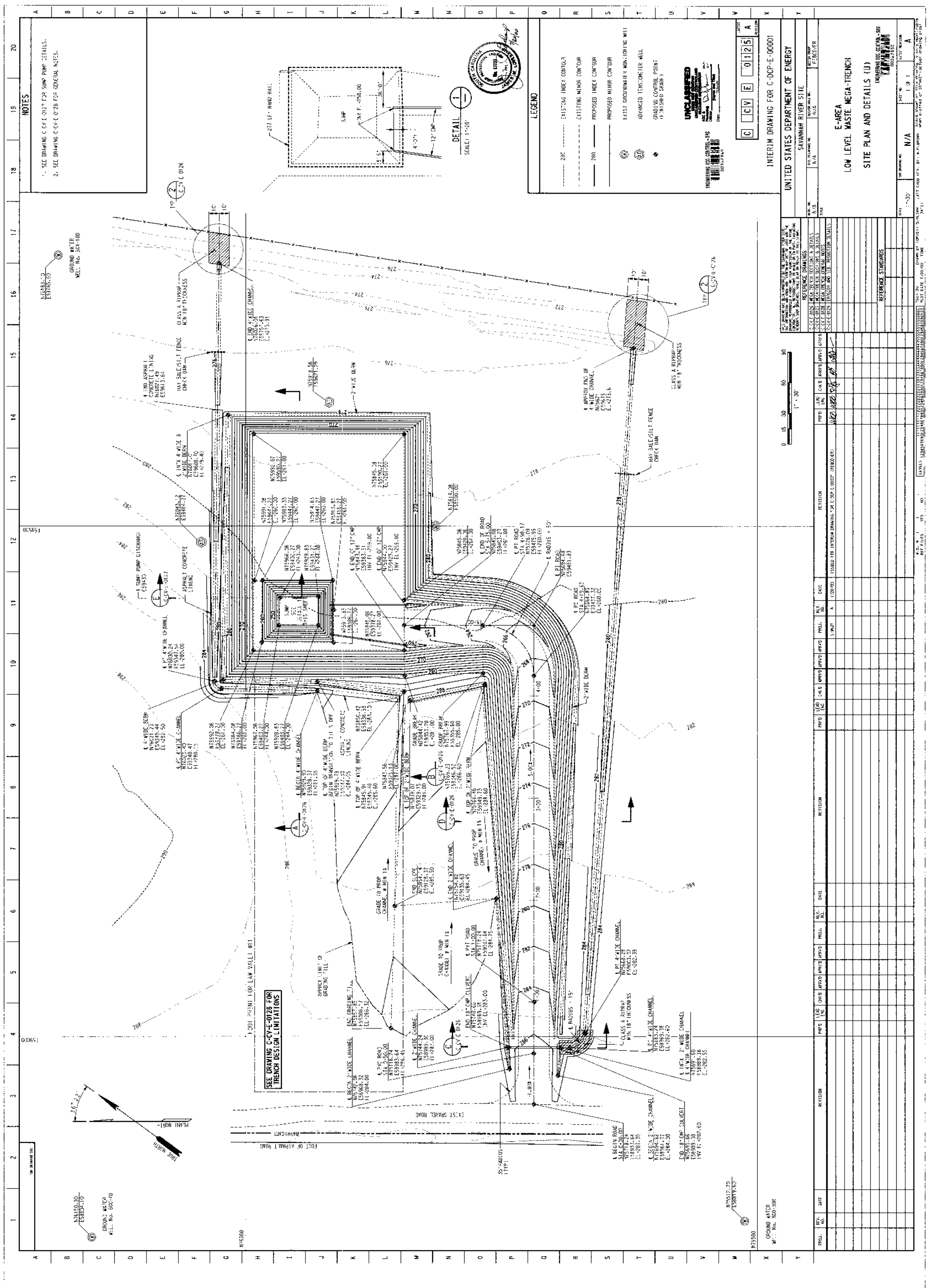
5. Anchor tendons and Geoweb sections at crest of slope and expand down slope surface.
6. Confirm each Geoweb section is expanded uniformly to the required dimensions and outer cells of each layer are correctly aligned. Interleaf or overlap edges of adjacent sections in each layer, according to which side wall profiles abut. Ensure upper surfaces adjoining Geoweb sections are flush at joint and adjoining cells are fully anchored.
7. Attach specified restraint pins to tendons at specified intervals to achieve necessary load transfer.
8. Place 4,000 psi concrete infill in expanded cells with suitable material handling equipment. Limit drop height to a maximum of 3 feet. Avoid displacement of Geoweb sections by infilling from crest of slope to toe of slope.
9. Overfill cells and manually compact or vibrate concrete. Screed surfaces to ensure finished surface is flush with top edges of cells and apply a rake finish.

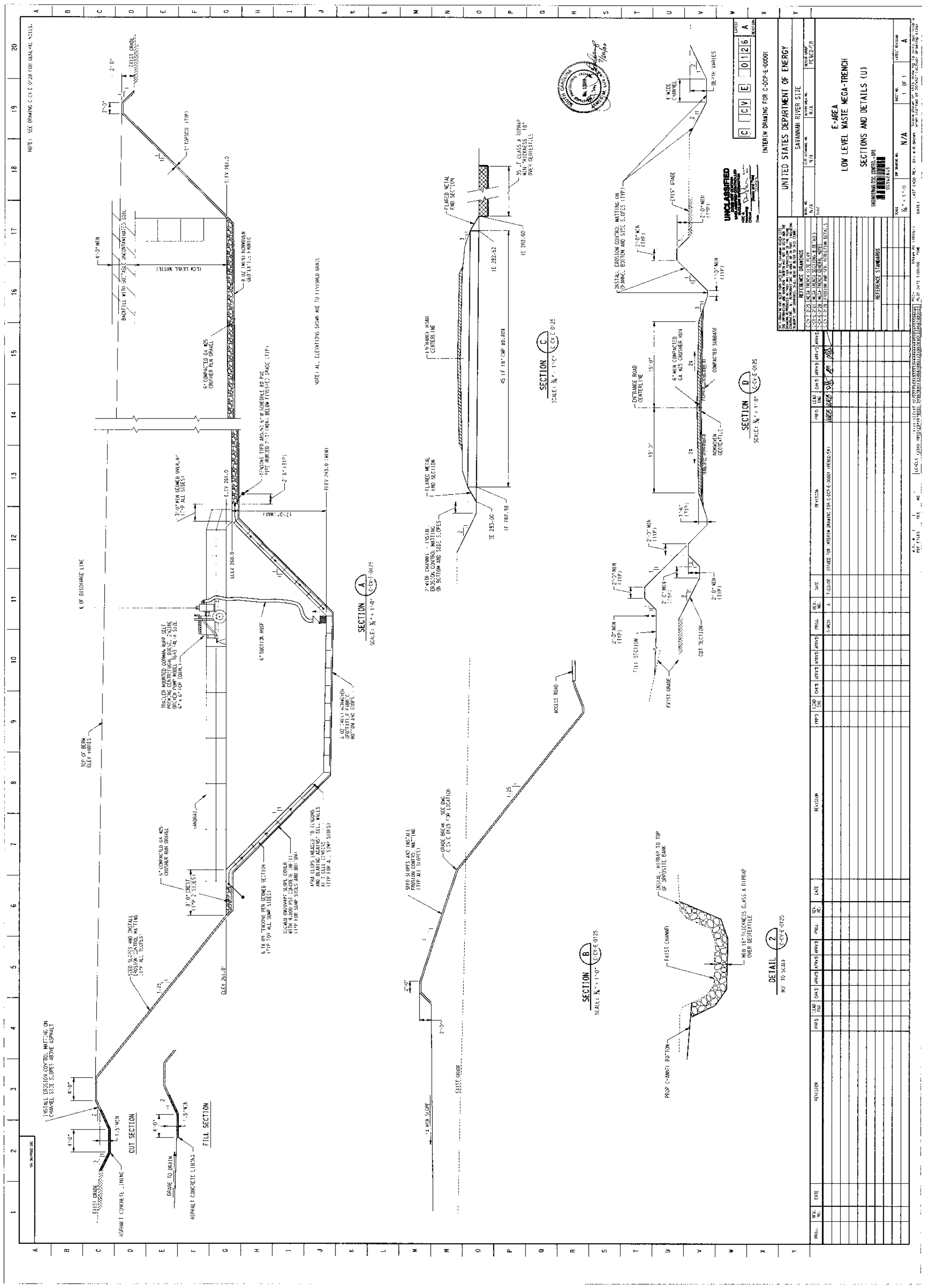
Discharge Line

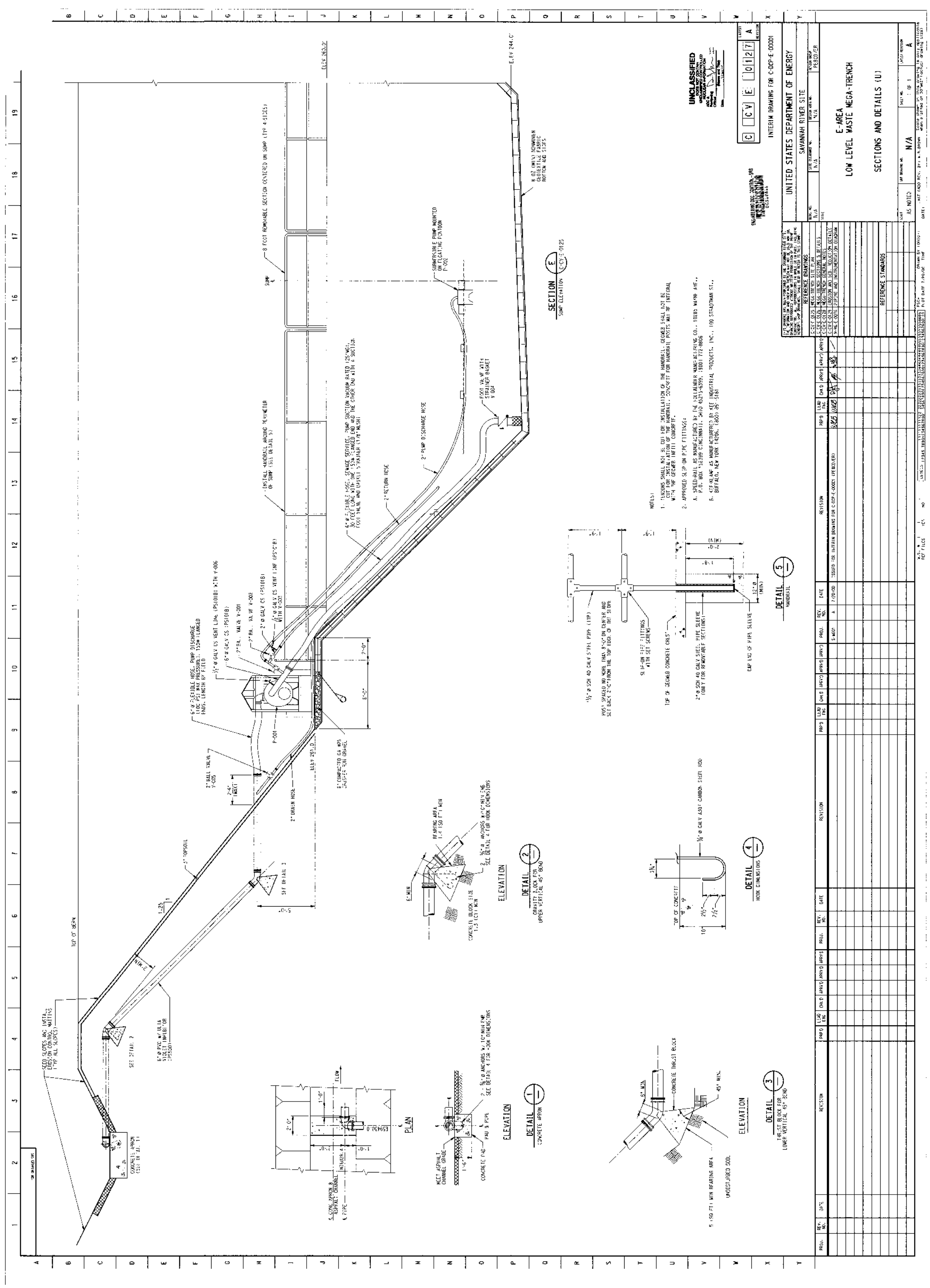
1. The discharge line shall be a 6"ϕ PVC pipe with a ultraviolet inhibitor. Install discharge line in accordance with this DCP and SRS Engineering Guide 15060-G, PS500.
2. Install thrust blocks in accordance with this DCP.
3. Install a drain line with a valve at the inlet of the discharge line.
4. Install a rirrap apron at outlet of discharge line.
5. Attach portable sump pump to the PVC discharge line with a flexible hose. The fitting(s) installed on the end of the discharge line shall be selected by construction to accommodate the use of a flexible hose.

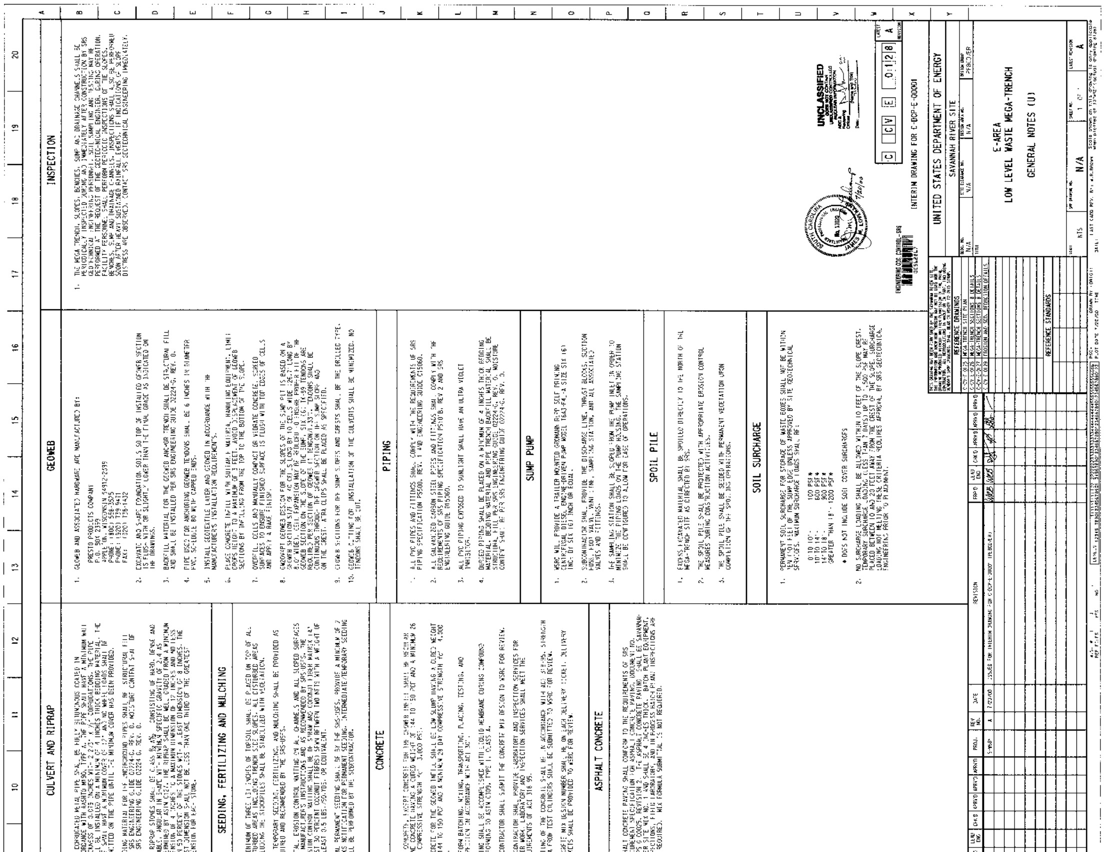
Suction Line

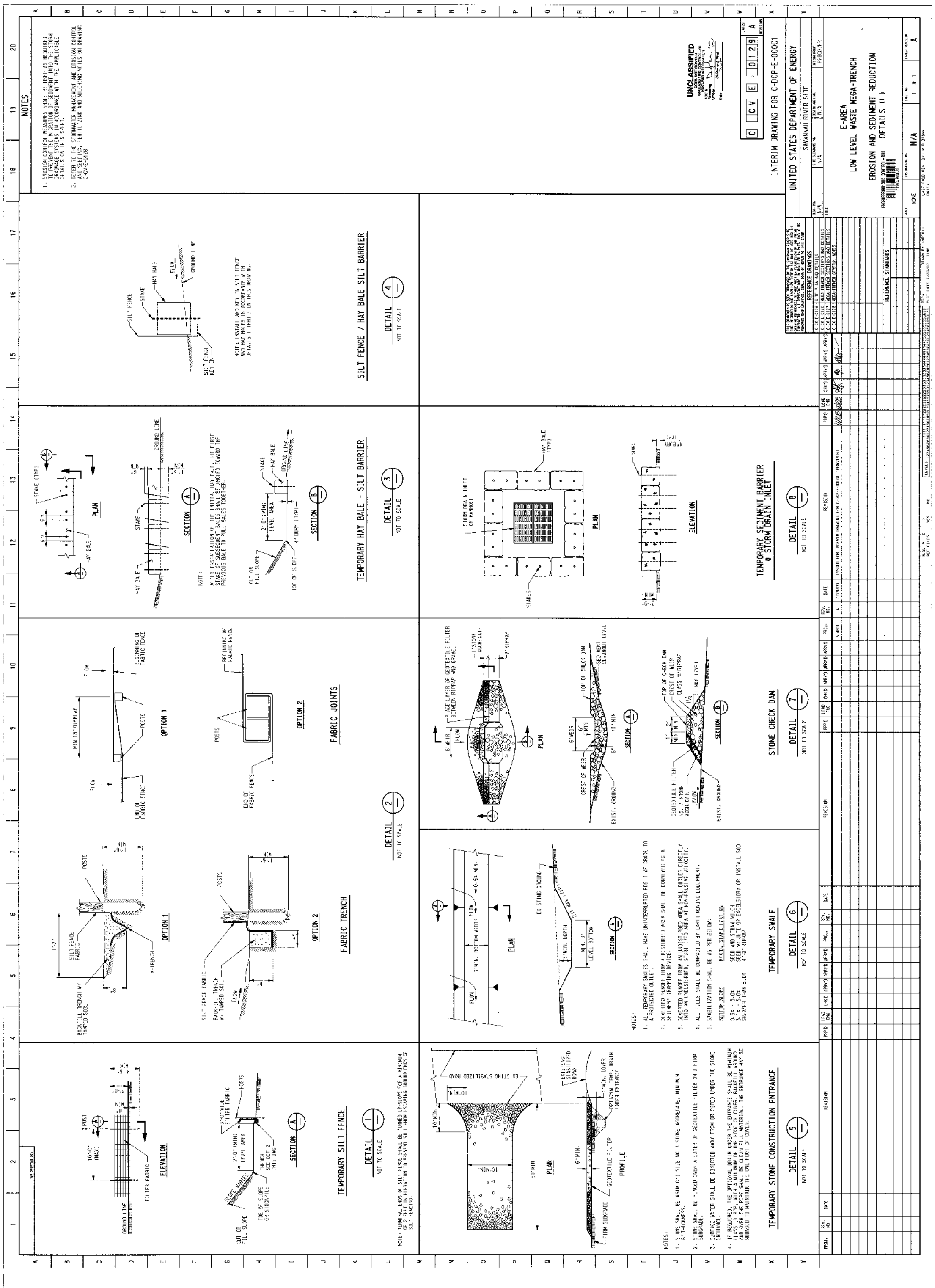
1. The suction line shall be a 6"ϕ schedule 40 galvanized carbon steel pipe for a distance of approximately 3' from the pump inlet flange. The remainder of the suction line shall be a 6"ϕ flexible hose. The 6"ϕ flexible hose shall extend from the end of the galvanized carbon steel pipe to the bottom of the sump. The 6"ϕ schedule 40 galvanized carbon steel pipe shall be sloped from the pump inlet flange toward the sump in order to minimize the loads on the pump housing.
2. Install suction line in accordance with this DCP and SRS Engineering Guide 15060-G, PS101B.
3. Install carbon steel pipe priming line, return line, and sampling line with associated valves and connections on the 6"ϕ schedule 40 galvanized carbon steel line. The piping and valves shall be orientated in a manner that allows for ease of operation.
4. Install priming line, return line, sample line, and associated valves in accordance with this DCP and SRS Engineering Guide 15060-G, PS101B.
5. Attach foot valve and inlet strainer to the inlet end of the 6"ϕ flexible hose at the bottom of the sump.
6. Attach 2"ϕ return line to the 2"ϕ galvanized carbon steel return line. 2"ϕ return line shall extend into the sump a minimum of 15'.
7. Attach 2"ϕ priming line, priming pump, and associated electrical cable per the pump manufacturer's installation instructions.
8. Install the portable generator per the manufacturer's installation instructions.
9. Install one (1) 10'-0" long copper clad steel ground rod for generator ground connection.


INTERIM DRAWING FOR C-DCP-E-00001
UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
E-AREA
LOW LEVEL WASTE MEGA-TRENCH
SITE PLAN AND DETAILS (U)
NOTES
LEGEND


UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
E-AREA
LOW LEVEL WASTE MEGA-TRENCH
SECTIONS AND DETAILS (U)
INTERIM DRAWING FOR C-DCP-E-00001
UNCLASSIFIED
SECTION A
SECTION B
SECTION C
SECTION D
DETAIL 2
CUT SECTION
FILL SECTION


UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
E-AREA
LOW LEVEL WASTE MEGA-TRENCH
SECTIONS AND DETAILS (U)
UNCLASSIFIED


PLANS & PERMITS
FUNCTIONAL CLASSIFICATION
TRENCH DESIGN LIMITATIONS
TENSIOMETER WELLS
SURVEY INFORMATION
STORMWATER MANAGEMENT AND EROSION CONTROL
EXCAVATION, BACKFILL AND GRADING
ROADS AND BOTTOM OF TRENCH
CULVERT AND RIPRAP
SEEDING, FERTILIZING AND MULCHING
CONCRETE
ASPHALT CONCRETE
GEOWEB
PIPING
SUMP PUMP
SPOIL PILE
SOIL SURCHARGE
INSPECTION
UNCLASSIFIED
UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
E-AREA
LOW LEVEL WASTE MEGA-TRENCH
GENERAL NOTES (U)


SILT FENCE / HAY BALE SILT BARRIER
TEMPORARY HAY BALE - SILT BARRIER
FABRIC JOINTS
FABRIC TRENCH
TEMPORARY SILT FENCE
TEMPORARY SEDIMENT BARRIER @ STORM DRAIN INLET
STONE CHECK DAM
TEMPORARY SWALE
TEMPORARY STONE CONSTRUCTION ENTRANCE
UNCLASSIFIED
INTERIM DRAWING FOR C-DCP-E-00001
UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
E-AREA
LOW LEVEL WASTE MEGA-TRENCH
EROSION AND SEDIMENT REDUCTION
DETAILS (U)

SOLID WASTE PLANT MODIFICATION TRAVELER

C-DCP-E-00001, R10

1. PMT NUMBER: U - PMT - E-00149	2. PMT TITLE: SWMF LLW Mega-Trench, Rev. 2	3. SHEET NUMBER: 1 OF 5

REQUEST

4. INITIATING DOCUMENT NUMBER (WR, REA, NCR, ETC.): NONE	5. AFFECTED SYSTEM(S): N/A

6. FACILITY: LLW	7. BUILDING NO: N/A	8. COMPONENT NUMBER/DESCRIPTION: NONE

9. REQUEST/MODIFICATION DESCRIPTION:
See Page 4 for Mega-Trench Requirements.

10. SUGGESTED RESOLUTION (OPTIONAL):
See page 5 of the PMT for the conceptual location of the Mega-Trench (future LAWV No. 11 per Drawing W2017860)

11A. INITIATOR: D. F. SINK	11B. DATE: 5/30/2000	11C. DEPARTMENT: DESIGN AUTHORITY	11D. LOCATION: 724-15E	11E. PHONE: 2-4846
12A. CONTACT (PRINT NAME): D. F. SINK	12B. DATE: 5/30/2000	12C. DEPARTMENT: DESIGN AUTHORITY	12D. LOCATION: 724-15E	12E. PHONE: 2-4846

WORK SCOPE REVIEW TEAM - REQUEST REVIEW

13A. [X] APPROVED - RELEASE TO ENGINEERING FOR DESIGN INPUT/OUTPUT

[ ] DISAPPROVED - STOP WORK

13B. PRIORITY / CATEGORY: 12-38-13

13C. DESIGN OUTPUT DUE DATE: 4-13-00

13D. MODIFICATION MANAGER: Don Sink

13E. COMMENTS (OPTIONAL):

14A. WSRT CHAIRMAN:

14B. DATE: 5/30/00

DESIGN AUTHORITY INPUT/TECHNICAL REVIEW

15. FUNCTIONAL PERFORMANCE REQUIREMENTS AND THE BASIS FOR THESE REQUIREMENTS (PRES, TEMP, FLOW, ETC.):
ALLOW FOR THE SAFE DISPOSAL OF LOW LEVEL WASTE INTO A SHALLOW LAND BURIAL SITE.

16. TECHNOLOGY RISK SCREEN: LOW RISK?
[X] YES [ ] NO

17. DESIGN CRITERIA:
[X] THE DESIGN AGENCY SHALL IDENTIFY ALL APPLICABLE DOE ORDERS, SRS ENGINEERING STANDARDS, NATIONAL CONSENSUS CODES AND STANDARDS APPLICABLE TO THIS MODIFICATION. A LIST OF THE CODES AND STANDARDS AND APPLICABLE SECTIONS SHALL BE PROVIDED WITH THE DESIGN OUTPUT.
[ ] CRITERIA DOCUMENT PROVIDED REFERENCE:
[X] THE ORIGINATOR OR DESIGN AGENCY SHALL COMPLETE OSR 3-161, PROJECT CHECKLIST FOR SAFEGUARDS AND SECURITY (SWMF ONLY).

18. SPECIAL QUALITY REQUIREMENTS:
NONE

19. SPECIAL OPERABILITY / MAINTAINABILITY / TESTABILITY / INSTALLATION REQUIREMENTS:
NONE

20. DESIGN RISK ASSESSMENT #: CATEGORY [ ] A [ ] B [ ] C [X] D SWD-RA-99-SWMF-876	21. FUNCTIONAL CLASSIFICATION: [X] GS [ ] PS [ ] SC [ ] SS	22. FOSC REVIEW: [ ] YES [X] NO

C-DCP-E-00001, R/0

1. PMT NUMBER: U-PMT- E-00149	2. PMT TITLE: SWMF LLW Mega-Trench, Rev. 2	3. SHEET NUMBER: 2 OF 5

DESIGN AUTHORITY INPUT TECHNICAL REVIEW (CONT)

23.USQD / MSB: # USQ-SWE-2000-0036	24. EEC REQ'D:# SW-E-100-016 [X] YES [ ] NO	25. ALARA REVIEW REQ'D? (YES FOR PROJECTS REQUIRING TR&C) [ ] YES [X] NO
26. FIRE SAFETY REVIEW CHECKLIST REQD? [X] YES [ ] NO	27. POLLUTION PREVENTION REQD? [X] YES [ ] NO	
28. OTHER TECHNICAL AGENCIES REQD? IDENTIFY: [ ] YES [X] NO		

29A. DESIGN AUTHORITY ENGINEER: [signature]	29B. DATE: 5/30/00	29C. DEPARTMENT: SWE	29D. LOCATION: 724-15E	29E. PHONE: 2-4846
30A. FACILITY PERMIT MANAGER: [signature]	30B. DATE: 5/30/00	30C. DEPARTMENT: SWEC	30D. LOCATION: 724-21E	30E. PHONE: 2-2278
31A. DESIGN AUTHORITY ENG MGR: [signature] / M W Lewis	31B. DATE: 5/31/00	31C. DEPARTMENT: SWE	31D. LOCATION: 724-7E	31E. PHONE: 2-4777

DESIGN AGENCY ACCEPTANCE

32A. DESIGN AGENCY ENGINEER: [signature]	32B. DATE: 7-3-00	32C. DEPARTMENT PE&CD	32D. LOCATION: 705K	32E. PHONE: 7-3457

DESIGN OUTPUT IMPACT SUMMARY

33. DESIGN OUTPUT DOCUMENTS (DCF, DCP, DWGS, ETC.):	34. WORK PACKAGE NUMBERS:

35. INTER DISCIPLINE DESIGN REVIEWS REQ'D:

[ ] MECH [ ] ELEC [ ] I&C [ ] CIVIL/STRUCTURAL [X] PERMIT [ ] T&PC (DCS) [ ] FIRE PROT [ ] ______

[ ] RADCON [ ] OPS [ ] MAINT [ ] CLI D-BASE [ ] SAFETY [ ] I/H [X] AUTH BASIS [ ] ______

36. FUNCTIONAL ACCEPTANCE CRITERIA (POST MODIFICATION TESTING REQUIREMENTS):

37A. CHANGE REQD ? YES	NO	N/A	37B. ITEM DESCRIPTION		37C. CHANGE REQD TO OPERATE ? YES	NO	37D. RESPON PERSON	37E. CHANGE COMP BY: SIGNATURE / DATE
[ ]	[ ]	[ ]	PROCUREMENT SPEC		[ ]	[ ]		/
[ ]	[ ]	[ ]	SPARE PARTS		[ ]	[ ]		/
[ ]	[ ]	[ ]	PREV MAINT (PM EVAL)		[ ]	[ ]		/
[ ]	[ ]	[ ]	INSTALLED INSTRUMENT DBASE		[ ]	[ ]		/
[ ]	[ ]	[ ]	EQUIPMENT LABELING		[ ]	[ ]		/
[ ]	[ ]	[ ]	MASTER EQUIP LIST (MEL)		[ ]	[ ]		/
[ ]	[ ]	[ ]	CLI DATABASE		[ ]	[ ]		/
[ ]	[ ]	[ ]	TRAINING:		[ ]	[ ]		/
[ ]	[ ]	[ ]	INST / SET POINT DOC		[ ]	[ ]		/
[ ]	[ ]	[ ]	ESSENTIAL DRAWINGS		[ ]	[ ]		/
[ ]	[ ]	[ ]	DCS SOFTWARE		[ ]	[ ]		/
[ ]	[ ]	[ ]	MODEL WORK ORDERS		[ ]	[ ]		/
[ ]	[ ]	[ ]	PRE - APPROVED MAINT INSTR		[ ]	[ ]		/
[ ]	[ ]	[ ]	8Q SMI 51 FINAL ACCEPTANCE INSP		[ ]	[ ]		/
[ ]	[ ]	[ ]	FD & PS (WSRC-TR-96-0211)	CIF ONLY	[ ]	[ ]		/
[ ]	[ ]	[ ]	ASA (WSRC-TR-96-0212)	CIF ONLY	[ ]	[ ]		/
[ ]	[ ]	[ ]	PR (WSRC-TR-96-0183)	CIF ONLY	[ ]	[ ]		/
[ ]	[ ]	[ ]	AUTHORIZATION BASIS	SS ONLY	[ ]	[ ]		/
[ ]	[ ]	[ ]	AUTHORIZATION BASIS	SWMF ONLY	[ ]	[ ]		/
[ ]	[ ]	[ ]	AUTHORIZATION BASIS	ETF ONLY	[ ]	[ ]		/

SOLID WASTE PLANT MODIFICATION TRAVELER

C-DCP-E-00001, R10

1. PMT NUMBER: U - PMT - E-00149	2. PMT TITLE: SWMF LLW Mega-Trench, Rev. 2	3. SHEET NUMBER: 3 OF 5

DESIGN OUTPUT IMPACT SUMMARY (CONT)

37A. CHANGE REQD ? YES	NO	N/A	37B. ITEM DESCRIPTION	37C. CHANGE REQD TO OPERATE ? YES	NO	37D. RESPON PERSON	37E. CHANGE COMP BY: SIGNATURE / DATE
☐	☐	☐	RCRA PERMIT	☐	☐		/
☐	☐	☐	SCDHEC AIR PERMIT	☐	☐		/
☐	☐	☐	EPA NESHAP PERMIT	☐	☐		/
☐	☐	☐	FIRE HAZARD ANALYSIS	☐	☐		/
☐	☐	☐	PROCEDURE NO ______	☐	☐		/
☐	☐	☐	PROCEDURE NO ______	☐	☐		/
☐	☐	☐	PROCEDURE NO ______	☐	☐		/
☐	☐	☐	OTHER	☐	☐		/

38A. DESIGN AUTHORITY ENGINEER:		38B. DATE:
39A. MAINTENANCE ENGINEER (OR DESIGNEE):		39B. DATE:
40A. PROCEDURES MANAGER (OR DESIGNEE):		40B. DATE:
41A. FACILITY AUTH BASIS MANAGER (OR DESIGNEE):	CHANGE REQD PRIOR TO INSTALLATION ? ☐ YES ☐ NO	41B. DATE:
42A. FACILITY PERMIT MANAGER (OR DESIGNEE):	CHANGE REQD PRIOR TO INSTALLATION ? ☐ YES ☐ NO	42B. DATE:
43A. DESIGN AUTHORITY ENGINEERING MANAGER:		43B. DATE:
44A. OPERATIONS MANAGER (OR DESIGNEE):		44B. DATE:

WORK SCOPE REVIEW TEAM - RELEASE FOR IMPLEMENTATION

45 ALL ITEMS (PERMITS, AUTH BASIS) IDENTIFIED AS "CHANGE REQD PRIOR TO INSTALLATION " IN BLOCKS 41A & 42B HAVE BEEN COMPLETED.

46. OPERATIONAL RISK ASSESSMENT # ______

CATEGORY ☐ A ☐ B ☐ C ☐ D

47. ☐ APPROVED - RELEASE FOR IMPLEMENTATION
☐ DISAPPROVED - STOP WORK

48A. WSRT CHAIRMAN	48B. DATE:

RELEASE FOR TESTING (OPTIONAL)

49 ALL ITEMS / ACTIVITIES REQUIRED TO SUPPORT COMPONENT / SYSTEM TESTING HAVE BEEN COMPLETED. THE AFFECTED COMPONENT(S) SYSTEM MAY BE RETURNED TO SERVICE AS NECESSARY TO SUPPORT POST MOD TESTING.
COMMENTS (OPTIONAL):

50A. OPERATIONS MANAGER (OR DESIGNEE):	50B. DATE:

RELEASE FOR OPERATION

51 ALL ITEMS "REQUIRED TO OPERATE" AS IDENTIFIED IN BLOCK 37 HAVE BEEN COMPLETED.
POST MODIFICATION TESTING HAS BEEN SATISFACTORILY COMPLETED.
THE IMPLEMENTING WORK PACKAGES HAVE BEEN CLOSED.
A SIGNED DESIGN CHANGE IMPLEMENTATION COMPLETION FORM IS AVAILABLE, IF REQUIRED.
COMMENTS (OPTIONAL):

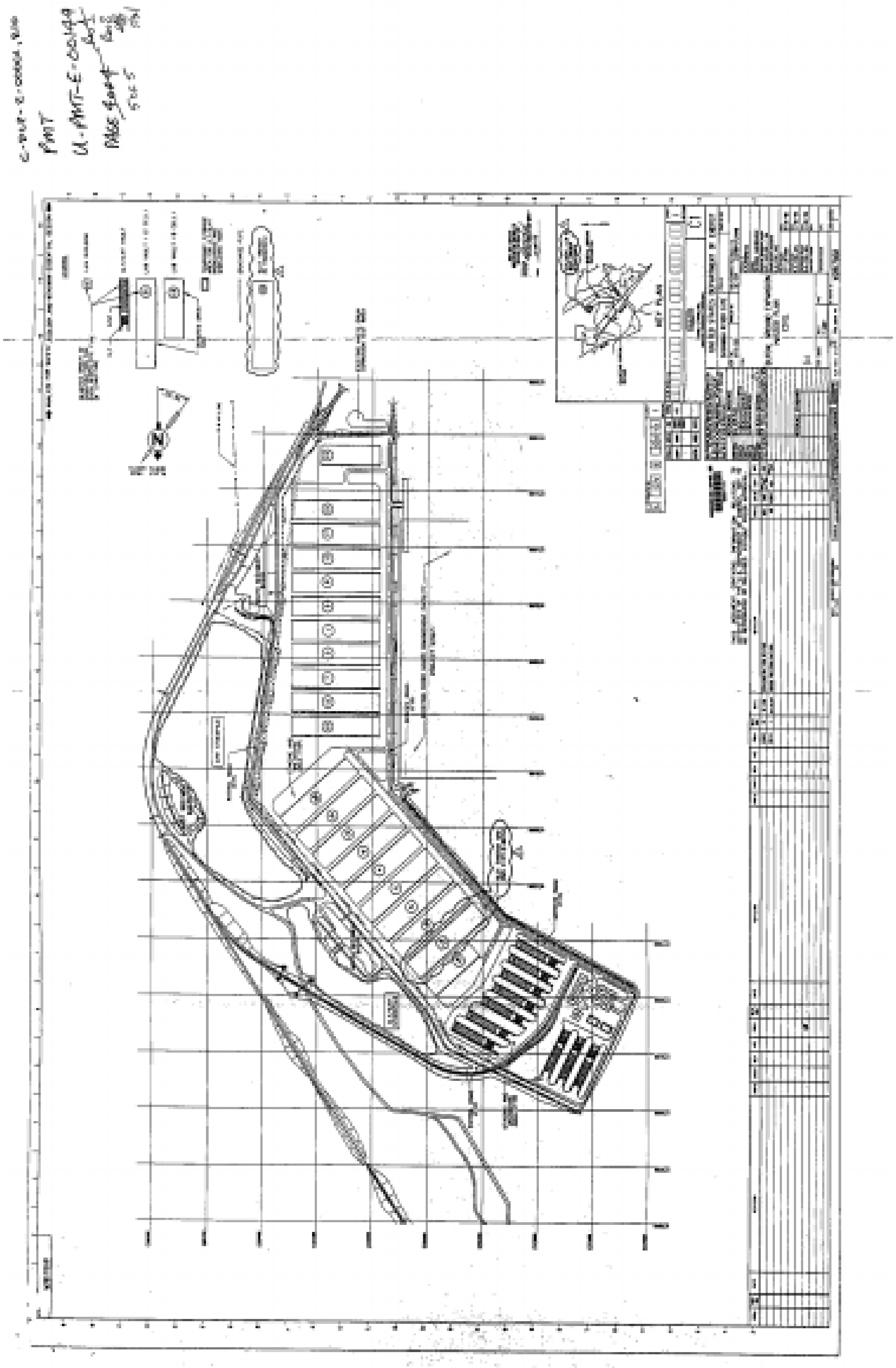
52A. OPERATIONS MANAGER (OR DESIGNEE):	52B. DATE:

FINAL CLOSEOUT

53 ALL "YES CHANGE REQUIRED " ITEMS IN BLOCK 37 HAVE BEEN COMPLETED.
COMMENTS (OPTIONAL):

54A. MODIFICATION MANAGER	54B. DATE:

Provide a shallow land burial site ("Mega-Trench") for the disposal of Low Level Waste. The location of the Mega-Trench should be located in future LAW Vault #11. The trench should be designed to stack 4 B-25's high in depth. The trench will be designed and constructed in sections of thirds due to limited funds for FY00. The design should provide allowances for extending the next section of the trench while operation continues in the previous section. The Mega-Trench will allow the drive-in function of flat bed trucks, fork lifts, or a crane for disposing of waste containers. The base of the Mega-Trench should allow for a minimum interior turning radius of at least 35 ft for heavy equipment. The roadway leading into the Mega-Trench should be at least 30 feet wide with a 5% grade and be designed to AASHTO HS-20 loads. The base of the Mega-Trench should be sloped to move water runoff to a low point sump for collection and pumping (using a portable pump on an elevated surface). The Performance Category of the Mega-Trench is PC-1 and shall be designed per the SRS Engineering Standards No.01110. The sump shall be designed to accommodate rainfall from a 6 hour-25 year storm event for third of the Mega-Trench area. The Mega-Trench floor should be used to accommodate the difference between the design storm event (24 hour - 500 year return period) and the 6 hour-25 year storm event. However, the depth of water at the trench bottom shall not exceed 2 feet of water to prevent waste containers from floating. The Mega-Trench side slope shall be designed with factor of safety of 1.5 against slope stability failure if site specific strength data is not available. If site specific strength data is obtained, a factor of safety less than 1.5 can be used. In no case shall the factor of safety against slope stability failure be less than 1.2. The sump should be able to be pumped out in 4 hours. A rigid pipe should be located near the pump to move water away from the sump and direct the water, at the top of the slope, toward the existing drainage ditch. In addition, the Mega-Trench should be provided with a small submersible non-clogging industrial pump. This pump should feed a sample station, located above the sump walls. This sample station should allow an operator to pull a sample off the discharge of the small pump. This station should provide a series of valves, which would allow the discharge water from the small pump to either be redirected back into the sump during the sampling process or direct the discharge water to prime the diesel engine driven pump and suction hose within 15 minutes. This small pump should be powered by a small gas generator located near the sampling station. The Mega-Trench walls should be sloped back to allow personnel to work safely at the base. Also, the sloped walls should be provided with erosion control features for keeping the walls intact. The life expectancy of the entire trench will be at least 20 years. The Mega-Trench design should be reviewed by SRTC prior to issuance for potential impacts to the Performance Assessment.



C-DCP-E-00001, R16
ATTACHMENT B
PAGE B1 OF B6

InterSol Engineering Inc.
540 Moorelands Cr., Milton, Ontario, Canada L9T 4B4
Tel/Fax: 905-875-1329

FAX TRANSMISSION SHEET

FAX # 803-557-3323 *DATE* July 18, 2000

ATTENTION: David Huizenga
Cc: Vicki Ginter (Stable Soil Technologies)

COMPANY:

FROM: Jamie Walls

MEMO: No. of Pages (including this page) = 6

Re: Savannah River Nuclear Site (# ID549600079)

Per your fax to Andy Lister of this morning, please find attached a preliminary design for a Geoweb slope cover for an 18 ft high, 1:1 slope, on the above referenced project.

Based on the assumptions listed on the drawing, the driving force (due to gravity) and resisting shear force along the geotextile/soil interface of an 18 ft high slope would be 902 lb/ft and 479 lb/ft respectively. Again considering the use of Presto TK-89 tendons a 6 tendon anchor system would provide an additional 'factored' resisting force up to 432 lb/ft. a 3 ft horizontal crest embedment would provide a resisting force of 80 lb/ft resulting in a required deadman anchorage of 422 – 80 = 342 lb/ft. For the assumed trench backfill soil properties, a 6 inch diameter pipe deadman would require a 2.2 ft embedment depth to develop a factor of safety against pullout greater than 1.5.

Since the calculations for deadman anchorage are theoretically based on horizontal forces, it is recommended to anchor the tendons at a relatively shallow angle of inclination. Typically, we use an inclination of 2H:1V to 1.5H:1V. Assuming a 1.5H:1V inclination the offset distance from the top end of the Geoweb to the center of the pipe would be 2.66 ft.

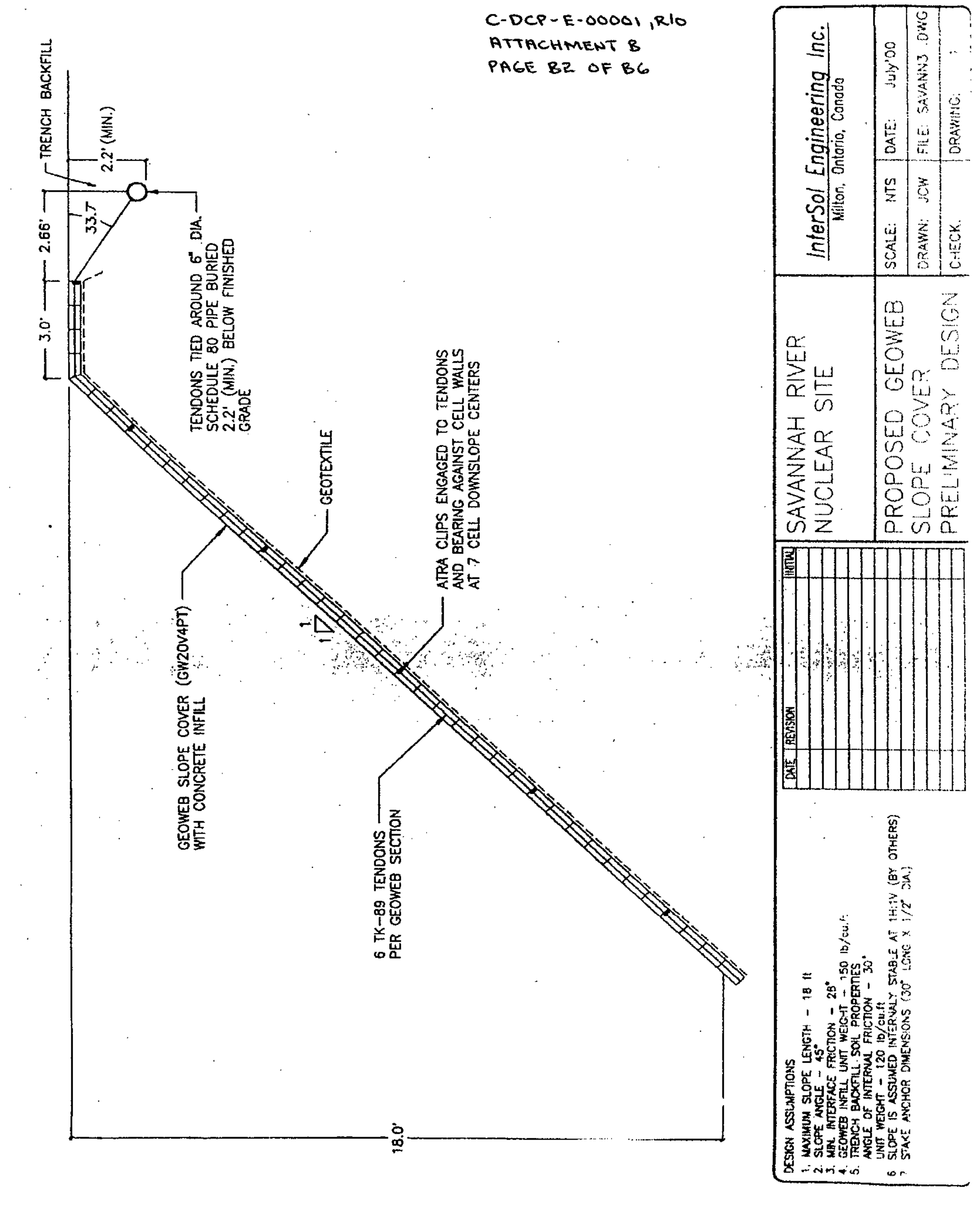
The preliminary design is based on 4" deep GW20V Geoweb sections. As drawn the cell dimensions are 8.9" by 10.2" resulting in 39 cell by 10 cell dimensions of 28.9 ft by 8.5 ft wide. Since the nearest section size produced by Presto is 40 cells long by 10 cells wide it will be necessary to reduce cell expansion from 8.9" to 8.67" or incorporate the extra cell at the top or bottom of the system.

I trust that the preliminary design will be sufficient for your immediate project requirements. If you have any questions, or require additional information, please contact me.

PS Part of your message may have been deleted or not received last week. Therefore, I did not know who to return the call to.

Sent by: INTERSOL 9058751329 07/18/00 12:47PM Job 91 Page 2

C-DCP-E-00001, R10
ATTACHMENT B
PAGE 82 OF 86



C-DCP-E-00001, R10
ATTACHMENT B
PAGE B3 OF B6

WebCover - Version 1.2 *InterSol* Engineering Inc.

Project: Savannah River Nuclear Site
Prepared by: JCW
Date: 26-Apr-00

English or Metric (E or M)	E		
Slope Angle	45	Slope (H:V)	
Slope Length (ft)	25.5		1.00
Interface Friction (degrees)	28	Vert. Height (ft)	
Cell Size? 8 or 16 (in)	8.9		18.0
Web thickness (in.)	4	Infill Wt (lb/ft)	
Infill Unit Weight (lb/cu.ft.)	150		1275.0
Additional Cover (in.)	0	Cover Wt (lb/ft)	
Cover Unit Weight (lb/cu.ft.)	0		0.0
Design Factor of Safety	1	Total Wt (lb/ft)	
Toe Load (lb/ft)	0		1275.0
Passive Resistance at toe (Y or N)	N		
Angle of internal friction of soil at toe	0		
Unit weight of soil at toe (lb/cu.ft)	0		
Infill type	Concrete		
Tendon type			

Factored Geoweb Tensile (lb/ft)	89.9	Design Tensile
Driving Force (lb/ft)	901.6	Weight+Toe Load
Factored Driving Force (lb/ft)	901.6	Weight Only
Factored Driving Force (lb/ft)	901.6	Weight+Toe Load
Resisting Force (lb/ft)	479.4	Shear Only
Passive Earth Force (lb/ft)	0.0	
Available Resistance (lb/ft)	0.0	Geoweb
Factor of Safety	0.53	Shear + Passive
Maximum Available F.S.	0.63	Anchored Geoweb

STAKE (J-PIN) ANCHOR DETAILS

Net Driving (lb/sq.ft)	16.56	Factored
Max. Geoweb Length (ft)	5.4	Unrestrained
Max. Downslope Spacing (in)	65	
Length (in)	0	
Diameter or Width (in)	0	
Downslope Spacing (in)	0	
Horizontal Spacing (in)	0	
Soil Friction (degrees)	0	
Soil Cohesion (lb/sq.ft)	0	
Unit Weight (lb/cu.ft)	0	
Kp (Coefficient)	0.00	
Buried Stake Length (ft)	0.00	
Stake Resistance (lb)	0.00	Single Pin
Number of Rows of Stakes	0	
Stake Resistance (lb/ft)	0.0	Resultant
Stake Resistance (lb/sq.ft)	0.00	Net Resultant

C-DCP-E-06001, R10
ATTACHMENT 8
PAGE 84 OF 86

Resisting Force (lb/ft)	479.4	Shear,Passive,Stakes
Factor of Safety	0.53	Shear,Passive,Stakes
Maximum Available F.S.	0.63	Anchored Geoweb
TENDONS		
Required Tension (lb/ft)	332.3	Tendons + Geoweb tensile
Required Tension (lb/ft)	422.2	Tendons only
Ultimate Strength (lb)	2000	
F.S. (Creep)	1.2	
F.S. (Knots)	1.5	
F.S. (Construction damage)	1.1	
F.S. (Chemical/Biological Durability)	1.1	
F.S. (Overall Uncertainties)	1.5	
Tendons Centers (in)	10.2	
Tendons/Slot	0.6	
Available Tension/Slot (lb)	367.3	
Available Tension (lb/ft)	432.1	OK
Factor of Safety	0.53	
Max. Available F.S.	1.11	Anchored GW & Tendons
Max. Available F.S.	1.01	Anchored tendons only
CREST/SLOPE ANCHORAGE		
Required Anchorage (lb/ft)	422.2	ANCHORAGE REQUIRED
Horizontal Embedment Length (ft)	3	From Slope Face to Key Trench
Depth Below Crest (in)	4	Bottom of Geoweb
Slope Angle of Key Trench (degrees)	0	
Depth of Key Trench (in)	0	
Horiz. Length at Bottom of Trench (in)	0	
Soil Unit Weight (lb/cu.ft)	150	
Soil Friction (degrees)	28	
Available Resisting Force (lb/ft)	79.76	OK
Available Crest Factor of Safety	0.62	
Required Tendon/Deadman Anchorage	342.4	lb/ft
Available F.S. with deadman anchorage	1.10	
SUMMARY OF TENDON REQUIREMENTS		
Tendon/Geoweb Section (ft)	0.0	
Tendon Density (ft/sq.ft)	0.00	
SUMMARY OF PIN REQUIREMENTS		
Stakes/Geoweb Section	0.0	
Stake Density (pins/sq.ft)	0.00	

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ATTACHMENT B
PAGE B5 OF B6

Deadman Anchorage in Granular Soils - Ovesun Method

English or Metric (E or M)				E		
Required Anchorage				342	lb/ft	
Height of Deadman, h				0.5	ft	
Width of Deadman, w				0.5	ft	
Unit weight of Deadman				0	lb/ft	
Length of Deadman, l				1	ft	
Depth to base of Deadman, H				2.2	ft	
Distance between centers, L				1	ft	
Friction angle - soil cover				30	degrees	
Unit weight of soil cover				120	lb/cu.ft	
Deadman/Soil Friction				0	degrees	
W - Weight of Deadman				0.00	lb/ft	
qm				234		
Ka				0.333		
Ph				290.4		
Pa				96.8		
Fa				-55.9		
				Chart	Rankine	Coulomb
Kg	Fig.4c	tan(delta)=	0.000	3.00	3.00	3.00
Ro				2.67	2.67	2.67
E				0.77	0.77	0.77
B				0.00	0.00	0.00
R				4.68	4.68	4.68
Ault				547.3	547.3	547.3
Tult				547.3	547.3	547.3
Factor of Safety (Deadman)				1.60	1.60	1.60

Sent by: INTERSOL 9058751329 07/18/00 12:49PM Job 91 Page 6

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ATTACHMENT B
PAGE B6 OF B6

GEOWEB® CELLULAR CONFINEMENT SYSTEM
V SERIES MATERIAL SPECIFICATION

Geoweb Section Prop[illegible] GW20V Cell

NOTE: All measurements are subject to manufacturing tolerances unless otherwise stated.

GW20V Geoweb Section

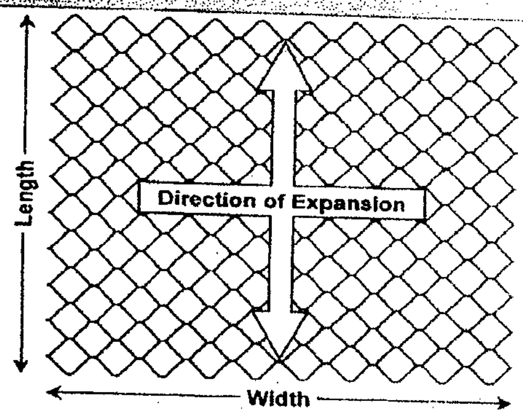

Figure 3 GW20V Geoweb Section

Presto Geoweb GW20V section dimensions shall be as indicated in Figure 3. Sections shall have a nomenclature of "GW20VDWWLL" where "GW20V" indicates the cell size, "D" indicates the cell depth in inches, "WW" indicates the number of cells wide, and "LL" indicates the number of cells long. Sections shall have expanded dimensions per Table 2. An example of the GW20V Geoweb section nomenclature is GW20V81025 where the section cell depth is 8 in or 200 mm and the section is 10 cells wide and 25 cells in length.

Table 2 Available GW20[illegible] Cells Wide

Cells Long	Minimum Expansion Length m	ft	Width m	ft	Maximum Expansion Length m	ft	Width m	ft	Nominal Area m²	ft²
18	3.7	12.0	2.8	9.2	4.4	14.5	2.3	7.7	10.4	112
21	4.3	14.0			5.1	16.9			12.1	[illegible]
25	5.1	16.7			6.1	20.1			14.5	[illegible]
29	5.9	19.4			7.1	23.3			16.8	[illegible]
34	6.9	22.7			8.3	27.3			19.7	[illegible]
40	8.1	26.7			9.8	32.2			23.1	[illegible]

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OSR 19-189# (6-11-91)

Calculation Sheet

SRS Savannah River Site	Project SWMF LLW Mega Trench Project						Calculation No. C-DCP-E-00001-M02		
	Subject Primer for Pump Suction Line							Sheet No. 1 of 5	
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	Edward Hunda	5/25/00		5/25/00					

C-DCP-E-00001, R/0
ATTACHMENT C
PAGE C1 OF C13

PURPOSE:
The purpose of this calculation is to:
1. Provide the means for priming and sampling the Mega Trench Sump Pump inlet line.
2. Verify that the submersible pump will fill the sump pump suction line within 15 minutes.

SUMMARY OF CONCLUSIONS:
Use a "High Head" submersible pump. Recommend pump in Reference 1 or approved equal.
Sump pump suction inlet connection as shown in Attachment 1.
Submersible pump discharge line as shown in Attachments 2 and 3.

REFERENCES:
1. Cut Sheet and Installation Instructions for Zoeller Pump Co., High Head Agricultural pump Model 4290.
2. Flow of Fluids Through Valves, Fitttings, and Pipe. Crane Technical Paper No. 410
3. Good Year Catalog # 99-130. Cut Sheet for Water Suction & Discharge Hose

INPUT:
Mega Trench Sump Pump configuration per C-DCP-E-00001-M01.
Sump pump suction line to be filled within 15 minutes.

ASSUMPTIONS:
See Sheet 5

ANALYTICAL METHOD:
See Sheets 2 through 5

RESULTS:
Submersible pump will provide approximately 75 gpm of water to the Mega trench sump pump suction line for priming and / or sampling.
The submersible pump will fill the sump pump suction line in 0.7 minutes (42 seconds)

CONCLUSION:
1. The submersible pump, per reference 1, is adequate to provide priming and sampling capability for the sump pump suction line.
2. The submersible pump will fill the sump pump suction line in 42 seconds. This meets the 15 minute requirement.

ATTACHMENTS:
1. Sketch 1. Sump pump suction line spool detail
2. Sketch 2. Submersible pump configuration
3. Cut Sheet and Installation Instructions for Zoeller Pump Co., High Head Agricultural pump Model 4290.
4. Cut Sheet for Water Suction & Discharge Hose.

C-DCP-E-00001, R10
ATTACHMENT C
PAGE C2 OF C13

Note: Pump flow is determined by iteration. Match flow rate with total dynamic head (Ht) in pump curve (Attachment 3).

$Flow := 75$ gpm — Reference 1

Hose size: 2" — Reference 2

$Q := \frac{Flow}{7.481}$ or $Q = 10.025 \ \frac{ft^3}{minute}$

$q := \frac{Q}{60}$ or $q = 0.167 \ \frac{ft^3}{sec}$

$d_i := 2$ in hose inside diameter — Reference 1

$D_i := \frac{d_i}{12}$ ft or $D_i = 0.167$ ft

$A := \pi \cdot \frac{D_i^{\,2}}{4}$ or $A = 0.022$ ft^2 pipe cross sectional area

Fluid velocity:

$v := \frac{q}{A}$ or $v = 7.659 \ \frac{ft}{sec}$

$h_d := 20$ vertical elevation (ft)

Properties for water at standard conditions:

$\rho := 62.3 \ \frac{lb}{ft^3}$ — Reference 2

$\mu := .95$ centipoise — Reference 2

Reynolds number:

$Re := 123.9 \cdot \frac{d_i \cdot v \cdot \rho}{\mu}$ or $Re = 1.245 \times 10^5$ — Reference 2

$f_h := 0.0305$ — Reference 2 & Assumption 1

$g_c \equiv 32.2$

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ATTACHMENT C
PAGE C3 OF C13

Submersible Pump Discharge Side Hardware Tabulation for pressure losses:
(Sketch 2)

2" Flexible Hose length (Lh) = 35 ft.

180 Deg bend on 2" hose = 1

2" Pipespool length (Lp) = 1 ft

2" Tee (run through) = 1

2" ball valve = 1

Head loss through 2" flexible hose and 2" pipe spool.

$L_h := 35$

$L_p := 1$

$f_p := .019$ Reference 2

$h_{hose} := \frac{f_h \cdot L_h \cdot v^2}{2 \cdot D_i \cdot g_c}$ $h_{hose} = 5.834$ ft Reference 2

$h_{pipe} := \frac{f_p \cdot L_p \cdot v^2}{2 \cdot D_i \cdot g_c}$ $h_{pipe} = 0.104$ ft Reference 2 and assumption 2

Resistance coefficients (K) for components in submersible pump line: Reference 2

$K_{90ell} := 30 \cdot f_h$ 90 deg elbow coefficient

$K_b := \left(.25 \cdot \pi \cdot f_h \cdot 10 + .5 \cdot K_{90ell}\right) + K_{90ell}$ 180 deg bend on hose

$K_b = 1.612$

$K_{tee\_run} := 20 \cdot f_p$ Flow through tee

$K_{tee\_run} = 0.38$

$K_{vlv} := 3 \cdot f_p$ Ball valve

$K_{vlv} = 0.057$

Head loss through line components: Reference 2

$h_b := K_b \cdot \frac{v^2}{2 \cdot g_c}$	$h_b = 1.468$	ft	180 deg bend on hose
$h_{tee} := K_{tee\_run} \cdot \frac{v^2}{2 \cdot g_c}$	$h_{tee} = 0.346$	ft	Flow through tee
$h_{vlv} := K_{vlv} \cdot \frac{v^2}{2 \cdot g_c}$	$h_{vlv} = 0.052$	ft	Ball valve

Head loss through line

$$h_{dyn} := h_{hose} + h_{pipe} + h_b + h_{tee} + h_{vlv}$$

$h_{dyn} = 7.804$ ft

Total discharge head loss

$H_t := h_d + h_{dyn}$ or

$H_t = 27.8$ ft

SUMP PUMP SUCTION LINE FILL TIME CALCULATION

Suction Line Cross sectional area:

$A_{suc} := .2\ ft^2$ C-DCP-E-00001-M01

Suction Line total length:

$L_{suc} := 35\ ft$

Suction line volume

$V_{suc} := A_{suc} \cdot L_{suc}$ or $V_{suc} = 7$ ft^3

Suction line volume conversion to gallons. Use 7.48 gallons per cubic foot.

$V_{suc\_gal} := V_{suc} \cdot 7.4$ or $V_{suc\_gal} = 52.36$ gallons

Pump flow

$Flow = 75$ gallons per minute

C-DCP-E-00001, R10
ATTACHMENT C
PAGE C5 OF C13

Time required to fill line

$t_{fill} := \frac{V_{suc\_gal}}{Flow}$ minutes

$t_{fill} = 0.698$ minutes

RESULTS

Submersible pump will provide approximately 75 gpm of water to the Mega Trench sump pump suction line for priming and or sampling.

Submersible pump will fill the sump pump suction line in 0.7 minutes (42 seconds)

See Attachment 1 for sump pump inlet spool detail.

See Attachments 2 and 3 for submersible pump configuration and details.

ASSUMPTIONS

1. Relative roughness for hose material to be equivalent to cast iron. This will result in conservative values for flow calculations

2. Use same inside diameter value for 2" hose and 2" pipe for simplification.
The difference (2" for hose and 2.067" for pipe) is inconsequential for this calculation.

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ATTACHMENT C
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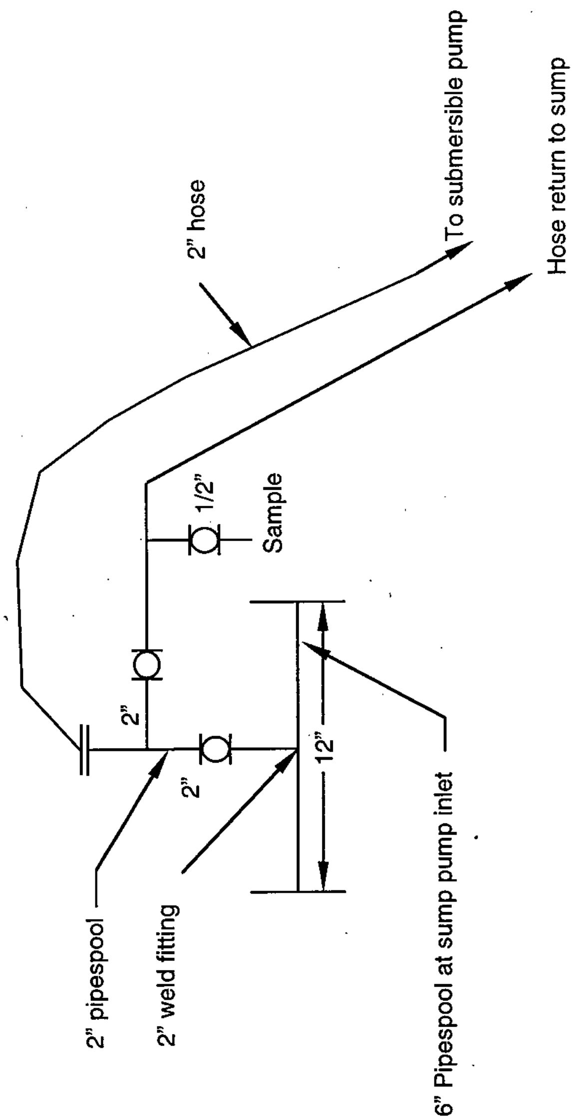
Revision 0
Attachment 1
Page 1 of 1



SKETCH 1. SUMP PUMP SUCTION LINE SPOOL DETAIL

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Attachment 2
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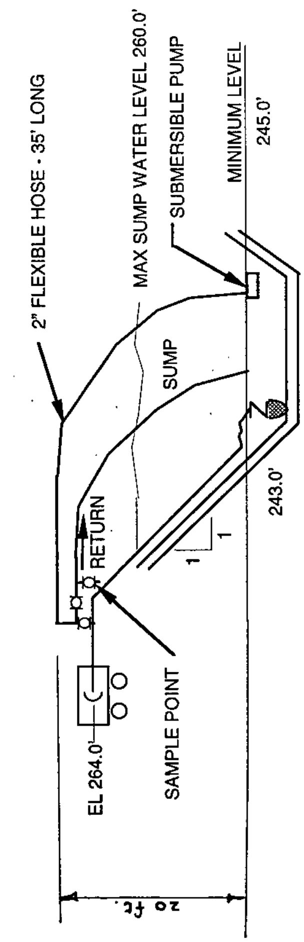

"Quality Pumps Since 1939"

Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

ZOELLER PUMP CO.

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SECTION: 2.60.130
FM1472
0400
Supersedes
1097

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SHIP TO: 3649 Cane Run Road • Louisville, KY 40211-1961
(502) 778-2731 • 1 (800) 928-PUMP • FAX (502) 774-3624

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ATTACHMENT C
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COMPARE THESE FEATURES

- Non-Clogging vortex impeller.
- Passes 1½" spherical solids.
- Available with 2" or 3" NPT vertical flange discharge.
- Durable cast iron construction with stainless steel screws and handle.
- Corrosion resistant powder coated epoxy finish.
- 50' UL listed neoprene jacketed power cable. Extra lengths, 75-100 ft. available.
- Motor - 230V, 60Hz, 3450 RPM, 1 HP (4290), 2 HP (4291), oil-filled, hermetically sealed, thermal overload protection with automatic reset.
- Available in both 1 & 3 Phase.
- Maximum operating temp. 130°F (54°C).
- Shaft Seals - Carbon and ceramic.
- Neoprene gaskets and seals.
- Double shaft seals provides extra protection for motor.
- Large clearances to prevent stoppage from build up of solids.
- Pump flotation devices available for Lagoon installations. (See FM1473)
- Width 12 7/8", Height 20 1/2".

4290 - 4291 Double Seal Series

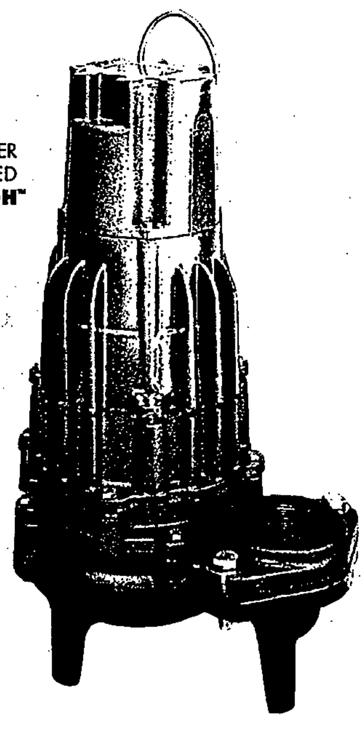
(For Pump Prefix Identification see News & Views 0052)

HIGH HEAD "AGRICULTURAL" PUMP

SSPMA MEMBER — SUMP AND SEWAGE PUMP MFRS. ASSN.

SPECIFICALLY DESIGNED FOR LAGOON OR SUMP PIT APPLICATIONS

POWDER COATED TOUGH™



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SECTION: 5.10.050
FM1507
0896
Supersedes
New

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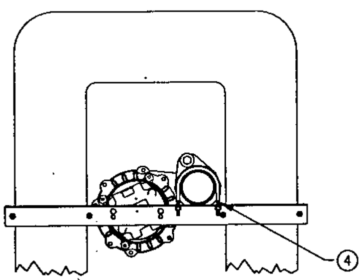
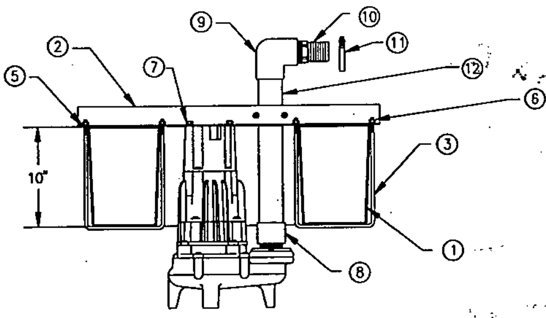
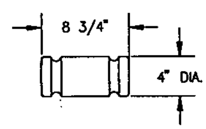
AGRICULTURAL PONTOON & ACCESSORIES SPECIFICATIONS

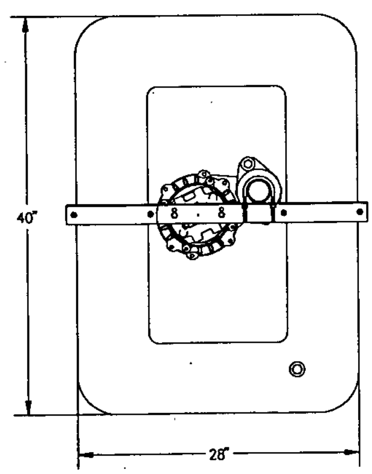


10-0625 3" DISCHARGE AG. PONTOON		
#	DESCRIPTION	QTY.
1	FLOAT,PONTOON 4290/4291 POLYETHYLENE	1
2	SUPPORT, ANGLE IRON SS 2 X 2 X 1/8 X 30	1
3	U-BOLT, SUPPORT LOCATOR SS	2
4	U-BOLT, DISCHARGE CLAMP SS	1
5	WASHER,LOCK SS 5/16 ID	8
6	NUT,5/16-18 HEX-SS	6
7	SCREW,5/16-18 X 3/4" HEX CAP SS	2
8	FITTING,3" NPT ADAPTER SCHD 40 PVC	1
9	FITTING,3" 90D SCHD 40 PVC FPT X SOC	1
10	FITTING,HOSE NIPPLE 3" MPT X BARB - POLYPROPYLENE	1
11	CLAMP,#60 WORM-SS	1
12	PIPE 3" SCHD 40 PVC X 18-7/16"	1





10-0631 AG. HOSE FLOAT ACCESSORIES	
DESCRIPTION	QTY.
FLOAT,HOSE AG. PUMP 4290/4291	4
TIE,CABLE 1/2W X 21 1/2LG - OUTDOOR NYLON	8



10-0624 2" DISCHARGE AG. PONTOON		
#	DESCRIPTION	QTY.
1	FLOAT,PONTOON 4290/4291 POLYETHYLENE	1
2	SUPPORT, ANGLE IRON SS 2 X 2 X 1/8 X 30	1
3	U-BOLT, SUPPORT LOCATOR SS	2
4	U-BOLT, DISCHARGE CLAMP SS	1
5	WASHER,LOCK SS 5/16"	8
6	NUT,5/16-18 HEX-SS	6
7	SCREW,5/16-18 X 3/4" HEX CAP SS	2
8	FITTING,2" NPT ADAPTER SCHD. 40 PVC	1
9	FITTING,2" 90D SCHD 40 PVC FPT X SOC	1
10	FITTING,HOSE NIPPLE 2" MPT X BARB - POLYPROPYLENE	1
11	CLAMP,#36 WORM-SS	1
12	PIPE,2" SCHD 40 PVC X 18-7/16"	1

SK1653

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ATTACHMENT C
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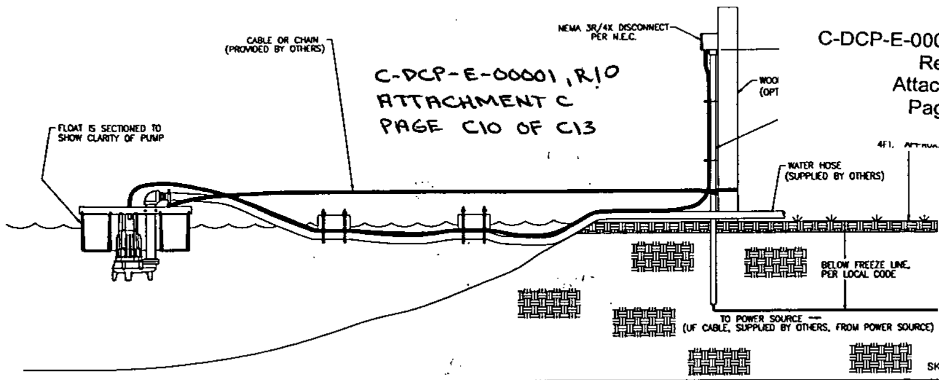
Fig. 1



TYPICAL LAGOON INSTALLATION

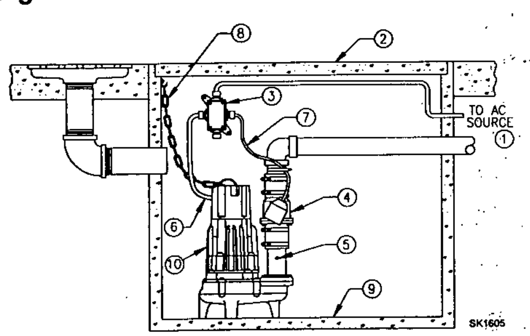
(1) Electrical wiring and enclosures must be in accordance with the National Electrical Code, and any other applicable state and local electrical requirements.
(2) Secure power cord on both ends. Tie off at the pontoon and strap rigidly to the pole support below the wiring enclosure.
(3) Connect flexible pipe to pump discharge using stainless steel hose clamp. Install pipe floats approximately 10 feet apart to ensure flotation.
(4) The pipe floats can also be used to support the power cable if the wiring terminal box and discharge pipe connection are located in the same area. If wiring terminal box is located in a different area, separate floats may be required to prevent power cable from drooping and entanglement with lagoon debris.
(5) Three phase pumps require motor starters. Refer to Zoeller FM0825.
(6) Voltage at the terminal point of the power supply line must be 90% or greater than the motor rated voltage when pump is running. Ex. 200/208V pumps must have 180/187V at the termination point (terminal box). 230V pumps must have 207V at the termination point. These voltages are required for proper motor operations and to avoid overheating and motor damage. See Fig. 2 for guide on wire size to avoid excessive voltage drops in the power supply line.
(7) If the power source for the terminal box connection is located at some distance away, the guideline in Fig. 2 must be followed to help assure the required voltage at the terminal box.
(8) Do not use plug caps and receptacles. Use rigid connection with proper fuses and/or circuit breakers with strain relief on power cable at entry to the enclosure.
(9) Pump must be mounted no more than 10 degrees from vertical and secured to prevent torquing. Use Zoeller Pontoon assembly P/N 10-0624 for 2" discharge, or 10-0625 for 3" discharge requirements.
(10) Pump must operate with motor and pump housing totally submerged in the water for adequate cooling. Zoeller Pontoon P/N 10-0624/10-0625 and hardware will assure proper depth of submersion.
(11) Do not attempt to locate the pump pontoon by pulling on the power cord. Install a chain, flexible cable or plastic rope for this purpose.
(12) Agriculture pumps are designed for pumping water with a maximum of 3% solids up to 1½" in particle size. Addition of make up water and lagoon maintenance is required for trouble free pump operation.
(13) **Agriculture pumps are subject to calcium, lime or salt build up. Pump must be de-scaled on a regular maintenance schedule to prevent clogging and overheating of motors. The addition of chemicals in flush tanks and make up water is essential for controlling the ammonia in the wash down water and subsequent scaling of pumps in the lagoon.**
(14) First, second and third generation lagoons and lagoons for nurseries and farrowing houses will require different maintenance schedules. Normally pumps will require de-scaling quarterly. This schedule will vary with size of lagoon, make up water and the chemicals used for control. It will be necessary to establish a pump maintenance schedule for each application from observation of scale build up.

Failure to provide this routine maintenance may void pump warranty.

Fig. 2

AWG WIRE SIZE	MAXIMUM LENGTH OF WIRE – FT.				
	PUMP VOLTAGES				
	208V-1PH	230V-1PH	208V-3PH	230V-3PH	460V-3PH
12	120	150	160	220	800
10	210	280	370	400	1500
8	330	450	900	740	—
6	550	620	900	1100	—

Fig. 3



PIT SYSTEMS

(1) Electric wiring and protection must be in accordance with the National Electric code and any other applicable state and local electrical codes.
(2) All installations require a basin cover to prevent debris from falling into the basin and to minimize the possibility of accidental injury.
(3) Wire pump to power source through a Zoeller J-Box P/N 10-0002, watertight junction box in accordance with the National Electrical code. (See FM0513)
(4) Install 2" full flow check valve. (See FM0217)
(5) When check valve is installed, drill a 3/16" diameter hole in the discharge pipe below the check valve. The hole is necessary to avoid air lock of the pump on start-up.
(6) Secure power cord to avoid entanglement with the float switch.
(7) Pump must be level and the tethered float switch must be free and not held up on the pump apparatus or pit peculiarities and is secured so that the pump will shut off at the proper level.
(8) Chain or cable should be installed for removing pump from the pit.
(9) Basin should be clean and free of scale after installation.
(10) **Pump must be de-scaled when used for pumping water containing animal waste. A regular maintenance schedule, minimum of three months, is required based on condition of water and chemical used for controlling the build up of ammonia.**

Failure to provide this routine maintenance may void pump warranty.

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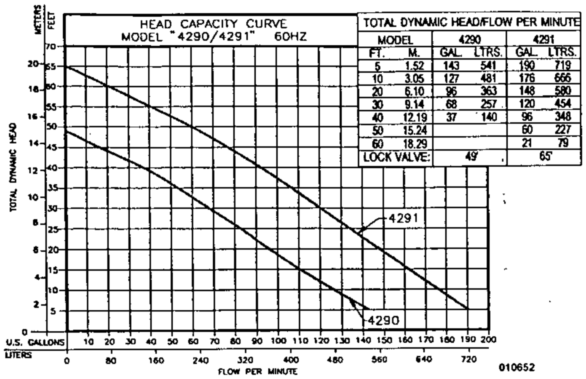
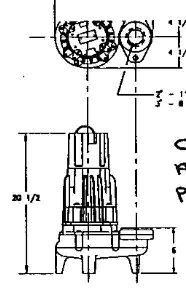


TOTAL DYNAMIC HEAD/FLOW PER MINUTE					
MODEL		4290		4291	
FT.	M.	GAL.	LTRS.	GAL.	LTRS.
5	1.52	143	541	190	719
10	3.05	127	481	176	666
20	6.10	96	363	148	560
30	9.14	68	257	120	454
40	12.19	37	140	96	348
50	15.24			60	227
60	18.29			21	79
LOCK VALVE:		49'		65'	



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ATTACHMENT C
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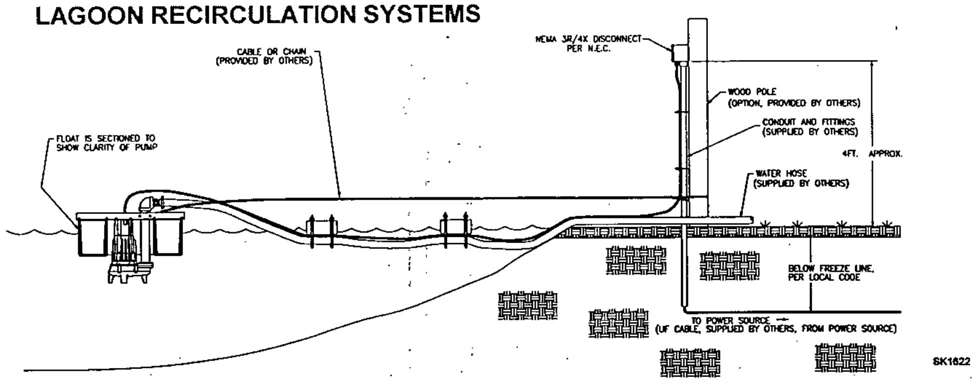
LAGOON RECIRCULATION SYSTEMS



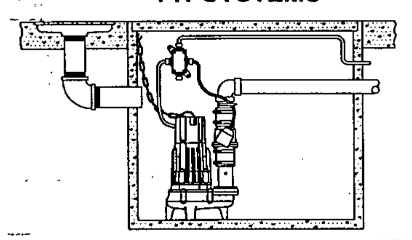
Pump Pontoons (See FM1507 for Specs.)

P/N 10-0624 Pontoon and hardware kit for connection to 2" discharge conduit.
P/N 10-0625 Pontoon and hardware kit for connection to 3" discharge conduit.

Pipe Floats

P/N 10-0631 Includes four floats with nylon pipe straps.

PIT SYSTEMS



STANDARD MODELS - 50 Ft. POWER CABLE - NO MOLDED PLUG

Model 4290 - 1 HP

Models	Volts	Ph	Amps	Hz	Lbs.
E4290	230	1	9.0	60	100
I4290	200-208	1	10.8	60	100
J4290	200	3	7.3	60	100
F4290	230	3	6.5	60	100
G4290	460	3	3.3	60	100
BA4290	575	3	*	60	100

Model 4291 - 2 HP

Models	Volts	Ph	Amps	Hz	Lbs.
E4291	230	1	14.5	60	102
I4291	200-208	1	17.5	60	102
J4291	200	3	11.4	60	102
F4291	230	3	10.0	60	102
G4291	460	3	5.0	60	102
BA4291	575	3	*	60	102

*Consult Factory

For information on additional Zoeller products refer to catalog on Piggyback Variable Level Float Switches, FM0477; Electrical Alternator, FM0486; Mechanical Alternator, FM0495; Sump/Sewage Basins, FM0487; Simplex Pump Control, FM1596; Alarm Systems, FM0732; and Disconnect/Rail Systems, FM0787.

CAUTION

All installation of controls, protection devices and wiring should be done by a licensed qualified electrician. All electrical and safety codes should be followed including the most recent National Electric Code (NEC) and the Occupational Safety and Health Act (OSHA).

RESERVE POWERED DESIGN

For unusual conditions a reserve safety factor is engineered into the design of every Zoeller pump.

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Revision 0
Attachment 3
Page 5 of 5

EASY DO'S & DON'T'S FOR INSTALLING AGRICULTURAL P

1. **DO** read thoroughly all installation material provided with the pump.
2. **DO** inspect pump for any visible damage caused by shipping. Contact dealer if pump ap
3. **DO** clean all debris from sumps. Be sure that the pump will have a hard, flat surface beneath it. **DO NOT** install on sand, gravel or dirt.
4. **DO** be sure that the sump is large enough to allow proper clearance for the level control switch(es) to operate properly.
5. **DO** make certain pump is mounted on pontoon properly for lagoon applications
6. **DO** Always Disconnect Pump From Power Source Before Handling. **DO** always connect to a separately protected and properly grounded circuit. **DO NOT** ever cut, splice, or damage power cord. **DO NOT** carry or lift pump by its power cord. **DO NOT** use an extension cord with a submersible pump.
7. **DO** install a check valve and a union in the discharge line for pit applications. **DO NOT** use a discharge pipe smaller than the pump discharge.
8. **DO NOT** use a submersible pump as a trench or excavation pump, or for pumping gasoline or other hazardous liquids.
9. **DO** test pump immediately after installation to be sure that the system is working properly.
10. **DO** cover pit with an adequate pit cover.
11. **DO** review all applicable local and national codes and verify that the installation conforms to each of them.
12. **DO** consult manufacturer for clarifications or questions.
13. **DO** consider a Two Pump System with an alarm (See FM0532) where an installation may become overloaded or primary pump failure would result in property damages.

YOUR ASSURANCE OF QUALITY — SSPMA MEMBER — SUMP AND SEWAGE PUMP MFRS. ASSN.®

C-DCP-E-00001, R10
ATTACHMENT C
PAGE C12 OF C13

The following will help assure longer pump life. If not completed or checked when pump is installed, the Limited warranty may be affected.

A. The voltage at the supply cord termination point must be 90% or greater than motor rated voltage when pump is running.

B. The power cord must be terminated in a NEMA 3R or 4X disconnect box per the NEC.

C. Pump must be mounted within 10 degrees of vertical.

D. Pump must be anchored to stop torquing while running, starting or stopping, relative to the float or anchor point.

E. Pump must be under water at all times and pump fluids with less than 3% solids.

G. The pump must be maintained on a regular basis. (De-scaled regularly to prevent deposits from stalling unit).

LIMITED WARRANTY

Zoeller Pump Company warrants, to the purchaser and subsequent owner during the warranty period, every new Zoeller Pump Company product to be free from defects in material and workmanship under normal use and service, when properly installed, used and maintained, for a period of one year from date of installation or 18 months from date of manufacturer, whichever comes first. Parts that fail, (within one year of installation or 18 months of manufacture, whichever comes first) that inspections determine to be defective in material or workmanship, will be repaired, replaced or remanufactured at Zoeller Pump Company's option, provided however, that by so doing we will not be obligated to replace an entire assembly, the entire mechanism or the complete unit. No allowance will be made for shipping charges, damages, labor or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled without prior approval of Zoeller Pump Company, subjected to misuse, misapplication, neglect, alteration, accident or act of God; that has not been installed, operated or maintained in accordance with Zoeller Pump Company installation instructions; that has been exposed to but not limited to the following: sand, gravel, cement, mud, tar, hydrocarbons or hydrocarbon derivatives (oil, gasoline, solvents, etc), wash towels or feminine sanitary products, etc. or other abrasive or corrosive substances.

This warranty is in lieu of all other warranties expressed or implied; and we do not authorize any representative or other person to assume for us any other liability in connection with our products.

Contact Zoeller Pump Company, 3649 Cane Run Road, Louisville, Kentucky 40211-1961, Attention: Customer Service Department to obtain any needed repair or replacement of part(s) or additional information pertaining to our warranty.

ZOELLER PUMP COMPANY EXPRESSLY DISCLAIMS LIABILITY FOR SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES OR BREACH OF EXPRESSED OR IMPLIED WARRANTY; AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND OF MERCHANTABILITY SHALL BE LIMITED TO THE DURATION OF THE EXPRESSED WARRANTY.

Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

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ATTACHMENT C
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Revision 0
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Page 1 of 1

Catalog #99-130
ersedes Catalog #98-130

YEAR

PLICORD® CON-AG®
WATER S & D

WATER SUCTION & DISCHARGE HOSE

APPLICATION: Con-Ag® hose is a general purpose water suction and discharge hose for applications in medium or heavy operations such as construction or agriculture.

CONSTRUCTION:

TUBE: Black Versigard®

REINFORCEMENT: Spiral plied synthetic fabric with wire helix

COVER: Black Versigard® (Wrapped Finish) with yellow spiral stripe

TEMPERATURE: -40°F to 180°F (-32°C to 82°C)

PACKAGING: 100' lengths, coiled and polywrapped

BRANDING: Continuous spiral brand example "Con-Ag Water S & D by Goodyear™."

COUPLINGS: Contact fitting manufacturer for proper fitting recommendation and coupling procedure.

NON-STOCK/SAMPLES: 400' minimum order for color change or special branding

ORDER CODES: 542-159

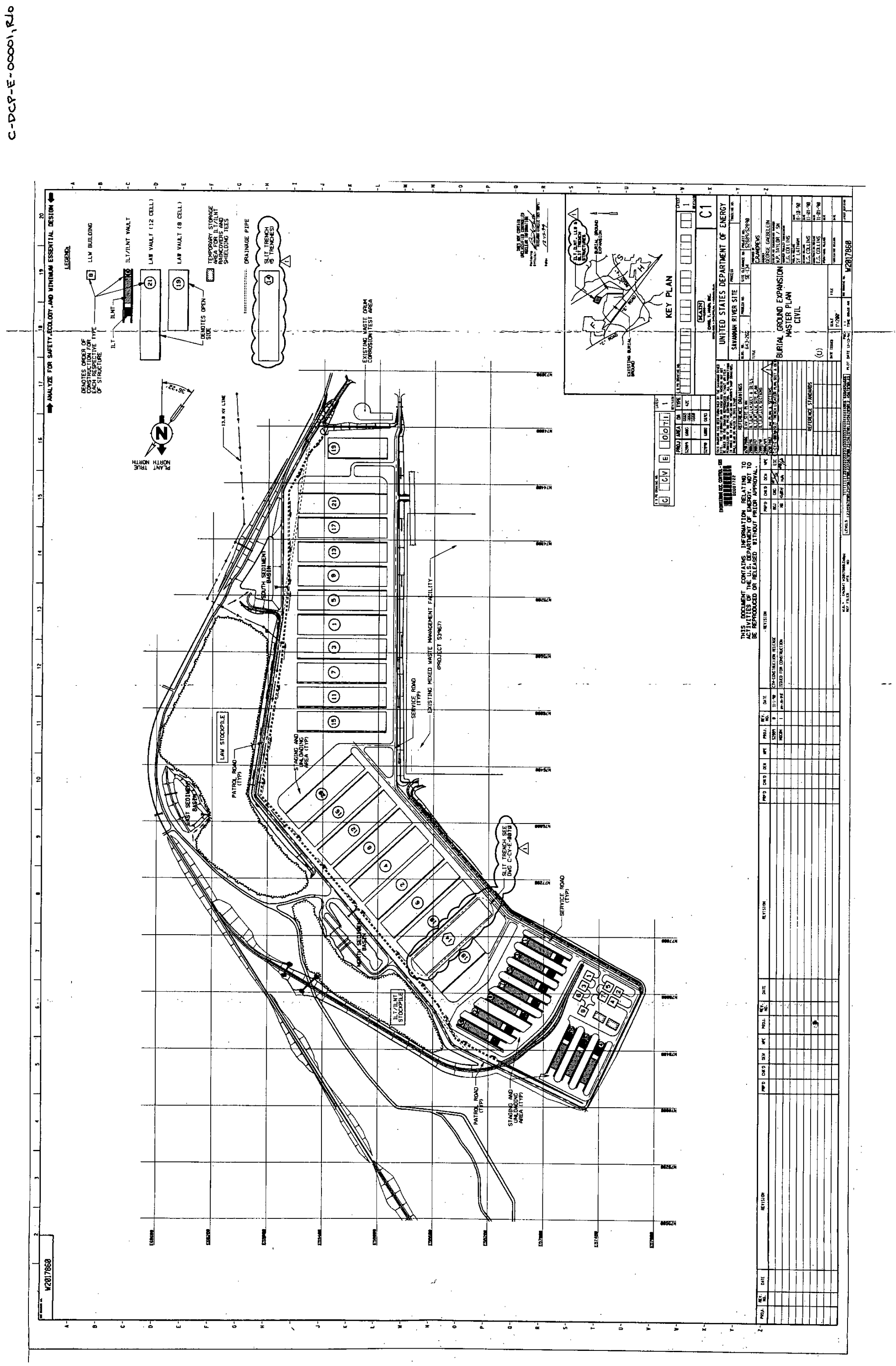
NOM. ID		NOM. OD		MAX. WP		BEND RADIUS		VACUUM HG		WEIGHT	
in.	mm.	in.	mm.	psi	Mpa	in.	mm.	in.	mm.	lb./ft.	kg./m
1 1/4	31.75	1 44/64	42.86	125	.86	4	102	29	736.6	.66	.98
1 1/2	38.10	1 60/64	49.21	125	.86	4	102	29	736.6	.76	1.13
2	50.80	2 29/64	62.31	125	.86	7	178	29	736.6	1.03	1.54
2 1/2	63.50	3 1/64	76.60	100	.70	10	254	29	736.6	1.51	2.25
3	76.20	3 32/64	88.90	100	.70	14	356	29	736.6	1.78	2.65
4	101.60	4 35/64	115.50	75	.52	18	813	29	736.6	2.48	3.70
6	152.40	6 39/64	167.88	75	.52	24	1168	29	736.6	4.48	6.68

MATERIAL HANDLING

PETROLEUM

WATER

Water Suction & Discharge


KEY PLAN
UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
BURIAL GROUND EXPANSION
MASTER PLAN
CIVIL
C1

OSR 31-688 (Rev 11-20-97)
Stores: 26-8910.00

WESTINGHOUSE SAVANNAH RIVER COMPANY
INTEROFFICE MEMORANDUM

BNFL

February 9, 2000

SWD-SWE-2000-00029

C-DCP-E-00001, R10
ATTACHMENT E
PAGE E1 OF E6

TO: Don Sink, Solid Waste Engineering, 724-15E

FROM: J. R. Brookshire
241-168H

J R Brookshire

NOTICE OF NEPA APPROVAL (NONA) (U)

EEC No.: SW - E - 2000 - 001 Rev. No.: 0
Title: SWMF LLW MEGA TRENCH

It has been determined that no further National Environmental Policy Act (NEPA) documentation is required for the scope of work identified in the subject Environmental Evaluation Checklist (EEC). The proposed action is documented as being:

- [x] No further NEPA is required as all prescreens are "NO"
- [ ] CX granted by DOE (Must meet all requirements of 10 CFR 1021.410(b)):
- [x] Covered by previous NEPA documentation: Waste Management EIS

The requirements of NEPA for the proposed activity have been satisfied and you are no longer restricted by NEPA to proceed with this action. Please note, however, that this concurrence relates to NEPA only. All other applicable environmental, safety, and management activities must be met for activities related to this action.

File this determination and the original Environmental Evaluation Checklist with the proposed project or activity file.

If you determine that actions or modifications outside of the originally approved scope of work must be performed, these changes must be submitted for evaluation to insure continued compliance with the National Environmental Policy Act.

Attached: Signed EEC

cc: C. B. Stevens, 724-21E
T. E. West, 724-36E
Document Control, 705-3C

Environmental Evaluation Checklist (EEC)

NEPA/Environmental Permits
C-DCP-E-00001, R10
ATTACHMENT E
PAGE E2 OF E6

EEC No. SW - E - 2000 - 001
Rev No. 0

Instructions:

- Fill in both the NEPA and Permits portion of the checklist.
- Submit one copy of the completed Checklist with supplemental information to the Department NEPA Coordinator (DNC). The DNC will distribute to the Site NEPA Coordinator for NEPA level determination by DOE.
- Submit one copy of the completed Checklist with supplemental information to the Department Environmental Coordinator (EC). The EC will distribute the completed checklist to the SW Waste Forecast Coordinator (where applicable).

Activity Title and Project No. (if any)	Date
SWMF LLW MEGA TRENCH	1/3/2000
Checklist Preparer (Name, Organization, Location)	**Phone No.**
Don Sink, Solid Waste Engineering, 724-15E	2-4846

Activity Start	Activity End	Est. Cost	Activity Location
6/1/00	6/1/05	$750,000	643-26E

Activity Description: This should be a brief but thorough description of the proposed activity. Be very specific in explaining the purpose and location (a developed/non-developed area, outside/inside/adjacent to existing building no., etc.). Attach a copy of Functional Performance Requirement, conceptual scope of work, maps, charts, or other equivalent information.

Summary:

Provide a shallow land burial site (i.,e. "Mega-Trench') for the disposal of containerized Low Level Waste. The location of the Mega-Trench shall be located in future LAWV Vault No. 11. The trench shall be designed to accommodate stacking 4 to 5 B-25's high in depth. The Mega-Trench will allow the drive-in function of flat bed trucks and fork lift trucks or a crane for disposing of waste containers. The base shall have structural features for allowing components to be grout in a selected portion of the Mega-Trench. The base of the Mega-Trench shall be sloped to move water runoff to a low point sump for collection and pumping. The Mega-Trench's walls shall be sloped back to allow personnel to work safely at the base. Also, the walls shall be provided with erosion control features for keeping the walls intact.

Detailed Description: Attachments (FPR, CDR, System Description, etc.)? ○ Yes ⊙ No

Refer to PMT NUMBER: U - PMT- E- 000149. The depth of the trench will be dictated by the elevation of the water table versus the Performance Assessment requirements. The life expectancy of the trench shall be at least five years. The location of the trench is shown on Drawing W2017860.

Additional NEPA considerations:
LLWVs for shallow land disposal are discussed in the Waste Management EIS, 0217, page. B-105 and page 55252 in the ROD for LLW.
EEC activity is covered by EIS 0217.
GL Peterson

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NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

CHECKLIST

C-DCP-E-00001, R10
ATTACHMENT E
PAGE E3 OF E6

EEC No. SW - E - 2000 - 001

Rev No. 0

Pre-Screen Evaluation: *

Will the proposed activity:

• Result in a change in emissions, generation rates, or new discharges of hazardous, radioactive, petroleum substance, or other pollutants from a facility or process to the environment (air, water, land, etc.)?	○ yes ⊙ no
• Be located outside of a previously developed area and have the potential for environmental impact.?	○ yes ⊙ no
• Involve siting, construction, modification, or D&D of facilities or processes which could potentially result in an environmental impact.?	○ yes ⊙ no
• Potentially affect environmentally sensitive resources such as floodplain/wetlands, sites of archeological significance, threatened or endangered species and/or their habitat, special sources of water (i.e., aquifer)?	○ yes ⊙ no
• Pose some change in the level of health and/or safety risks (e.g., result in an Unreviewed Safety Question)?	○ yes ⊙ no
• Involve site characterization, environmental monitoring, or field research programs?	○ yes ⊙ no

***Note:** - If any unknown, call Department NEPA Coordinator (DNC) for consultation.
- If all are "No", no further NEPA action needed. Consult with DNC to verify; file with project & complete PERMITS CHECKLIST.
- If any are "Yes", complete rest of NEPA CHECKLIST & the PERMITS CHECKLIST.

Environmental Impacts Evaluation: (Note: If any are "Yes", provide specifics/supplemental information.)

Air	
• Will there be a new air emission or a change in the quantity or quality of an existing air emission?	○ yes ⊙ no
Surface Water	
• Will there be a liquid release to streams, swamps, wetlands, seepage basins, storm drains, process sewers, ponds, or lakes?	○ yes ⊙ no
• Will river or stream water be utilized?	○ yes ⊙ no
Groundwater	
• Will there be a discharge to groundwater?	⊙ yes ○ no
• Will groundwater be utilized?	○ yes ⊙ no
Safety	
• Is there a potential exposure to hazardous substances (e.g., radiological/toxic/chemical materials)?	○ yes ⊙ no
• Is there a potential for explosion or criticality?	○ yes ⊙ no
• Does action involve transportation of hazardous materials?	○ yes ⊙ no
Natural/Cultural Resources	
• Is there a potential for impacts on wetlands, swamps, streams, river beds, ponds, set aside areas?	○ yes ⊙ no
• Is there a potential impact on fish/wildlife resources or habitats?	○ yes ⊙ no
• Is there a potential impact on protected species (e.g., sensitive, rare, threatened, endangered)?	○ yes ⊙ no
• Is there a potential for impacting archeological sites?	○ yes ⊙ no
• Does this action require a site clearance/site use permit?	○ yes ⊙ no

For Department NEPA Coordinator and Site NEPA Coordinator Use Only (NEPA Recommendation)

• Are there potential cumulative effects when combined with other actions?	○ yes ⊙ no
• Is the proposed activity a component of a larger line item project?	○ yes ⊙ no

☒ No further NEPA is required as all prescreens are "NO". ______ (document title/number)

☐ CX applied for by DNC (Must meet all requirements of 10 CFR 1021.410(b)): ______

■ Covered by previous NEPA Documentation (CX, EA, EIS): Waste Management EIS (document title) EIS 0217 (document number)

☐ Additional NEPA Documentation Required: ☐ EA ☐ EIS ☐ SA

DNC: *J. R. Brookshire* 1/13/2000 Date

SNC: *Greg Peterson* Greg Peterson 5-5196 2/3/2000 Date

For DOE NEPA Compliance Officer Use Only (NEPA Determination)

Based on my review of information conveyed to me and in my possession concerning the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1A), I have determined that the proposed action fits within the specified class of actions of 10 CFR 1021 dtd.: 1996

For categorically excluded actions I have determined that the proposed action meets the requirements of 10 CFR 1021.410(b).

■ Approved
☐ Approved w/ Comments
☐ Not Approved - Alternate NEPA Action Required: ______

[signature] 2/9/2000 Date

Andrew R. Grainger, NCO 5-1523
Engineering & Analysis Division

Page 2

ENVIRONMENTAL PERMITS CHECKLIST

C-PCP-E-00001, R10
ATTACHMENT E
PAGE E4 OF E6

EEC No. SW - E - 2000 - 001
Rev No. 0

General:

Does this activity involve any land disturbance which may potentially result in erosion or sedimentation? (If "yes", what is the approximate disturbance?) — ⦿ yes ○ no

☐ Less than 1/2 acre ☐ 1/2 acre to 2 acres ☒ 2 to 5 acres ☐ Greater than 5 acres

Will the proposed activity install, modify, or remove an (including tie-in to) Underground Storage Tank? — ○ yes ⦿ no

Will the proposed activity consist of a Renovation or Demolition to an existing building/structure? — ○ yes ⦿ no
(Please specify): ☐ Renovation ☐ Demolition

Is asbestos containing material present? ☐ yes ☒ no

*If "no", inspector signature and license number required:

Inspector Signature: Kenny Barrineau

License Number: 10-1155

Date: 1/17/2000

Will you import or manufacture a new chemical substance? — ○ yes ⦿ no

Will the proposed activity impact a Site Evaluation Area or RCRA/CERCLA Area or an associated 200 ft Buffer Zone? — ○ yes ⦿ no

Will the proposed activity involve construction or modification, or to a facility or process where the potential exists for a radioactive emission? — ○ yes ⦿ no

Air:

Will the proposed activity impact a non-radionuclide air emission source? (answer "yes" if any of the following are "yes") — ○ yes ⦿ no

- Will the project install or modify a piece of equipment which will emit, or have the potential to emit, an air emission?
- Will the project modify (including demolition) an existing permitted facility or process, which emits an air emission?
- Will the project modify (including demolition) an existing facility or process, not already permitted by SCDHEC, which emits, or has the potential to emit an air emission?
- Will the project be a demonstration (short term or long term) of a new technology which will emit an air emission?
- Will the project install or modify a piece of equipment that is used to sample or monitor air emissions?

Air emissions include regulated criteria pollutants (i.e., particulate matter, lead, nitrogen oxides, carbon monoxide, sulfur dioxide, volatile organic compounds (VOC's), etc.) and hazardous and toxic pollutants identified in SCDHEC R.61-62.5 Standard 8 and Section 112(b) of the Clean Air Act.

Examples of typical permitted equipment or process air emission sources include, but are not limited to the following:

- coal or fuel oil fired boilers
- diesel generators
- diesel powered equipment
- process feed chemical storage tanks
- fuel oil storage tanks
- waste combustion incinerators
- paint booths
- lead melters
- air strippers, etc.
- degreasing operations
- HVAC and chiller equipment

Groundwater:

Will the proposed activity: (See "HOW" Manual WSRC-IM-91-69 for permitting guidance)

Install a monitoring well or piezometer(s)?	⦿ yes ○ no
Involve subsurface penetration for a hydrogeological investigation, or characterization?	○ yes ⦿ no
Involve the injection of a fluid, gas, or air mixture into the subsurface?	○ yes ⦿ no
Involve the extraction of a fluid or air mixture from the subsurface?	○ yes ⦿ no

Wastewater:

Will the proposed activity install, construct, modify, or demolish: (See "HOW" Manual WSRC-IM-91-69 for permitting guidance)

A sanitary/industrial process wastewater treatment system?	○ yes ⦿ no
A sanitary/industrial process wastewater collection system?	○ yes ⦿ no
A pump station(s) to transfer sanitary/industrial waste?	○ yes ⦿ no
A septic tank/tile field system?	○ yes ⦿ no
A stormwater management system?	○ yes ⦿ no

Domestic Water:

Will the proposed activity install, construct, modify, or demolish:

A domestic water distribution/treatment system?	○ yes ⦿ no
A domestic or process water well?	○ yes ⦿ no

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ENVIRONMENTAL PERMITS
CHECKLIST (cont.)

EEC No. SW - E - 2000 - 001
C-DCP-E-00001, R10
ATTACHMENT E
Rev No. 0
PAGE E5 OF E6

Wastes:

Will the proposed activity install, construct, modify, demolish, or otherwise impact a RCRA permitted facility? ○ yes ⊙ no

Will the proposed activity generate a mixed waste? ○ yes ⊙ no

If yes: Does a wastestream with similar characteristics currently exist at SRS? (Consult with Facility Environmental Coordinator if assistance is needed) ☐ yes ☐ no

Will the proposed activity generate a hazardous waste? ○ yes ⊙ no

Will you be sending hazardous/mixed waste to other on-site Treatment/Storage/Disposal (TSD) facilities? ○ yes ⊙ no

Is the TSD permitted to accept this waste? ○ yes ○ no

(If "yes", provide the following)

- name of receiving facility: ______
- source used to confirm facility can accept waste: ______

Is this activity to take place at an existing TSD (including groundwater unit, vadose zone, process sewer, Carolina Bay, secondary containment system, etc.)? ○ yes ⊙ no

Would this activity impact an existing TSD (including changing or improving stormwater runoff/runon drainage, security, communications, electrical, etc.)? ○ yes ⊙ no

Does this activity involve Research and Development (R&D)? ○ yes ⊙ no

(If "yes", answer the following)

- Does it involve hazardous/mixed waste? ☐ yes ☐ no
- Does it treat more than 1,000 kg of hazardous waste? ☐ yes ☐ no
- Does it involve polychlorinated biphenyls (PCBs)? ☐ yes ☐ no
- Will this activity continue for more than 30 days? ☐ yes ☐ no
- Will more than 250kg of hazardous waste be introduced into treatment in a single day? ☐ yes ☐ no
- Does it treat more than 500kg of soil, water, or debris contaminated with acute hazardous or 1kg of acute hazardous waste? ☐ yes ☐ no
- Does it involve the placement of hazardous waste on the land or open burning of hazardous waste? ☐ yes ☐ no

Waste Identification, Generation and Management:

Will the proposed activity include the purchase of lead or lead components? (If "yes", complete OSR 29-6 for each item and submit with Checklist) ○ yes ⊙ no

Will the proposed activity disturb soil, sludge or water at or near a RCRA/CERCLA Unit or Site Evaluation Area? ○ yes ⊙ no

If "yes", were any listed wastes disposed of at this facility? (Consult with Facility EC if assistance is needed) ○ yes ○ no
If "yes", please contact EPD for guidance regarding the Investigation-Derived Waste Management Plan.

Does this activity result in a new liquid and/or solid waste generation (one-time or continuous), or a change in the quantity or the characteristic of an existing waste stream? If "yes" check all that apply: ○ yes ⊙ no

☐ TRU	☐ Hazardous	☐ TSCA (PCB)
☐ Mixed - Covered by LDR FFCA	☐ Suspect Hazardous	☐ Wastewater
☐ Low-Level	☐ Sanitary/Industrial	☐ Acute Hazardous
☐ High-Level	☐ Used/Waste Oil	☐ Other...(specify)

Where will waste be stored/disposed/treated? ______

Is the facility permitted to manage this waste? ○ yes ○ no

If "yes", complete the following items and submit with the Checklist

- ☐ Source utilized to confirm facility is permitted to accept the waste.
- ☐ Description of generated waste.
- ☐ Dates generation is to begin/end.
- ☐ Estimate of waste generation rate for each category.
- ☐ Description of activity/process generating waste.
- ☐ Description of waste reduction principles (reducing the volume, mass, or toxicity) for this activity.

Has the proposed activity been evaluated for waste minimization/pollution prevention? ⊙ yes ○ no

For Department EC use only:

J. R. Brookshire
1/13/2000
Date

Page 4

C-DCP-E-00001, R/0
ATTACHMENT E
PAGE E6 OF E6

Author: Mark Gober at SRCCC08
Date: 3/21/00 7:05 AM
Normal
TO: Don Sink at SRCCH08
Subject: Re[3]: Grading Permit
---------------------------------- Message Contents

FYI

__________ Forward Header __________
Subject: Re[3]: Grading Permit
Author: Pearce Atkins at SRCCA15
Date: 3/20/00 8:21 AM

I would like to have an "informal" review of the drawing prior to issuance of design. When design is issued a copy should be sent to Sharon Nicodemus, 2-2266, for inclusion in the area Stormwater PPP

__________ Reply Separator __________
Subject: Re[2]: Grading Permit
Author: Mark Gober at SRCCC08
Date: 3/20/00 8:07 AM

An Erosion Control Plan is not required, per Pearce, and any needed erosion control information will be included in the final design drawings.

Our task will be enveloped by the E Area Pollution Prevention Plan and this plan will be needed to be updated to include this design.

__________ Reply Separator __________
Subject: Re: Grading Permit
Author: Mark Fachada at SRCCC01
Date: 3/20/00 7:21 AM

Mark,

Does this include the Erosion Control Plan? Are we enveloped by the E-Area Plan?

__________ Reply Separator __________
Subject: Grading Permit
Author: Mark Gober at SRCCC08
Date: 3/17/00 08:25 AM

I talked with Pearce yesterday regarding the need for a grading permit for the Mega Trench Project and he stated the following:

A Grading Permit is not required for this project since this excavation is within the fence of E Area. He define this task as an industrial excavation and compared it to a land fill operation.

C-DCP-E-00001, R/0
ATTACHMENT F
PAGE F1 OF F3

Westinghouse
Savannah River Company
Aiken, SC 29808

BNFL

SOLID WASTE MANAGEMENT FACILITY

UNCLASSIFIED FACSIMILE TRANSMITTAL

FAX NUMBER: (803) 952-4405 **FAX LOCATION:** 724-7E

DATE: 3/16/00 **TIME:** 11:00Am

TO: M. GOBER

LOCATION: 705K

TELEPHONE NO: 7-3457 **FAX NO:** 7-3323

FROM: D. SINK

LOCATION: 724-15E

TELEPHONE NO: 2-4846

TOTAL NUMBER OF PAGES: 3 **(INCLUDING COVER SHEET)**

MESSAGE: THIS IS THE PUMP INFORMATION. FOR THE MEGA-TRENCH. CALL ME @ 2-4846 TO DISCUSS.

PLEASE CALL (803) 952- 4846 IF THERE IS ANY TROUBLE WITH THE RECEIPT OF THIS TRANSMITTAL.

SENT BY 11-11-99 ; 6:52 ; GORMAN RUPP PUMPS

Specification Data	Sec. 45	PAGE 1576 JANUARY 1997

Self Priming Centrifugal Pump

GORMAN-RUPP PUMPS

CERTIFIED PERFORMANCE CONTRACTORS PUMP BUREAU cpb

Diesel Engine-Driven

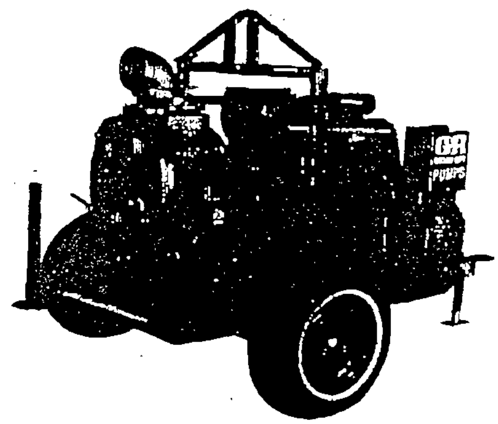
Model T6A3–F4L–A

Size 6" x 6"

C-DCP-E-00001, R10
ATTACHMENT F
PAGE F2 OF F3

70MT

Total Head		CAPACITY OF PUMP IN U.S. GALLONS PER MINUTE (GPM) AT CONTINUOUS PERFORMANCE				
P.S.I.	Feet					
58	130	340	340	340	340	340
45	106	585	820	1020	1020	1020
35	80	745	960	1120	1200	1200
25	60	800	1020	1200	1360	1500
17	40	830	1060	1265	1460	1610
Suction lift		25'	20'	15'	10'	5'



Do not use in explosive atmosphere or for pumping volatile flammable liquids.

PUMP SPECIFICATIONS

Size: 6" x 6" (152 mm x 152 mm) NPT – Female.
Casing: Gray Iron No. 30. Maximum Operating Pressure 84 psi (6 kg/cm^2).
Open Type, Two Vane Impeller: Ductile Iron No. 60-40-18. Handles 3" (76 mm) Diameter Spherical Solids.
Impeller Shaft: Stainless Steel No. 17-4 PH.
Intermediate Bracket: Gray Iron No. 30.
Replaceable Wear Plate: Steel No. 1020.
Removable Cover Plate: Gray Iron No. 30; 50 lbs. (23 kg).
Seal Plate: Gray Iron No. 30.
Seal: Mechanical, Oil-Lubricated, Floating, Self-Aligning. Tungsten Titanium Carbide Rotating and Stationary Faces; Stainless Steel No. 316 Stationary Seat; Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel No. 18-8 Cage and Spring. **Maximum Temperature** of Liquid Pumped 160°F (71°C).*

**Consult Factory for Applications with Liquids In Excess of Temperature Indicated.*
Shaft Sleeve: Alloy Steel No. 4130.
Flap Valve: Neoprene with Steel Reinforcing.
Radial Bearing: Open Ball.
Thrust Bearing: Open Double Ball.
Bearing Lubrication: Oil.
Flanges: Gray Iron No. 30.
Gaskets: Compressed Synthetic Fibers; Teflon.
O-Rings: Buna-N.
Hardware: Standard Plated Steel.

Standard Equipment: Hoisting Bail. Skid Base. 90° Discharge Elbow. Strainer. Oil Level Sight Gauge. Pressure Relief Valve: Brass. Liquid Level Controls: Submersible Transducer* and Electronic Pressure Switch (EPS) Control with Start/Stop Setpoint Adjustments for Automatic Watering/Dewatering.

**75 Ft. (23 m) Standard Length; Specify Length; 150 Ft. (46 m) Maximum at Time of Order.*

Optional Equipment: Wheel Truck Assembly with Two P235/75R15 Pneumatic Tires. Battery. Over-the-Road Trailer (Meets D.O.T. Requirements). Austempered Ductile Iron Impeller. Hardened Steel Wear Plate.

ENGINE SPECIFICATIONS

Model: Deutz F4L912.
Type: Four Cylinder, Four Cycle, Air Cooled Diesel.
Displacement: 230.1 Cu. In. (4 liter).
Governor: Mechanical.
Lubrication: Forced Circulation.
Air Cleaner: Oil Bath.
Oil Reservoir: 11.6 U.S. Qts. (11 liter) Dry; 10 U.S. Qts. (10 liter) Refill.
Fuel Tank: 38.9 U.S. Gals. (147 liter).
Operating Time, Full Load: 17.5 Hours.
Starter: 12 Volt Electric.

Standard Features: Low Oil Pressure and V-Belt Failure Safety Shut Down Switches. Instrument Panel with: Temperature Gauge, Oil Pressure Gauge, Ammeter, Hourmeter, Tachometer & Alternator Failure Light. Muffler with Guard and Weather Cap.

DEUTZ PUBLISHED PERFORMANCE:
Maximum Continuous B.H.P. 63 @ 2300 RPM
Maximum Dynamic B.H.P. 80 @ 2800 RPM

GORMAN-RUPP PUMPS

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

Specifications Subject to Change Without Notice

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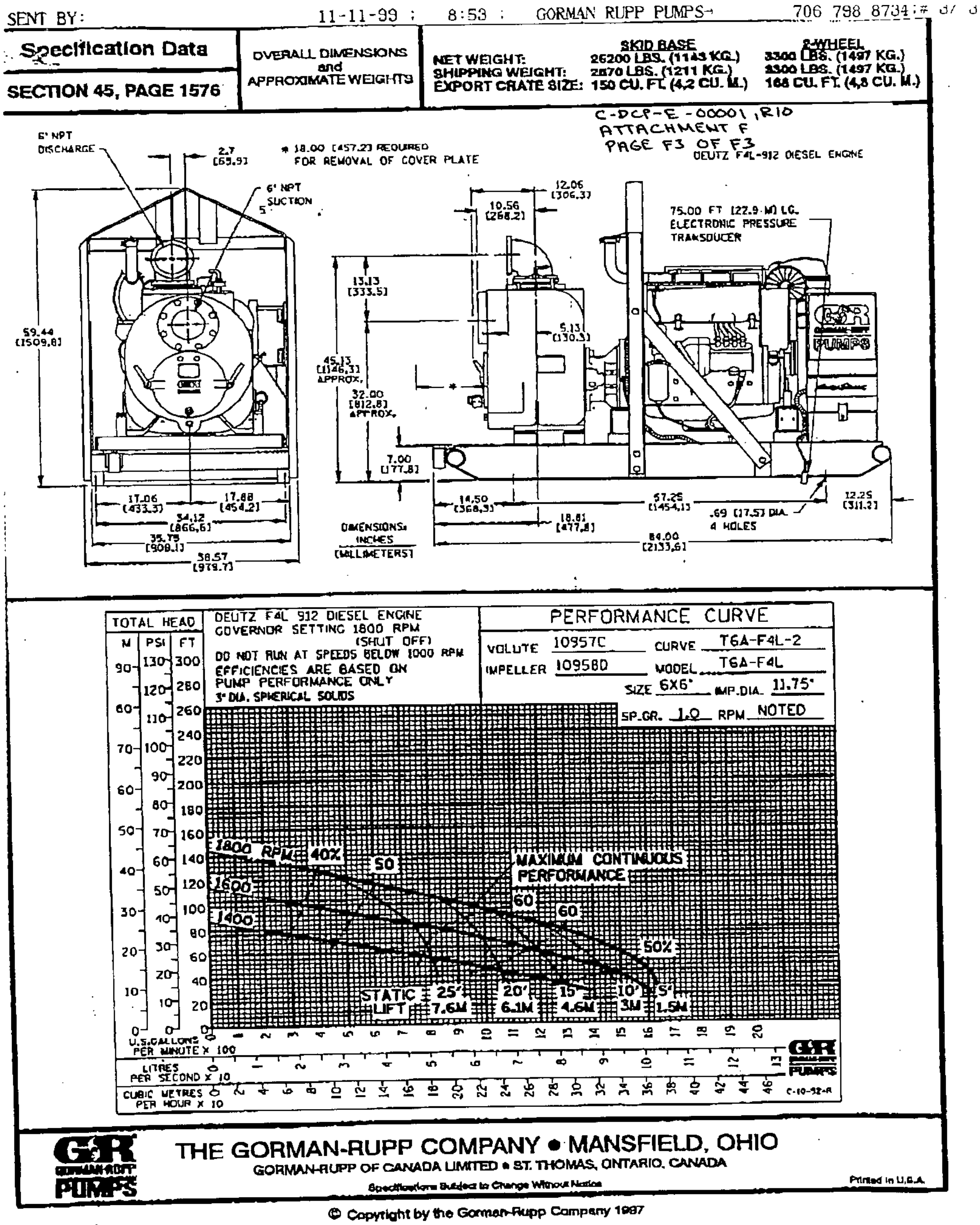

SENT BY: 11-11-99 ; 8:53 ; GORMAN RUPP PUMPS→ 706 798 8734
Specification Data
SECTION 45, PAGE 1576
OVERALL DIMENSIONS and APPROXIMATE WEIGHTS
SKID BASE
2-WHEEL
NET WEIGHT: 25200 LBS. (1143 KG.) 3300 LBS. (1497 KG.)
SHIPPING WEIGHT: 2670 LBS. (1211 KG.) 3300 LBS. (1497 KG.)
EXPORT CRATE SIZE: 150 CU. FT. (4.2 CU. M.) 168 CU. FT. (4.8 CU. M.)
C-DCP-E-00001, R10
ATTACHMENT F
PAGE F3 OF F3
DEUTZ F4L-912 DIESEL ENGINE
6" NPT DISCHARGE
* 18.00 [457.2] REQUIRED FOR REMOVAL OF COVER PLATE
6" NPT SUCTION
75.00 FT [22.9 M] LG. ELECTRONIC PRESSURE TRANSDUCER
DIMENSIONS: INCHES [MILLIMETERS]
.69 [17.5] DIA. 4 HOLES
DEUTZ F4L 912 DIESEL ENGINE
GOVERNOR SETTING 1800 RPM (SHUT OFF)
DO NOT RUN AT SPEEDS BELOW 1000 RPM
EFFICIENCIES ARE BASED ON PUMP PERFORMANCE ONLY
3" DIA. SPHERICAL SOLIDS
PERFORMANCE CURVE
VOLUTE 10957C CURVE T6A-F4L-2
IMPELLER 10958D MODEL T6A-F4L
SIZE 6X6" IMP.DIA. 11.75"
SP.GR. 1.0 RPM NOTED
TOTAL HEAD
M PSI FT
1800 RPM
1600
1400
MAXIMUM CONTINUOUS PERFORMANCE
STATIC LIFT
U.S.GALLONS PER MINUTE X 100
LITRES PER SECOND X 10
CUBIC METRES PER HOUR X 10
THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA
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OSR 19-246 (3-25-93)

Design Change Package Materials Sheet

DCP Number C-DCP-E-00001 Sheet 1 of 3 Sheet Revision 0

Description and Material Type	Unit of Measurement	Size	Qty	Procurement Responsibility (ENG/CONST)	Specification Number	Rev	Purchase Requisition Number	Purchase Requisition Item No.	Purchase Requisition Rev	Requested Delivery Date
PORTABLE GEN,:	EA.	N/A	1	CONSTRUCTION						
Made by Devilbiss										
Air Power Co., Ltd,										
Model #EXGB4000,										
Grainger Stock No.										
3MK72, a brushless										
generator, 120/240V,										
ckt brkr protection w/ *										
2 recep (NEMA 6-20R)										
a Briggs & Stratton										
gas engine, recoil start										
8Hp engine, rated										
4000 Watts, 7-gal tank										
or Engineering										
approved equal										
* MUST BE										
GFI PROTECTED FOR OUTSIDE USE.										

OSR 19-246 (3-25-93)

Design Change Package Materials Sheet

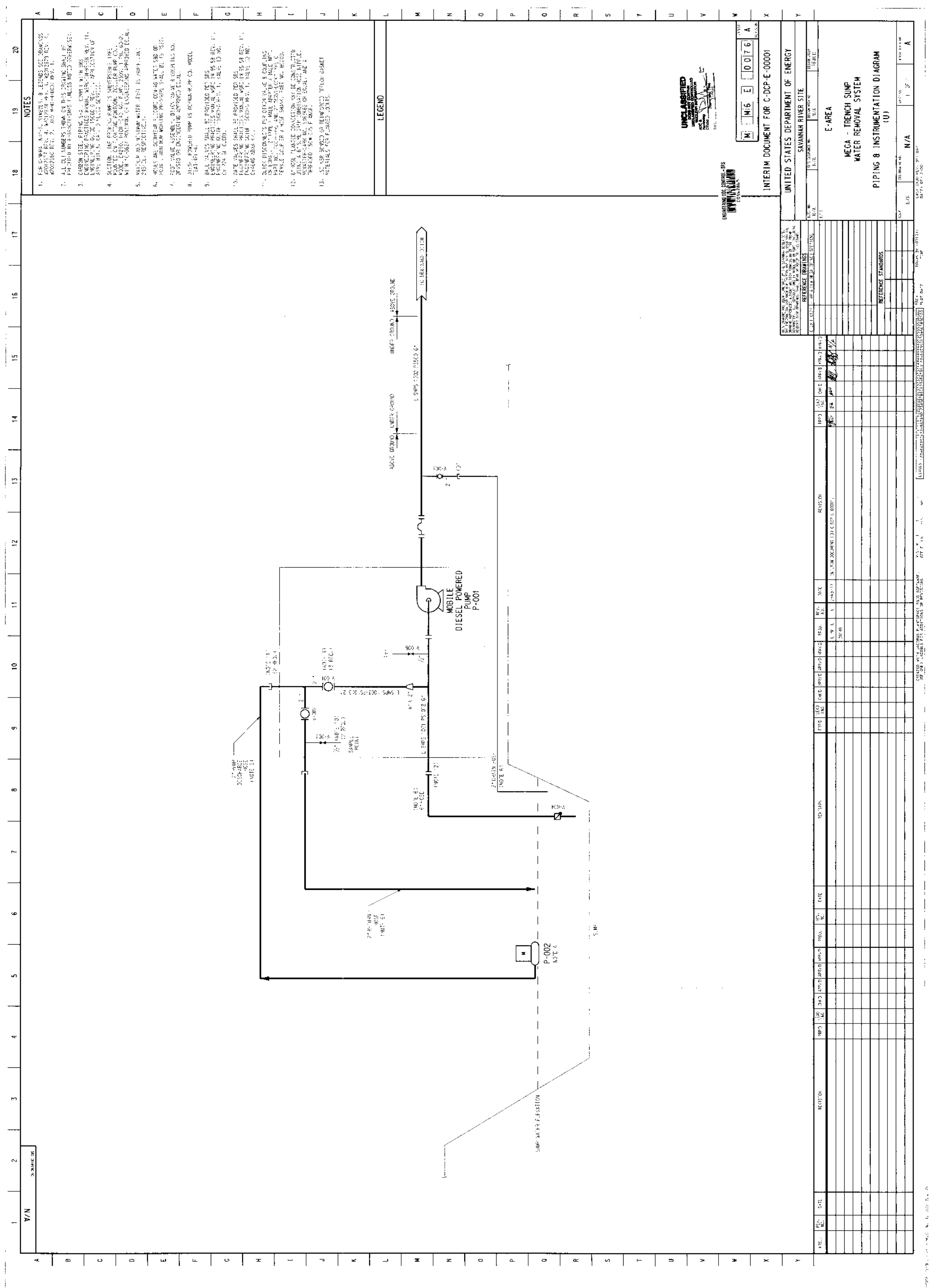
DCP Number C-DCP-E-00001 Sheet 2 of 3 Sheet Revision 0

Description and Material Type	Unit of Measurement	Size	Qty	Procurement Responsibility (ENG/CONST)	Specification Number	Rev	Purchase Requisition			Requested Delivery Date
							Number	Item No.	Rev	
ELECTRIC PLUG:	EA.	N/A	1	CONSTRUCTION						
type NEMA 6-20P,										
20A, 250V, to match										
the generator outlet										
receptacle, to be used										
the primer pump										
extension cord, plug										
in a weatherproofing										
seal-tite cover for										
insulgrip:										
Plug is a Hubbell										
Cat. #5466-C &										
Seal-tite cover,										
Cat. No. 6017 or										
Construction approved										
equal.										

Design Change Package Materials Sheet

DCP Number C-DCP-E-00001 Sheet 3 of 3 Sheet Revision 0

Description and Material Type	Unit of measurement	Size	Qty	Procurement Responsibility (ENG/CONST)	Specification Number	Rev	Purchase Requisition Number	Purchase Requisition Item No.	Purchase Requisition Rev	Requested Delivery Date
Ball Valve ID No. CV224BL CJCBX	Each	2"	3	CONST						
Gate Valve ID No. CV464G ABAA X/L	Each	½"	2	CONST						
Quick disconnect, hose coupling, Type F male adapter x male NPT Dixon Valve & Coupling No. 200-F-BR or equal	Each	2"	2	CONST						
Quick disconnect, hose coupling, Type C Cam & Groove coupler, Dixon Valve & Coupling No. BC200 or equal	Each	2"	2	CONST						
Combination Hose Nipple No. 5363K62 McMaster-Carr Supply Co. or equal.	Each	6"	2	CONST						
Threaded Type Flange, 150# RF, C/S	Each	6"	1	CONST						
Foot Valve assembly, Dixon Valve & Coupling No. DFVS60 or equal	Each	6"	1	CONST						
Submersible pump, Zoeller Pump Co. High Head Agricultural Pump Model No. E4290 or engineering approved equal	Each	N/A	1	CONST						
2" Discharge AG. Pontoon, Zoeller Pump Co. No. 10-0624 or engineering approved equal	Each	N/A	1	CONST						


NOTES
LEGEND
UNCLASSIFIED
INTERIM DOCUMENT FOR C-DCP-E-00001
UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
E-AREA
MEGA - TRENCH SUMP
WATER REMOVAL SYSTEM
PIPING & INSTRUMENTATION DIAGRAM
(U)
N/A
REFERENCE DRAWINGS
REFERENCE STANDARDS
MOBILE
DIESEL POWERED
PUMP
P-001
P-002

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Piping Specification PS-101 (A,B,C,D)	GUIDE NO: 15060 DATE: 3/3/97 Revision:2 ESB TECH COMMITTEE: Piping and Valves

Design Parameters

P-Spec.	PS-101(A, B, C, D)						
Design Pressure (psig)	285	260	230	200	170	140	125
Design Temperature (^{o} F)	100	200	300	400	500	600	650
Minimum Temperature (^{o} F)	-20	-20	-20	-20	-20	-20	-20
Minimum Test Pressure (psig)	430	390	345	300	270	245	225

Calculation Reference:	M-CLC-G-00231
Code of Reference:	B31.3 1994 Addenda
Fluid Service:	Normal
Material:	Carbon Steel
Pressure Rating:	Class 150

General Notes:

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PAGE 2 OF 6

1. This piping specification provides the required information to meet the pressure design requirements of the ASME B31.3 piping code. Additional requirements include, but are not limited to, support design, thermal expansion, material selection, examination, and testing. These additional requirements are addressed in ASME B31.3 and Engineering Guide 15060.
2. This piping specification was developed to address the requirements of ASME B31.3 Normal Fluid Service. This specification may be used for Category D fluid services without restrictions. For Category M fluid services, and piping systems subjected to severe cyclic conditions, additional restrictions apply. These additional restrictions shall be addressed by Engineering.
3. Selection of the different options provided in this piping specification (i.e., socket-weld vs. buttweld fittings, slip-on vs. weldneck flanges, etc.) will affect the stress levels in the piping system. Components in an existing piping system shall be replaced in kind. If components are changed in an existing piping system, these changes shall be addressed by Engineering. For new piping system design, specific requirements for options shall be specified on the design drawings.
4. To address the fluid service requirement of a piping system, a corrosion allowance will need to be determined to select the required wall thickness. The fluid service requirements will also affect the selection of materials such as gaskets, valve seats and packing, etc.. The corrosion allowance shall be specified by the letter suffix in the piping specification identification (e.g., PS-101A)
5. Galvanized piping is acceptable where required for external corrosion protection.
6. The minimum test pressures to meet the hydrostatic test limits of ASME B31.3 are provided in the Design Parameters table above for the listed design pressures and temperatures. Actual system design pressures should be used to establish hydrostatic test pressures for testing. These test pressures are the minimum pressure requirements to be achieved throughout the entire piping system, adjustments may be required to account for elevation changes in the piping system. The maximum test pressure provided in the schedule tables below represent the pressure where the piping will reach its yield stress. These pressures shall not be exceeded at any location in the piping system. Valves, instruments, fittings and other components may have additional pressure limitations and may require isolation from the test pressure.
7. 3D bends are permitted for pipe sizes NPS 1/2 through 6.
8. Branch Connections shall be made with Tees for full size and one size smaller branches, and for all run sizes NPS 2 and smaller. Welded branch connections are otherwise permitted, and shall be reinforced if required as shown in the reinforcement table below.
9. Piping components not provided in this piping specification can be selected from the standards listed in Table 326.1 of ASME B31.3. Components used in piping systems that are not listed in this table are considered unlisted by the Code and require additional qualification.
10. The minimum design temperature may be limited by the need for impact testing of material and the qualification of the welding procedure. The temperature limits of the bolting material may also control the minimum design temperature.
11. Components of higher pressure ratings (e.g., thicker pipe or higher rated fittings and flanges) may be used in this specification without additional analysis. All changes shall be documented on design drawings.

Joints

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Joint	Size	Component
Runs-Not allowed in PS-101D	1/4 - 4	Threaded Fittings
Runs-Not allowed in PS-101D	1/4 - 2	Socket-Weld Fittings
Runs	1/4 - 24	Buttweld
Maintenance	1/4 - 24	Class 150 Flanges
Fit-up to Flanged Components	1/4 - 24	Class 150 Flanges
Fit-up to Threaded Components	1/4 - 6	Threaded piping per threaded Sch. Tables

Piping

Allowable Materials

Component	Size	Rating	Standard	Material	Material Grade	Additional Requirements
Piping	1/4 - 24	Sch. Tables	ANSI B36.10	ASTM A53	Grade B	Welded/Seamless
Piping	1/4 - 24	Sch. Tables	ANSI B36.10	ASTM A106	Grade B	Seamless

Required Pipe Schedules for Non-Threaded Pipe:

P-SPEC	Corrision Allowance	Pipe Size	1/4	1/2	3/4	1	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16
A	0.00	Sch/ Thick	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
B	1/32	Sch/ Thick	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
C	1/16	Sch/ Thick	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
D	1/8	Sch/ Thick	-	XXS	160	160	160	80	80	80	STD	STD	STD	STD	STD	STD	STD
	Maximum Test Pressure (psig)		7365	5750	4705	4405	3275	2765	3020	2625	2230	1780	1565	1420	1560	1420	1240

Required Pipe Schedules for Threaded Pipe:

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P-SPEC	Corrision Allowance	Pipe Size	1/4	1/2	3/4	1	1 1/2	2	2 1/2	3	4	6
A	0.00	Sch/ Thick	80	80	80	80	80	STD	STD	STD	STD	STD
B	1/32	Sch/ Thick	80	80	80	80	80	STD	STD	STD	STD	STD
C	1/16	Sch/ Thick	-	80	80	80	80	80	80	80	STD	STD
D	1/8	Sch/ Thick	-	XXS	160	160	160	160	160	80	80	80
	Maximum Test Pressure (psig)		7210	5430	4670	4155	3450	1670	1640	1540	1445	1325

Fittings

Component	Size	Rating	Standard	Material	Material Grade	Additional Requirements
Threaded Fittings	1/4 - 4	2000#	ANSI B16.11	ASTM A105	WPB	Not allowed in PS-101D
Socket Weld Fittings	1/4 - 2	3000#	ANSI B16.11	ASTM A105	WPB	Not allowed in PS-101D
Buttweld Fittings	1/4 - 24	Sch. Tables	ANSI B16.9	ASTM A234	WPB	
Buttweld Fittings	1/4 - 24	Sch. Tables	ANSI B16.28	ASTM A234	WPB	

Flanges

Component	Size	Rating	Standard	Material	Material Grade	Additional Requirements
Threaded Flanges	1/2 - 6	Class 150	ANSI B16.5	ASTM A105	N/A	Not allowed in PS-101D
Socket-Weld Flange	1/2 - 2	Class 150	ANSI B16.5	ASTM A105	N/A	Not allowed in PS-101D
Weldneck Flange	1/2 - 24	Class 150	ANSI B16.5	ASTM A105	N/A	
Slip-On Flange	1/2 - 24	Class 150	ANSI B16.5	ASTM A105	N/A	
Blind Flange	1/2 - 24	Class 150	ANSI B16.5	ASTM A105	N/A	
Backup Flange	1/2 - 24	Class 150	ANSI B16.5	ASTM A105	N/A	

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Mechanical Fasteners

Component	Size	Standard	Material	Material Grade	Additional Requirements
Bolts/Studs	1/2 - 1 1/4	ANSI B18.2.1	ASTM A193	B7-HH	With 2H nuts only
Bolts/Studs	1/2 - 1 1/4	ANSI B18.2.1	ASTM A307	Grade B-HH	With A563 nuts only. Limited-20°F to 300°F
Nuts	1/2 - 1 1/4	ANSI B18.2.2	ASTM A194	2H-HH	
Nuts	1/2 - 1 1/4	ANSI B18.2.2	ASTM A563	Grade A-HH	

Welded Branches

Branch welds in the following table must be reinforced.

Branch Angle	Corrosion Allow. = 0.00		Corrosion Allow. = 1/32		Corrosion Allow. = 1/16		Corrosion Allow. = 1/8	
	Run NPS	Branch NPS	Run NPS	Branch NPS	Run NPS	Branch NPS	Run NPS	Branch NPS
90°	24	3/4, 1 1/2 - 24	20	3/4, 1 1/2, 2, 12-20	18	1/4 - 2, 3 - 18	14	2, 4 - 14
			24	1/4 - 24	20	1/4 - 20	16	2 - 16
					24	1/4 - 24	18	3/4 - 18
							20	3/4 - 20
							24	3/4 - 24
75°	24	3/4 - 24	20	3/4, 1 1/2, 2, 6-20	18	1/4 - 18	14	2, 4 - 14
			24	1/4 - 24	20	1/4 - 20	16	2 - 16
					24	1/4 - 24	18	3/4 - 18
							20	3/4 - 20
							24	3/4 - 24
	18	18	18	18	16	1/4, 3/4, 16	12	4-12
	20	18-20	20	1/2-20	18	1/4 - 18	14	2, 4 - 14
	24	3/4 - 24	24	1/4 - 24	20	1/4 - 20	16	3/4, 2 - 16

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60°					24	1/4 - 24	18	3/4 - 18
							20	3/4 - 20
							24	3/4 - 24
45°	14	14	12	12	10	10	4	4
	16	14 - 16	14	12 - 14	12	12	6	6
	18	16 - 18	16	14 - 16	14	12 - 14	8	8
	20	2, 6 - 20	18	1/2 - 2, 3 - 18	16	1/4 - 16	10	8 - 10
	24	1/2 - 24	20	1/4 - 20	18	1/4 - 18	12	2, 4 - 12
			24	1/4 - 24	20	1/4 - 20	14	2, - 14
					24	1/4 - 24	16	3/4 - 16
							18	3/4 - 18
							20	3/4 - 20
							24	3/4 - 24

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Piping Specification PS-500	GUIDE NO: 15060 DATE: 3/3/97 Revision: 1 ESB TECH COMMITTEE: Piping and Valves

Design Parameters

P-Spec.	PS-500
Design Pressure (psig)	150
Design Temperature (^{o} F)	100
Minimum Temperature (^{o} F)	0
Minimum Test Pressure (psig)	225

Calculation Reference:	M-CLC-G-00231
Code of Reference:	B31.3 1994 Addenda
Fluid Service:	Normal
Material:	PVC
Pressure Rating:	150 psi

General Notes:

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1. This piping specification provides the required information to meet the pressure design requirements of the ASME B31.3 piping code. Additional requirements include, but are not limited to, support design, thermal expansion, material selection, examination, and testing. These additional requirements are addressed in ASME B31.3 and Engineering Guide 15060.
2. This piping specification was developed to address the requirements of ASME B31.3 Normal Fluid Service. This specification may be used for Category D fluid services without restrictions. For Category M fluid service piping systems additional restrictions apply. These additional restrictions shall be addressed by Engineering.
3. Selection of the different options provided in this piping specification (i.e., socket-weld vs. buttweld fittings, slip-on vs. weldneck flanges, etc.) will affect the stress levels in the piping system. Components in an existing piping system shall be replaced in kind. If components are changed in an existing piping system, these changes shall be addressed by Engineering. For new piping system design, specific requirements for options shall be specified on the design drawings.
4. The minimum test pressure to meet the hydrostatic test limit of ASME B31.3 is provided in the Design Parameters table above for the listed design pressure and temperature. Actual system design pressures should be used to establish hydrostatic test pressures for testing. This test pressure is the minimum pressure to be achieved throughout the entire piping system, adjustments may be required to account for elevation changes in the piping system. The maximum test pressure provided in the schedule tables below shall not be exceeded at any location in the piping system. Valves, instruments, fittings and other components may have additional pressure limitations and may require isolation from the test pressure.
5. Bends are not permitted for this piping specification.
6. Piping components not provided in this piping specification can be selected from the standards listed in Table A326.1 of ASME B31.3. Components used in piping systems that are not listed in this table are considered unlisted by the Code and require additional qualification.
7. PVC piping in all Fluid Service except Category D shall be safeguarded per ASME B31.3.
8. Components of higher pressure ratings (e.g., thicker pipe or higher rated fittings and flanges) may be used in this specification without additional analysis. All changes shall be documented on design drawings.
9. Ultraviolet inhibitor shall be specified if piping is to be used above Ground.

Joints

Joint	Size	Component
Runs	1/4 - 6	Threaded Fittings
Runs	1/4 - 8	Solvent Welded Fittings
Maintenance	1/4 - 8	Class 150 Flanges/Sch. 80 PVC Flanges
Fit-up to Flanged Components	1/2 - 8	Class 150 Flanges/SCH. 80 PVC Flanges
Fit-up to Threaded Components	1/4 - 6	Threaded piping per threaded Sch. Tables
Fit-up to Solvent Welded Components	1/4 - 8	Solvent Welded Fittings

Piping

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Allowable Materials

Component	Size	Rating	Standard	Material	Material Grade	Additional Requirements
Piping	1/4 - 8	Sch. Tables	ASTM D1785	ASTM D1784	12454-B	Note 9
Piping	1/4 - 8	Sch. Tables	ASTM D1785	ASTM D1784	12454-C	Note 9

Required Pipe Schedules for Non-Threaded Pipe:

Corrision Allowance	Pipe Size	1/4	1/2	3/4	1	1 1/2	2	2 1/2	3	4	6	8
0.00	Sch/ Thick	40	40	40	40	40	40	40	40	40	80	80
	Maximum Test Pressure (psig)	250	250	250	250	250	250	250	250	250	250	

Required Pipe Schedules for Threaded Pipe:

Corrision Allowance	Pipe Size	1/4	1/2	3/4	1	1 1/2	2	2 1/2	3	4	6
0.00	Sch/ Thick	80	80	80	80	80	80	80	80	80	80
Maximum Test Pressure (psig)		250	250	250	250	250	250	250	250	250	250

Fittings

Component	Size	Rating	Standard	Material	Material Grade	Additional Requirements
Solvent Welded Fittings	1/4 - 4	40	ASTM D2466	ASTM D1784	12454-B, 12454-C	
Solvent Welded Fittings	1/4 - 8	80	ASTM D2467	ASTM D1784	12454-B, 12454-C	
Threaded Fittings	1/4 - 6	80	ASTM D2464	ASTM D1784	12454-B, 12454-C	

Flanges

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Component	Size	Rating	Standard	Material	Material Grade	Additional Requirements
Threaded Flange	1/2 - 8	Class 150	ANSI B16.5	ASTM A105	N/A	
Threaded Flange	1/2 - 8	Class 150	ANSI B16.5	ASTM A182	304L/316L	
Solvent Welded Flange	1/2 - 8	Sch. 80	Manufacturers	ASTM D1784	12454-B, 12454-C	

Mechanical Fasteners

Component	Size	Standard	Material	Material Grade	Additional Requirements
Bolts/Studs	1/2 - 3/4	ANSI B18.2.1	ASTM A307	Grade A	
Nuts	1/2 - 3/4	ANSI B18.2.2	ASTM A563	Grade B	

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Appendix D
Valve Selection Guide

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Example Valve ID Number

V 1 0 1 GW - # - A B C D E
1 2 3 4 5 6 7 8 9 10 11

1. Accetable Standards - SRS Valve
2. Basic Material (Body Material)
3. Pressure Class
4. Type of End Connection
5. Type of Valve
6. Valve Size
7. Disc or Ball Material (optional)
8. Seat Material (optional)
9. Stem Material (optional)
10. Packing Material (optional)
11. Body Gasket Material (optional)

Notes:

1. ASTM A216 WCB or A105
2. CF3, CF8, F304, or F304L
3. CF3M, CF8M, F316, or F316L
4. Use only in copper piping systems
5. Includes Swagelok and Parker tube fittings
6. Includes NBR and Buna-N
7. Use only non-asbestos
8. Non welded end stainless steel valves pressure rating is based on the high carbon (non L) grade.
9. Specify port requirement.

Required Specification Features

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PAGE 2 OF 3

1) Acceptable Standards	2) Basic Material	3) Pressure Class	4) End Connection	5) Type of Valve
CV Code Valve	1 - Brass	1 - 125	1 - Flanged	BL Ball
NV Non Code Valve	2 - Brass	1 - 150	2 - Socket Weld	BT Butterfly
	3 - Iron (Cast/Ductile)	2 - 200	3 - Butt weld	CB Ball Check
	4 - Carbon Steel (1)	3 - 300	4 - Threaded	CF Folding Disc Check
	5 - Stainless Steel 304/403L (2)	4 - 400	5 - Wafer	CL Tilting Disc Check
	6 - Stainless Steel 316/316L (3)	6 - 600	6 - Solder (4)	CP Poppet Check
	7 - Monel	8 - 800	7 - Flare	CS Swing Check
	8 - Alloy 20	9 - 900	8 - Mechanical	CT Tilting Disc Check
	9 - Hastelloy	P - Pressure Rated	9 - Compression (5)	DV Diaphragm
	E Engineered Procurement		E Engineered Procurement	GF FlexWedge/Split Disc Gate
				GK Knife Gate
				GP Parallel Gate
				GW Solid Wedge Gate
				PI Pinch
				PV Plug
				SC Stop Check
				TA Angle Globe
				TN Needle Globe
				TS Standard Globe
				TY Y Pattern Globe
				V3 Three Way Valve (9)

Optional Specification Features

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7) Disc Material	8) Seat Material	9) Stem Material	10) Packing Material	11) Body Gasket
Chromium (11-13%)	A-Chromium (11-13%)	Chromium (11-13%)	A Graphite	A Graphite
B Stellite (Hard Face)	B Stellite (Hard Face)	B Carbon Steel	B Teflon	B Teflon
C Bronze	C Bronze	C Bronze	C Natural Rubber	C Natural Rubber
D Stainless Steel	D Stainless Steel	D Stainless Steel	D Nylon	D Nylon
E Monel	E Monel	E Monel	E Nitrile (6)	E Nitrile (6)
Alloy 20	F-Alloy 20	Alloy 20	F Neoprene	F Neoprene
G Hastelloy	G Hastelloy	G Hastelloy	G Viton	G Viton
H Brass	H Brass	H Brass	H EPDM	H EPDM)
I Nickle Copper	I Nickel Copper	I Nickel Copper	S Special (Specify)	I Ferrous
J Teflon	J Teflon	S Special (Specify)	X No Specific Requirements (7)	J Non-Ferrous
K Natural Rubber	K Natural Rubber	X No Specific Requirements (7)		K Spiral Wound w/Teflon
L Nylon	L Nylon			L Spiral Wound w/ Graphite
M Nitrile (6)	M Nitrile (6)			S Special (Specify)
N Neoprene	N Neoprene			X No Specific Requirements (7)
O Viton	O Viton			
P EPDM	P EPDM			
Q Vespel	Q Vespel			
S Special (Specify)	R UHMWPE			
X No Specific Requirements (7)	S Special (Specify)			
	X No Specific Requirements (7)			

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SRS Engineering Standards Manual	Manual: WSRC-TM-95-1
SAFETY • RESPONSIBILITY • SECURITY SRS SAVANNAH RIVER SITE	ENGINEERING STANDARD
CIVIL SITE DESIGN CRITERIA	STANDARD NO: 01110 DATE: 4/11/00 REVISION: 3 ESB TECH COMMITTEE: Civil / Structural

REVISION HISTORY

REV	DATE	DESCRIPTION OF REVISION
0	8/1/95	Initial Issue
1	10/1/96	Reference to DOE Order 6430.1A removed. Included DOE Order 420.1 and reference to DOE-STD-1021 and Engineering Guide No. 02224-G. Also editorial changes.
2	6/18/98	Added Rainfall Intensity Curves for 50-, 500-, 2,000-, 10,000-, and 100,000-, Year Return Periods, inserted Table 1, removed codes and standards dates, included CLSM requirements.
3	4/11/00	Removed references to Standard Building Code (SBC), clarified use of return period rainfall events and updated values given in Table 1, provided guidance on flooding, removed reference to WSRC-IM-93-28 and added reference to DOE/SR-5000-29, removed detailed requirements for clay caps in section 5.4 , associated paragraph 3.1.6 standards, and replaced with reference to Eng. Guide 02224-G.

1.0 PURPOSE AND SCOPE

1.1 This document delineates the site-specific civil design criteria to be used for all new facilities and modifications to existing facilities at the Savannah River Site when invoked by the Design Authority (Reference 6.1), and meets the criteria stipulated in DOE Order 420.1 (see Section 2.1).

This document applies to all functional classifications (Reference 6.2) of structures, systems and components.

1.2 All changes, deviations, additions and deletions shall be approved by the ESB.

2.0 DOE ORDER AND STANDARDS APPLICABILITY

2.1 DOE Order No. 420.1, *Facility Safety*

2.2 DOE Guide 420.1-Y, Interim Guidelines for the Mitigation of Natural Phenomena Hazards for Doe

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Nuclear Facilities and Non-Nuclear Facilities

3.0 NATIONAL CODES AND STANDARDS APPLICABILITY

3.1 General

3.1.1 Applicability of the code and standards given in this document is limited to the extent of the reference in the text.

3.1.2 National codes and standards incorporated by reference in this document shall be the revision number/date at the time this document is invoked in the Design Output Documents, or as otherwise noted.

3.1.3 In case of conflict between various codes, standards, regulations and specifications, the more restrictive requirement shall apply. Conflict between codes, standards, regulations and specifications and these standards shall be brought to ESB for resolution.

3.1.4 Civil design shall be in accordance with DOE-STD-1020 and the UBC for PC-1 through PC-4 SSCs.

3.1.5 Since Performance Category PC-0 (Reference 6.15) applies only to lightweight equipment items, furniture, etc., no guidance is provided within this document.

3.2 Codes, Standards and Regulations

3.2.1 DOE Standard 1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*

3.2.2 *Uniform Building Code*, International Conference of Building Officials, Whittier, California

3.2.3 DOE STD-1021-93, *Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems and Components*

3.2.4 Regulation 72-300, *Standards for Stormwater Management and Sediment Control,* South Carolina Department of Health and Environmental Control (SCDHEC).

4.0 DEFINITIONS

4.1 ASTM - American Society for Testing and Materials

4.2 CLSM - Controlled Low Strength Material (Reference 6.3)

4.3 DA - Design Authority (Reference 6.1)

4.4 DBFL - Design Basis Flood

4.5 DOE - Department of Energy

4.6 PE&CD - Projects, Engineering and Construction Division at SRS

4.7 ESB - Engineering Standards Board at SRS

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4.8 Functional Classifications - As defined in Reference 6.2

4.9 PC -1 through PC-4 - Performance Categories 1 through 4 (see Section 3.1.4)

4.10 SCDHEC - South Carolina Department of Health and Environmental Control

4.11 SRS - Savannah River Site

4.12 SSC - Structures, Systems, and Components

4.13 UBC - Uniform Building Code

4.14 WSRC - Westinghouse Savannah River Company

5.0 REQUIREMENTS

5.1 General

5.1.1 The responsibility for all design functions including the production of engineering drawings, procurement and project specifications and documents lies with PE&CD and/or designated engineering service subcontractors. The appropriate individual representing these entities is referred to herein as the "Engineer."

5.1.2 The responsibility for all construction activities including the installation of vendor supplied and field procured items lies with PE&CD and/or selected subcontractors. The appropriate individual representing these entities is referred herein as the "Constructor."

5.2 Site Work

5.2.1 Clearing and grubbing of all stumps and roots greater than 1 1/2 in. in diameter shall be done to a recommended depth of not less than 18 in. below rough grade or natural ground surface.

5.2.2 All timber, logs, stumps, roots, brush, rubble, excess topsoil and other trash (collectively called inert waste) shall be disposed of by the Constructor in accordance with Reference 6.4.

5.3 Excavation, Backfill and Site Grading

5.3.1 Excavation, Backfill and Site Grading shall be performed in accordance with Engineering Guide No. 02224-G (Reference 6.12).

5.4 Low Permeability Soil Layer

5.4.1 Low permeability soil layer placement shall be performed in accordance with Engineering Guide No. 02224-G (Reference 6.12)

5.5 Foundations

5.5.1 The frost penetration depth at SRS is 5 in. below the finished grade. As a minimum, foundations of buildings shall be designed to meet the requirements of UBC.

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5.6 Construction in Security Area

5.6.1 Location of buildings, poles, parking stalls, driving lanes, and any other features that may interfere with security systems within 20 ft of a DOE security area shall be coordinated with WSRC Safeguards and Security Department.

5.7 Stormwater Management and Sediment Control

5.7.1 Stormwater management and sedimentation control at SRS shall be in accordance with Section 3.2.4 and References 6.5 through 6.8.

5.7.2 Land disturbing activity categories, plan approval and permit requirements for SRS have been stipulated in References 6.8 through 6.11.

5.7.3 Facility drainage systems shall be designed, as a minimum, per the requirements of South Carolina Regulation 72-300, Standards for Stormwater Management and Sediment Reduction Regulation and SCDHEC Permit No. SCR100000 (Ref. 6.11). The South Carolina Stormwater Management and Sedimentation Control Handbook for Land Disturbance Activities (Ref 6.5) provides supporting information and guidance on the development of permitting documentation. Appendix G of the handbook provides the 24 hour storm event data for 1, 2, 5, 10, 25, 50, and 100 year return periods.

5.7.4 The required function of individual SSCs shall not be adversely impacted by the Design Basis Flood (DBFL) level resulting from the rainfall intensity at the return period applicable to the SSC. This flooding can be caused either by inadequate local storm water system and run off or can be due to back up in the site drainage basins (e.g. Upper Three Runs basin, etc.) and watersheds.

In addition to 5.7.3, potential for local area flooding shall be determined using the 24-hour storm event data appropriate for the SSC's Performance Category if the local accumulation is greater than that required by Section 5.7.3. If the results of this analysis, using the existing storm water management system or one designed in accordance with 5.7.3, demonstrate that flooding does not compromise the site SSCs, then it may be concluded that the facility stormwater management system is adequate. Note that local flooding in streets, parking lots, etc. may occur due to the DBFL precipitation. If flooding does have an unacceptable impact, then the design must be modified to:

increase drainage capacity to reduce the flooding to an acceptable level,
move the impacted SSCs out of the flood zone, and/or
provide local flood protection for the SSCs.

SRS Rainfall Accumulation values (Ref. 6.13) for 500 (PC-1), 2000 (PC-2), 10,000 (PC-3), and 100,000 (PC-4) year return periods are provided in Table 1

The flooding hazards in SRS areas resulting from non-local events; i.e., back up in the site drainage basins and watersheds, may be obtained from the report "Flood Hazard Recurrence Frequencies for C-, F-, E-, S-, H-, Y- and Z-Areas (U) (Ref 6.14).

5.7.5 R-Factors used in the Universal Soil Loss Equation for computation of storage shall be taken as follows (See Appendix G, Reference 6.5):

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Aiken County 250

Barnwell County 275

5.8 Sanitary Landfill and Industrial Solid Waste Disposal

5.8.1 For the design of the sanitary landfill and industrial solid waste disposal at SRS refer to the applicable local, state and federal regulations, and for permitting process, see Sections 1.10 and 2.10 of Reference 6.9.

5.9 Controlled Low Strength Material (CLSM)

5.9.1 The delivery and supply of materials for CLSM are provided in SRS Procurement Specification C-SPS-G-00085, Furnishing and Delivery of Concrete. (Reference 6.3) Placement and installation testing requirements are provided in SRS Engineering Guide 02224-G, Excavation, Backfill and Site Grading. (Reference 6.12)

6.0 REFERENCES

6.1 SRS Procedure No. 1.10, Design Authority, Procedure Manual E7, Conduct of Engineering and Technical Support.

6.2 SRS Procedure No. 2.25, Functional Classifications, Procedure Manual E7, Conduct of Engineering and Technical Support.

6.3 SRS Procurement Specification No. C-SPS-G-00085, Furnishing and Delivery of Concrete.

6.4 SRS Procedure No. CMP-05-1.2, Procedure for the Disposal of Inert Construction Waste.

6.5 South Carolina Stormwater Management and Sedimentation Control Handbook for Land Disturbance Activities, SCDHEC.

6.6 South Carolina Stormwater Management and Sediment Control Sedimentology Resource, SCDHEC.

6.7 Soil Survey of Savannah River Plant Area, Parts of Aiken, Barnwell, and Allendale Counties, South Carolina, Soil Conservation Service, US Department of Agriculture.

6.8 WSRC Environmental Compliance (ECM) Manual 3Q, Procedure ECM 12.2, Stormwater Management and Sediment Reduction.

6.9 Manual No. WSRC-IM-91-69, SRS Environmental Permitting, "HOW" Manual, Sections 1.9 and 1.13.

6.10 DOE/SR-5000-29, Handbook for Erosion and Sediment Control on the Savannah River Site.

6.11 Permit No. SCR100000 - SCDHEC NPDES General Permit for Stormwater Discharge from Construction Activities that are Classified as "Associated with Industrial Activity" by EPA Regulation, Issue Date: January 15,1998, Expiration Date: January 31, 2003.

6.12 SRS Engineering Guide No. 02224-G, Excavation, Backfill and Site Grading.

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6.13 Report No. WSRC-RP-98-00329, Tornado, Maximum Wind Gust, and Extreme Rainfall Event Frequencies at the Savannah River Site, September, 1998

6.14 Report No. WSRC-TR-99-0369, Flood Hazard Recurrence Frequencies for C-, F-, E-, S-, H-, Y- and Z-Areas (U), September, 1999

6.15 DOE-STD-1020-94, NPH Design and Evaluation Criteria for DOE Facilities

7.0 FIGURES / TABLES

7.1 Table 1- Rainfall Accumulation in Inches for 500-, 2000-, 10,000-, and 100,000- Year Return Periods.

			Accumulation Period				
Performance Category	Annual Hazard Exceedance Probability	Return Period (Years)	15 min.	1 hour	3 hour	6 hour	24 hour
PC-1	$2x10^{-3}$	500	2.6	4.7	6.7	7.4	10.3
PC-2	$5x10^{-4}$	2000	2.9	5.4	8.2	9.2	12.8
PC-3	$1x10^{-4}$	10,000	3.3	6.2	10.3	11.8	16.3
PC-4	$1x10^{-5}$	100,000	3.9	7.4	14.1	16.7	22.7

Table 1

Rainfall Accumulation in Inches for 500-, 2000-, 10,000-, and 100,000- Year Return Periods.

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SRS Engineering Practices Manual	Manual: WSRC-IM-95-58
SAFETY • RESPONSIBILITY • SECURITY SRS SAVANNAH RIVER SITE	ENGINEERING GUIDE
EXCAVATION, BACKFILL, AND GRADING (U)	GUIDE NO: 02224-G DATE: 3/31/97 REVISION: 0 ESB TECH COMMITTEE: Civil / Structural

REVISION HISTORY

REV	DATE	DESCRIPTION OF REVISION
0	3/31/97	Initial Issue

1.0 PURPOSE & SCOPE

1.1 Purpose

This document is an Engineering Guide and represents information considered appropriate for the Savannah River Site (SRS). It is written in mandatory language for adoption by projects and/or operation procedures for a facility. To be mandatory, the provisions in this Engineering Guide must be invoked by appropriate project or operation documents. If necessary, provisions in this Engineering Guide may be augmented by detailed requirements shown on project documents.

1.2 Scope

The scope of information contained herein is applicable for the excavation, hauling, stockpiling, disposal, backfilling, and grading of all soil and soil-like materials necessary for the construction of facilities at SRS.

1.2.1 Except as noted, the technical requirements described herein are applicable for the excavation, backfill, and site grading operations for all structures and facilities. Requirements for water impoundment structures, such as dams, dikes, and berms, and landfill liners and caps are included in project-specific specifications. The technical requirements are to be augmented further by the appropriate level of Quality Assurance requirements as stated on design drawings.

1.2.2 The Constructor shall control the quality of items and services to meet the requirements of this document, the appropriate Quality Assessment Report requirements, and the requirements of other Codes and Standards as applicable.

2.0 DOE ORDER APPLICABILITY

Department of Energy (DOE) Order 420.1, Facility Safety, is applicable to the work described herein. Technical requirements, as specified, meet or exceed the minimum standards set by the above Order.

3.0 NATIONAL CODES AND STANDARDS APPLICABILITY

3.1 General

3.1.1 The applicability of the following Codes and Standards is limited to the extent of the reference in the text.

ASTM	C39-94	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM	D422-90	Standard Test Method for Particle-Size Analysis of Soils
ASTM	D1556-90	Standard Test Method for Density and Unit Weight of Soil In-Place by the Sand-Cone Method
ASTM	D1557-91	Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m3))
ASTM	D1883-94	Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM	D2216-92	Standard Test Method for Laboratory Determination Water (Moisture) Content of Soil and Rock
ASTM	D2487-93	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM	D2922-91	Standard Test Methods for Density of Soil and Soil- Aggregate In-Place by Nuclear Methods (Shallow Depth)
ASTM	D3017-93	Standard Test Method for Water Content of Soil and Rock by Nuclear Methods (Shallow Depth)
ASTM	D4318-95	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM	D4643-93	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

3.1.2 Later editions of the Codes and Standards may be used provided the minimum requirements specified herein are fully satisfied.

3.1.3 In case of conflicts between the various Codes and Standards, the more restrictive requirement shall apply. When conflict exists between the Codes, Standards, and engineering drawings, the latter shall prevail.

4.0 DEFINITIONS

Abbreviations used in this document shall have the following meanings:

ASTM	American Society for Testing and Materials
CLSM	Controlled Low Strength Material
DE	Design Engineering
PS	Production Support
GS	General Services
PE&CD	Projects, Engineering, and Construction Division
SRS	Savannah River Site
SC	Safety Class
SS	Safety Significant

5.0 GUIDANCE

5.1 General

5.1.1 The responsibility for all design functions including the production of engineering drawings, procurement and project documents lies with PE&CD. The appropriate individual representing these entities is referred to herein as the "Engineer".

5.1.2 The responsibility for all construction activities including the installation of vendor supplied and field procured items lies with PE&CD and/or selected subcontractors. The appropriate individual representing these entities is referred to herein as the "Constructor".

5.1.3 Based on the appropriate project documents, such as QAR, design drawings shall establish the Functional Classification of construction for various structures, systems, and components. Unless noted otherwise, field inspection activities for SC and SS classifications shall be independently inspected by the quality control organization and inspections for PS and GS classifications shall be peer-verified by the Constructor's line organization.

5.1.4 Unless noted otherwise on drawings, site grading operations including common backfill need only be subject to Quality Assurance requirements that are appropriate for GS classification regardless of the design classification of the structures and facilities for which these operations are undertaken.

5.1.5 The agency responsible for all soil testing is referred to herein as the "Testing Agency".

5.1.6 Unless noted otherwise on design drawings, excavation and common backfill operations need only be subject to the Quality assurance requirements that are appropriate for General Service (GS) classification regardless of the structures or facilities for which the operations are undertaken.

5.2 Excavation

5.2.1 The Constructor shall determine the suitability of excavated soil for use as backfill as described in Section 5.4. Suitable material shall consist of material meeting the requirements for structural or common fill. All material shall be removed within the limits of excavation as shown on the design drawings.

5.2.2 Any soil suitable for reuse, as determined by the Constructor, shall be placed or stockpiled in designated areas. Excess material, unsuitable material, and excavated CLSM shall be disposed of in areas designated by the Engineer.

5.2.3 Prior to the commencement of stripping operations for grading, the site shall have been cleared and grubbed. Stripping shall include the removal of all topsoil and organic material to a maximum depth of one foot within the limits of site grading shown, unless otherwise directed by the Engineer. Directed removal of topsoil and organic material below this depth will be considered removal of soil unsuitable as backfill material.

5.2.4 Topsoil shall be stockpiled in the quantities and at the locations shown on engineering drawings. Stockpiled topsoil shall be fertile, friable, loamy, and free from subsoil, refuse, roots, heavy or stiff clay, stones larger than 1.5 inches, coarse sand, weeds, sticks, brush, litter, and other deleterious substances.

5.2.5 Different classes of material, based on gradation and plasticity as determined by the Constructor, shall be stockpiled separately as directed by the Engineer and shall be placed to provide natural drainage and a stable embankment. Stockpiles shall not exceed a height of 40 feet.

5.2.6 Excess topsoil, rubble, trash, organic material, and other inert waste shall be disposed of by the Constructor as indicated on design drawings or as directed by the Engineer.

5.2.7 Materials within the limits of excavation that are defined as non-compliant backfill within this specification shall be removed and disposed of appropriately.

5.2.8 Any work to be undertaken in the "wetlands" shall require a separate written authorization from the appropriate SRS implementing organization in accordance with their applicable procedures.

5.2.9 The final 6 inches of excavation beneath a load bearing surface shall be made using either smooth blade equipment or hand excavation. The bearing surface for footings, mats, grade beams, sumps, floor slabs, and other load carrying members shall be undisturbed naturally deposited inorganic soil or compacted structural fill. Bearing surfaces shall be approved by the Engineer for all SC and SS projects. PS and GS projects shall be inspected by the Constructor unless noted otherwise on the design drawings. All inspections shall take place prior to the placement of reinforcing steel and concrete forms. The Engineer reserves the right to disapprove a bearing surface after initial approval was given if the bearing surface has deteriorated or softened. The bearing surface shall then be reapproved after additional preparation is executed by the Constructor.

5.2.10 In the event that non-compliant fill materials are encountered at the construction elevation, the Engineer shall be notified. Where excavation is performed to elevations below those shown on the design drawings, the planned elevation shall be re-established. Elevations may be re-established by filling the space with concrete of a minimum 28-day strength of 2000 psi, CLSM, or by backfilling and compacting with suitable structural fill with written approval from the Engineer.

5.2.11 All excavations shall conform to the lines, grades, sections, elevations, and tolerances shown on the drawings. Where no tolerances are specified, a tolerance of ± 6 inches shall be utilized. A smooth grade shall be maintained to provide positive drainage at all times.

5.2.12 Ditches, gutters, and channel changes shall be cut accurately to the cross sections and grades shown. All roots, stumps, rocks, and foreign matter in the sides and bottom of ditches, gutters, and channels shall be trimmed and dressed or removed. Excavation below grades shown shall be backfilled to grade with suitable material. All ditches, gutters, and channel changes shall be maintained until final acceptance. No excavated material shall be deposited closer to the edges of the ditches than indicated and in no case less than 3 feet.

5.2.13 The method of excavation shall not weaken surrounding areas nor damage structures or parts thereof that are completed or under construction. Existing structures and utilities adjacent to excavations shall be protected and supported to prevent movement.

5.2.14 Shoring impacted by, or affecting, structures or facilities shall be provided by the Engineer. All other shoring shall be provided by the Constructor unless otherwise indicated on the design drawings.

5.2.15 Areas being excavated and areas to be filled shall be maintained in a clean condition free from leaves, brush, sticks, trash, and other debris.

5.2.16 Temporary roads shall be constructed by the Constructor as required to complete the work. At the completion of the project, these construction roads shall be removed and the land returned to the original condition unless otherwise specified.

5.2.17 Construction roadside slopes and spoil area slopes shall be graded to meet existing contours to prevent water accumulation and erosion.

5.3 Drainage

5.3.1 Excavation shall be performed such that the site area and the area directly adjacent to the site shall be continually and effectively drained. Water shall not be permitted to accumulate in the excavation. The excavation shall be drained by pumping or other satisfactory methods to prevent softening of the foundation bottom, undercutting of footings, or other action detrimental to proper construction procedures.

5.3.2 In the event unforeseen groundwater or contamination is encountered, the Constructor shall immediately notify the Engineer for disposition of groundwater or contaminants.

5.3.3 Rainfall and surface water shall be controlled and removed and discharged at locations indicated by the erosion control plan.

5.3.4 Construction roadside slopes and spoil area slopes shall be graded to meet existing contours to prevent water accumulation and erosion.

5.4 Fill Materials

5.4.1 Unless otherwise approved or designated, fill materials for earthwork construction shall be obtained from the excavation, stockpiles located near the work, designated borrow areas, or from other sources approved in writing by the Engineer. Material containing brush, roots, peat, sod, other organic material, rock greater than 2 inches in diameter, frozen material, or any other deleterious material shall not be used as, or in, backfill. Suitable fill material shall consist of any inorganic mineral soil that can be readily placed and spread and meets the requirements of this specification. Unsuitable excavated material and excavated CLSM shall be disposed of as directed by the Engineer.

5.4.2 Unless otherwise approved, borrow sources and stockpiles shall be excavated and maintained to provide satisfactory drainage.

5.4.3 Structural fill used for backfilling shall consist of well-graded sands (SW) or silty sands (SM) as defined per ASTM D2487 and shall be free of organic material, loam, trash, snow, ice, frozen soil, rock greater than 2 inches in diameter and greater than 1/2-inch at the exposed surface, and other objectionable material. Structural fill shall be well-graded within the following limits as determined in accordance with ASTM D422 with a plasticity index less than 15 %.

Sieve Size	Percent Passing By Weight
3/8-inch	100
No. 4	95 to 100
No. 10	85 to 100
No. 20	70 to 95
No. 40	35 to 85
No. 60	15 to 70
No. 140	2 to 20
No. 200	0 to 15

5.4.4 Common fill used for backfilling shall consist of soils defined per ASTM D2487 as SW, SP, SM, and SC and shall be free from organic material, loam, trash, snow, ice, frozen soil, rock greater than 3 inches in diameter and greater than 1 inch at the exposed surface, and other objectionable material. Common fill shall be compacted to a minimum in-place dry density of 100 pcf and shall be graded within the following limits as determined in accordance with ASTM D422. Unsuitable material and soil shall be disposed of as directed by the Engineer.

Sieve Size	Percent Passing By Weight
3/4-inch	100
3/8-inch	95 to 100
No. 4	85 to 100
No. 10	75 to 100
No. 20	50 to 100
No. 40	25 to 95
No. 60	15 to 80
No. 140	2 to 30
No. 200	0 to 15

5.4.5 As a construction option, CLSM (Controlled Low Strength Material) may also be used as structural or common fill as approved by the Engineer. For specific requirements controlling production or placement of CLSM refer to Section 5.6 and Reference 6.1.

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5.5 Fill Placement

5.5.1 Structural Fill

5.5.1.1 Structural fill placed beneath foundations on approved subgrade is subject to the provisions of this section. After the completion of footings and walls, and prior to the placement of backfill, all forms will be removed and the excavation shall be cleaned of all trash, debris, and unsuitable material.

5.5.1.2 Subgrades for fills supporting roadway, light structures, or other loaded areas shall be proof-rolled with a 30-ton roller. All areas that "pump" or appear to be soft shall be replaced with compacted fill.

5.5.1.3 No backfill shall be placed on the foundation soils or around foundation concrete until the area has been inspected and approved by the Constructor. Before placing backfill material, the subgrade shall be scarified to a minimum depth of at least 2 inches, moisture conditioned, if necessary, and compacted to the requirements as given in the sections below.

5.5.1.4 Backfill shall be placed in successive uniform loose layers and to a depth at which densities can be obtained. In no case shall any layer of loose material placed for compaction exceed 9 inches when hand-operated mechanical equipment is used and 12 inches when self-propelled or towed mechanical equipment is used. No backfilling against concrete shall be done until the concrete has attained a strength equal to 80 % of the design strength, or as directed by the Engineer. If the subgrade concrete has been waterproofed, the backfilling shall be done so as not to damage the waterproofing or its protective materials. CLSM may be used against concrete immediately after form removal.

5.5.1.5 To ensure proper bonding between lifts, the Constructor shall scarify the previous compacted soil lift surface prior to placing the next lift. To ensure proper lift bonding, soil fill with substantial clay content, and other materials noted within the design documents, require scarification to a minimum depth of 2 inches to ensure proper bonding between lifts, or as directed by the Engineer. Granular materials shall be lightly scarified between lifts, unless noted otherwise. Scarification is not required when placing CLSM.

5.5.1.6 Prior to terminating work for the day, the final layer of compacted fill, after compaction, shall be rolled with a smooth-wheeled roller to eliminate ridges of soil left by tractors, trucks, and other compaction equipment. Fill layers shall not be placed on snow, ice, or soil that was permitted to freeze prior to compaction. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of a day's operations. Removal of these unsatisfactory materials will be required.

5.5.1.7 Desiccated contact surfaces of compacted fill layers, subgrades, or disturbed surfaces shall be scarified to a depth of 6 inches, moistened to the required moisture content, and compacted to the specified density.

5.5.1.8 Before placing additional fill, material that is soft and yielding as a result of excess water shall be replaced with suitable material or scarified and allowed to dry out to the specified moisture content and recompacted.

5.5.1.9 Oversize material as defined in Section 5.4.4 shall be removed from the backfill and disposed of in designated areas.

5.5.1.10 Structural fill shall be compacted to a minimum density of 95 % of maximum dry density determined in accordance with ASTM D1557.

5.5.1.11 Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed shall be plowed, stepped or benched, or broken up as required to facilitate bonding between the fill and the existing surface. Prepared surfaces on which compacted fill is to be placed shall maintain the required moisture content and compaction level.

5.5.2 Common Fill

5.5.2.1 Unless noted otherwise within the design documents, areas to receive fill shall be "common fill" areas.

5.5.2.2 In no case shall unsuitable material remain in or under the fill area. Placement and compaction procedures shall be the same as for Structural Fill described in Section 5.5.1, except for compaction criteria. Common backfill shall be compacted to a minimum of 90 % of the maximum density as determined in accordance with ASTM D1557.

5.5.2.3 Fills shall be constructed at the locations and to lines and grades shown or required on drawings. The material shall be placed in successive horizontal layers with a loose thickness not to exceed 9 inches when hand-operated equipment is used and 12 inches when self-propelled mechanical equipment is used. The fill material shall be placed for the full width of the cross section and shall be compacted as required.

5.5.2.4 Sloped ground surfaces steeper than one vertical to four horizontal on which fill is to be placed shall be plowed, stepped or benched, or broken up as required to facilitate bonding between the fill and the existing surface.

5.5.2.5 Prepared surfaces on which compacted fill is to be placed shall be wetted or dried as may be required to obtain the moisture specified.

5.5.2.6 Material shall be placed in fill areas to form a homogeneous mass, free from lenses, pockets, streaks, and layers of material differing substantially in texture and gradation from surrounding material. Fill material with a substantial clay content and other materials as noted within the design documents are required to be scarified to a minimum depth of 2 inches to ensure proper bonding between lifts. Granular materials do not require scarification between lifts unless noted otherwise.

5.5.2.7 No fill shall be placed upon a frozen surface nor shall any ice or frozen earth be incorporated in the backfill.

5.6 Controlled Low Strength Material (CLSM)

5.6.1 The CLSM shall have a 28-day compressive strength of 30 to 150 psi. In-place pour density shall be within the range of 115 to 145 pcf. After the CLSM has set, the density may be determined by ASTM D2922 or ASTM D1556.

5.6.2 The water content of CLSM as placed shall be between 60 and 66 gallons per cubic yard unless noted otherwise by the engineer. Water addition, if required, shall be added to the CLSM batch upon receipt at the jobsite prior to any discharge and shall be mixed by a minimum of 30 revolutions of the drum. Any water added to the batch at the jobsite shall be recorded on the batch ticket by the receiving organization.

5.6.3 Preparation of subgrade prior to use of CLSM shall be the same as is required for soil backfill. Scarification and recompaction of undisturbed natural grade is not required. CLSM may be screeded, if required, to provide a uniform grade, but shall not be vibrated.

5.6.4 CLSM is not designed to resist freeze and thaw or erosive weathering and requires erosion control as stipulated by the design documents. If erosion control is not stipulated, then a minimum of 6 inches of common soil backfill, select aggregate base coarse, or a protective wearing surface such as asphalt or concrete shall be placed over the CLSM. In areas where the native soil is highly impervious and standing water does not cause sloughing or penetrates the surface more than 1 inch, the CLSM may be deposited directly into 3 inches or less of standing water. Drainage must be provided to allow the displaced water to run-off.

5.7 Moisture Control

5.7.1 Unless otherwise designated or approved, for materials where a definable moisture-density curve can be established utilizing ASTM D1557, the moisture content during compaction shall be within ± 3 % of optimum moisture content. For very clean sands where a definable moisture-density curve cannot be established, the material shall be saturated. Optimum moisture content will be determined by the Testing Agency per ASTM D1557. Moisture content is a guidance criteria and shall not be used as an acceptance criteria for compaction of any fill material.

5.7.2 Fill material to be compacted shall be moisture conditioned, as far as practicable, in the stockpiles or borrow sources. Fill material not maintaining a uniform moisture content shall be conditioned by flooding, sprinkling, aerating, harrowing, disking, draining, or other approved means. Natural moisture content of the fill material shall be determined by the Testing Agency in accordance with ASTM D2216 or D4643.

5.7.3 After placement of loose material in the fill area, the moisture content shall be adjusted as necessary to bring the material within required moisture content limits. The Testing Agency will verify moisture content per ASTM D2216, D3017, or D4643, as necessary. Material placed too wet for compaction shall be left to drain or shall be aerated and dried by disking and harrowing or otherwise mixed until the moisture content of the entire layer is uniform and within the specified limits. Sprinkling shall be by sprinkler trucks (or other suitable means for congested areas) equipped with pressure spray bars and valves to give a uniform and even application of water to the dry areas and control of the rate of water application at all times. Any section of the fill area containing material that is too wet or too dry shall not be compacted until the moisture content of the material is brought within the specified limits or the material shall be removed and replaced with material having a moisture content within the specified limits.

5.7.4 Placement of fill for which moisture conditioning is required shall be suspended when the ambient temperature is 35°F and falling.

5.8 Compaction

5.8.1 Material satisfactorily placed and spread and having a moisture content within the specified limits shall be compacted by vibratory or static rolling. Rolling shall be performed systematically on all portions of each area.

5.8.2 Unless otherwise approved by the Engineer, all roller trips shall be made in parallel paths. To ensure complete coverage of the area rolled, each trip of the roller shall overlap the adjacent trip by not less than 2 feet. If there is sufficient area, the dumping, spreading, sprinkling, mixing, and compacting may be performed at the same time at different points on the backfill surface.

5.8.3 Compaction equipment shall be suitable for the type of soil and magnitude of compaction required. All backfill not accessible to roller compaction shall be compacted by power tampers or vibratory compactors or other approved means to the same degree of compaction achieved by roller-compaction.

5.8.4 Material satisfactorily placed and spread in the fill, and having a moisture content uniformly distributed through the fill within the specified limits, shall be compacted by rolling to attain the satisfactory compaction of not less than 95 % for structural fill and 90 % for common fill (95 % for the top two feet of fill under roads, parking areas, and railroads) of the maximum dry density determined in accordance with ASTM D1557. Compliance shall be verified per ASTM D1556 or D2922.

5.9 Test Fill

5.9.1 Existing test fill data from previous work at SRS should be utilized for guidance on construction methodology for placement and compaction of backfill provided similar materials and placement conditions are maintained and per approval of the Engineer.

5.9.2 A test fill shall be required to evaluate specific compaction equipment or backfill materials not previously evaluated. The methods of handling, spreading, and moisture conditioning of the material shall be the same for the test fill as for the earthwork operations.

5.9.3 The test fill, using approved materials and specific methods, shall be constructed to include as a minimum the following variables for the evaluation of equipment to produce the required compaction: equipment type, number of equipment passes per lift, lift thickness, density per lift, moisture content, gradation, and Atterberg limits.

5.9.4 If more than one type of soil material is approved for backfill or fill, each material shall be tested separately in the test fill.

5.9.5 The Constructor shall monitor the test fill. The Testing Agency shall take test samples as often as required for evaluation of the compaction effort. Based on the evaluation, the Engineer may direct modification of the variables listed above.

5.10 Grading

5.10.1 All finished areas covered by the project, including excavated and filled sections, shall be smoothly and uniformly graded and free from surface irregularities according to the line, grade, and cross section shown on the design drawings. The degree of finish shall be that ordinarily obtainable from blade-grader operations unless otherwise specified.

5.10.2 Prior to placement of foundation material and subgrade areas for paving, the following shall be accomplished as required per Sections 5.5.1 and 5.5.2.

5.10.3 The surface of excavated or filled areas on which foundations, base course, or pavement are to be placed shall vary not more than ± 0.1 foot from the established grade or approved cross section.

5.10.4 The surface of unfinished fills and subgrades shall be bladed smooth to a crown and rolled, with a smooth wheeled roller, at the conclusion of each day's work or before shutdown for any cause to permit adequate drainage. Ditches and gutters shall be finished to permit adequate drainage.

5.11 Testing

5.11.1 The Testing Agency shall conduct field density and related tests in the compacted fill and the related laboratory compaction testing to determine the relative degree of compaction and other properties. Field density tests shall be taken as required with at least one test each day for each area in which compaction is being carried out or at least one test for each 250 or 500 cubic yards of fill per Table 1. Testing shall be performed at a greater frequency, as determined by the Engineer, at the start of compaction for every new structure, facility, or project and in congested areas requiring small placement volumes.

5.11.2 Concurrent with construction, the Testing Agency shall take samples of the material from the borrow areas and fill and test these samples for moisture content, compaction, Atterberg limits, and gradation, and carry out any other control or record tests that may be required. Testing shall be performed by the Testing Agency as frequently as is deemed necessary by the Constructor. Retesting of fill that has failed criteria shall be at the discretion of the Engineer.

5.11.3 Use of the nuclear method for density and moisture determination shall require field calibration in accordance with ASTM D2922 and ASTM D3017. One sand cone density test in accordance with ASTM D1556 shall be performed for every ten nuclear density tests as verification.

5.11.4 Testing of CLSM shall be as required by design documents or as requested by Engineering or the Constructor. The following tests are applicable and shall conform to the standards listed below:

Compressive Strength: compressive strength tests shall be prepared in accordance with ASTM C 39 and be used for information only. Strength tests shall be performed at cure times of 14 and 28 days and shall use a minimum of two specimens for each cure time.

Density: moist densities shall be obtained either by ASTM D1556 or ASTM D2922 after a cure period of at least 24 hours.

Bearing Capacity: California Bearing Ratio shall be performed in accordance with ASTM D1883. Recommended tests shall be performed at cure times of 2, 14, and 28 days.

5.12 Erosion Control

Requirements for erosion control shall be as described on the design drawings.

5.13 Inspection

5.13.1 Excavation and Backfill

Prior to final acceptance, all work shall be inspected (by the Engineer, if so specifically stated on design drawings) for conformance to drawings and document requirements. A graded approach shall be used for inspection of excavation and backfill activities as specified in Table 1, which may include frequency of testing, adequacy of test results, and results of inspections on natural subgrades or compacted fill surfaces prior to placement of foundation concrete or additional backfill.

5.13.2 Grading

Prior to final acceptance, all work shall be inspected (by the Engineer, if so specifically stated on design drawings) for conformance to drawings and document requirements. As a minimum, a record shall be generated to document the inspection results for proper selection of the fill or backfill material, in-place density and moisture content of the compacted material, and excavation and grading within specified tolerance.

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6.0 REFERENCES

6.1 Procurement Specification for Furnishing and Delivery of Concrete; GS, PS, and SS (U), Specification No. C-SPS-G-00085.

7.0 ATTACHMENTS

7.1 Table 1. Graded Approach for Inspection of Excavation, Backfill, and Grading.

Table 1. Graded Approach for Inspection of Excavation, Backfill, and Grading

INSPECTION ACTIVITY	SC	SS	PS	GS
Excavation within specified tolerances	X			
Subgrade inspection prior to backfill or concrete placement	X	X	X	
Proper selection of fill material	X	X		
In-place density of compacted material	X	X	X	X
In-place moisture content of structural fill material	X	X	X	X
Frequency of testing (minimum of once per specified volume)	250	250	5001	5002
Grading within specified tolerances	X	X	X	X
DOCUMENTATION RESPONSIBILITY	Q	Q	C	C

Notes:

1. No testing required for individual, nonadjacent fills of less than 2 cubic yards.
2. No testing required for individual, nonadjacent fills of less than 5 cubic yards.
3. Q denotes Quality Organization independent inspection.
4. C denotes Constructor peer verification.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Manufacturing Certification

Presto Products Company (the manufacturer) shall have earned ISO 9002 certification for its quality-management system at its Geoweb (geocell) cellular confinement system manufacturing plant.

Product Certification

Presto Products Company (the manufacturer) shall provide certification of compliance to all applicable testing procedures and related specifications upon the customer's written request. Request for certification shall be submitted no later than the date of order placement.

Product Warranty

Presto Products Company (the manufacturer) shall warrant each Geoweb cellular confinement system section that it ships to be free from defects in materials and workmanship at the time of manufacture. Presto's exclusive liability under this warranty or otherwise will be to furnish without charge to Presto's customer at the original f.o.b. point a replacement for any section which proves to be defective under normal use and service during the **10-year period** which begins on the date of shipment by Presto. Presto reserves the right to inspect any allegedly defective section in order to verify the defect and ascertain its cause.

This warranty shall not cover defects attributable to causes or occurrences beyond Presto's control and unrelated to the manufacturing process, including, but not limited to, abuse, misuse, mishandling, neglect, improper storage, improper installation, improper alteration or improper application.

PRESTO MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OR MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, IN CONNECTION WITH THE GEOWEB CELLULAR CONFINEMENT SYSTEM. In no event shall Presto be liable for any special, indirect, incidental or consequential damages for the breach of any express or implied warranty or for any other reason, including negligence, in connection with the Geoweb cellular confinement system.

Specifier Choice for Certification and Warranty

The Specifier shall determine the applicability of Manufacturing Certification, Product Certification and a Product Warranty and state which of the above is to be part of the project specifications.

Disclaimer

This document has been prepared for the benefit of customers interested in the Presto Geoweb Cellular Confinement System. It was reviewed carefully prior to publication. Presto Products Company assumes no liability and makes no guarantee or warranty as to its accuracy or completeness. Final determination of the suitability of any information or material for the use contemplated, or for its manner of use, is the sole responsibility of the user. Geoweb® is a registered trademark of Presto Products Company.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Geoweb Base Material

NOTE: All measurements and colorants are subject to manufacturing tolerances unless otherwise stated.

Polyethylene - Stabilized with Carbon Black

Polyethylene used to make strips for Presto Geoweb sections shall have a density of 0.935 - 0.965 g/cm³ (58.4 - 60.2 lb/ft³) tested per ASTM D1505.

Polyethylene used to make strips for Presto Geoweb sections shall have an Environmental Stress Crack Resistance (ESCR) of 3000 hour tested per ASTM D1693.

Carbon black shall be used for ultra-violet light stabilization. Carbon black content shall be 1.5% - 2% by weight through the addition of a carrier with a certified carbon black content. The carbon black shall be homogeneously distributed throughout the material.

The resin manufacturer's certification of polyethylene density and ESCR shall be available upon request from Presto (the Geoweb manufacturer). Presto shall certify the percentage of carbon black.

Polyethylene - Colored and Stabilized with HALS

Polyethylene used to make strips for Presto Geoweb sections shall have a density of 0.935 - 0.965 g/cm³ (58.4 - 60.2 lb/ft³) tested per ASTM D1505.

Polyethylene used to make strips for Presto Geoweb sections shall have an Environmental Stress Crack Resistance (ESCR) of 3000 hour tested per ASTM D1693.

The color(s) of the polyethylene shall be (Tan, Green, other). Colorants shall be non-heavy metal types. The colorant shall be homogeneously distributed throughout the material.

Hindered amine light stabilizer (HALS) shall be used for ultra-violet light stabilization. HALS content shall be 1.0% by weight through the addition of a carrier with a certified HALS concentrate. The HALS shall be homogeneously distributed throughout the material.

The resin manufacturer's certification of polyethylene density and ESCR shall be available upon request from Presto (the Geoweb manufacturer). Presto shall certify the percentage of HALS.

Specifier Choice for Base Material

The polyethylene used for all Geoweb material meets the same standards. The specifier shall state the desired color. The color determines which ultraviolet light stabilizer is to be used. Polyethylene stabilized with carbon black is used for most applications. Colored polyethylene stabilized with HALS is generally used for the facia strip for Geoweb earth retention systems.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Strip Properties and Assembly

NOTE: **All measurements are subject to manufacturing tolerances unless otherwise stated.**

Perforated Textured Strip/Cell (Recommended)

Polyethylene sheet used to make strips for Presto Geoweb sections shall have a thickness of 1.27 mm -5% +10% (50 mil -5% +10%) prior to any surface disruption. The strips shall have a perforated, textured surface. **Performance**: The peak friction angle between the surface of the perforated, textured plastic and a #40 silica sand at 100% relative density shall be no less than 85% of the peak friction angle of the silica sand in isolation when tested by the direct shear method per ASTM D 5321. The quantity of perforations shall remove 16% ± 1% of the cell wall area. **Material**: The surface texturing shall be a multitude of rhomboidal (diamond shape) indentations. The rhomboidal indentations shall have a surface density of 22 - 31 per cm^2 (140 - 200 per in^2). The thickness of the textured sheet shall be 1.52 mm ±0.15 mm (60 mil ±6 mil) determined per ASTM D5199. The perforations shall be horizontal rows of 10 mm (0.391 in) diameter holes. Perforations within each row shall be 19 mm (0.75 in) on-center. Horizontal rows shall be staggered and separated 12 mm (0.50 in) relative to the hole centers. The edge of strip to the nearest edge of perforation shall be 8 mm (0.312 in) minimum and the centerline of the spot weld to the nearest edge of perforation shall be 6 mm (0.25 in) minimum.

Non-perforated Textured Strip/Cell

Polyethylene sheet used to make strips for Presto Geoweb sections shall have a thickness of 1.27 mm -5% +10% (50 mil -5% +10%) prior to any surface disruption. The strips shall have a textured surface. **Performance**: The peak friction angle between the surface of the textured plastic and a #40 silica sand at 100% relative density shall be no less than 85% of the peak friction angle of the silica sand in isolation when tested by the direct shear method per ASTM D 5321. **Material**: The surface texturing shall be a multitude of rhomboidal (diamond shape) indentations. The rhomboidal indentations shall have a surface density of 22 - 31 per cm^2 (140 - 200 per in^2). The thickness of the textured sheet shall be 1.52 mm ±0.15 mm (60 mil ±6 mil) determined per ASTM D5199.

Assembly

Presto Geoweb [*Cell Type*] sections shall be fabricated using strips of sheet polyethylene each having a length of ... (per Table 1) and a width equal to the cell depth. Polyethylene strips shall be connected using uniformly-spaced, full-depth, ultrasonic spot-welds. Welds shall be offset and aligned perpendicular to the longitudinal axis of the strip. Weld spacing shall be ... (per Table 1). The ultrasonic weld melt-pool width shall not exceed 25 mm (1.0 in).

Table 1 Strip Lengths & Weld Spacing for Cell Types

Cell Type	GW20	GW40
Strip Length	3.35 m (132 in)	3.35 m (132 in)
Weld Spacing	330 mm ± 2.5 mm (13.0 in ± 0.10 in)	660 mm ±2.5 mm (26.0 in ± 0.10 in)

Specifier Choice for Strip Properties and Assembly

The specifier shall state the desired strip/cell type: Perforated Textured or Non-Perforated Textured and use either the **Performance** or **Material** language. Refer to *THE GEOWEB SYSTEM TECHNICAL OVERVIEW* documents for recommendations.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Cell and Seam Properties

NOTE: **All measurements are nominal and subject to manufacturing tolerances unless otherwise stated.**

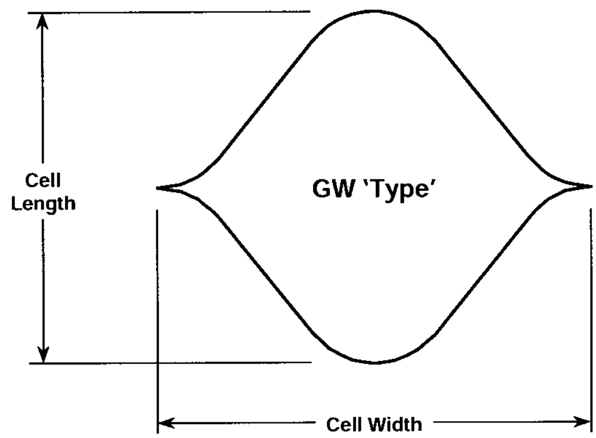

Figure 1 Expanded Geoweb Cell

Cell Length, Width and Area

The individual cells of the GW(TT) Geoweb section shall be uniform in shape and size when expanded. The nominal cell dimensions shall be of length (LL) and width (WW). Individual cells shall have a nominal area of (AA). See Figure 1.

Type (TT)	Length (LL)	Width (WW)	Area (AA)
GW20	200 mm (8.0 in)	240 mm (9.6 in)	240 cm^2 (38 in^2)
GW40	400 mm (16.0 in)	480 mm (19.2 in)	960 cm^2 (153 in^2)

Cell Depth

The Geoweb section shall have a nominal cell depth of (DD).

Depth (DD) =	200 mm (8.0 in)	150 mm (6.0 in)	100 mm (4.0 in)	75 mm (3.0 in)

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Cell Seam Peel Strength Test

NOTE: All measurements are subject to manufacturing tolerances unless otherwise stated.

Short-Term Seam Peel-Strength Test

Cell seam strength shall be uniform over the full depth of the cell. Short-term peel strength shall be tested per U.S. Army Corps of Engineers Technical Report GL-86-19, Appendix A. See Figure 2. Minimum seam peel strengths shall be...

- 2000 N (450 lbf) for the 200 mm (8.0 in) depth cell.
- 1420 N (320 lbf) for the 150 mm (6.0 in) depth cell.
- 1000 N (225 lbf) for the 100 mm (4.0 in) depth cell.
- 710 N (160 lbf) for the 75 mm (3.0 in) depth cell.

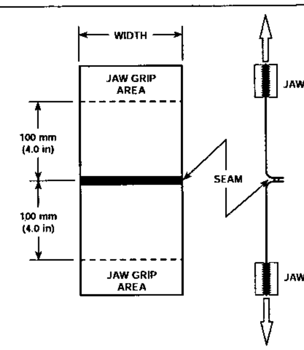

Figure 2 Seam Peel Strength Test

Long-Term Seam Hang-Strength Test

Seam hang-strength test shall be performed for a period of **7 days minimum** in a temperature-controlled environment that undergoes change on a 1-hour cycle from room temperature to 54 °C (130 °F). Room temperature is defined in ASTM E41. Test samples shall be made by welding two 100 mm (4.0 in) wide polyethylene strips together. A test sample consisting of two carbon-black stabilized strips shall support a 72.5 kg (160 lb) load for the test period. A test sample consisting of a carbon black stabilized strip and a HALS stabilized strip shall support a 63.5 kg (140 lb) load for the test period.

Alternative Long-Term Seam Hang-Strength Test

Seam hang-strength test shall be performed for a period of **30 days minimum** at room temperature. Room temperature is defined in ASTM E41. Test samples shall be made by welding two 100 mm (4.0 in) wide polyethylene strips together. A test sample consisting of two carbon-black stabilized strips shall support a 72.5 kg (160 lb) load for the test period. A test sample consisting of a carbon black stabilized strip and a HALS stabilized strip shall support a 63.5 kg (140 lb) load for the test period.

Specifier Choice for Seam and Cell Properties

The specifier shall state the desired cell size: either the GW20 or GW40 Geoweb section and the cell depth. Refer to *THE GEOWEB SYSTEM TECHNICAL OVERVIEW* documents for recommendations.

The specifier shall also state the Short-Term Seam Peel-Strength Test and either the Long-Term Seam Hang-Strength Test (recommended) or the Alternative Long-Term Seam Hang-Strength Test. There are three possibilities for seams for a Geoweb section. First, is two carbon black stabilized strips welded together. This is most typical for Geoweb sections used in all application areas. Second, is a carbon black strip welded to a HALS stabilized strip. This is typically used when a colored facia is desired on the Geoweb earth retention system. Third, is two HALS stabilized strips welded together. However, this is uncommon and would apply only to fully colored Geoweb sections. Presto should be consulted before specifying fully colored Geoweb sections. In the Long Term and the Alternative Long Term Seam Hang-Strength Test, the load capacity is given for seams made of two carbon black stabilized strips welded together and a carbon black stabilized strip welded to a HALS stabilized strip.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Geoweb Section Properties – GW20 Cell

NOTE: **All measurements are subject to manufacturing tolerances unless otherwise stated.**

GW20 Geoweb Section

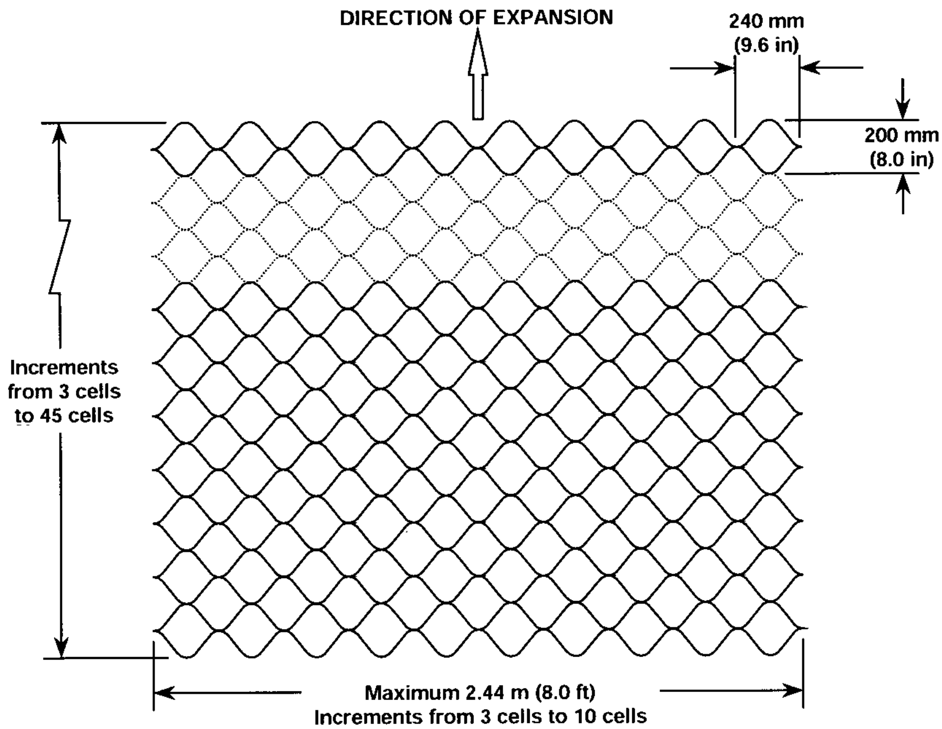

Figure 3 GW20 Geoweb Section

Presto Geoweb GW20 section dimensions shall be as indicated in Figure 3. Sections shall have a nomenclature of "GW20DDWWLL" where "GW20" indicates the cell size, "DD" indicates the cell depth in inches, "WW" indicates the number of cells wide, and "LL" indicates the number of cells long. Sections shall have expanded dimensions and weights per Table 2. An example of the GW20 Geoweb section nomenclature is GW20081030 where the section cell depth is 8.0 in or 200 mm and the section is 10 cells wide and 30 cells in length.

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Table 2 GW20 Perforated Geoweb Sections - Dimensions & Weights for Maximum Width Section

GW20 Geoweb Section	Length m	Length (ft)	Width (10 cells) m	Width (10 cells) (ft)	Area m²	Area (ft²)	Weight per Section, kg (lb) Where DD = 03 kg	Where DD = 03 (lb)	Where DD = 04 kg	Where DD = 04 (lb)	Where DD = 06 kg	Where DD = 06 (lb)	Where DD = 08 kg	Where DD = 08 (lb)
GW20 DD 10 03	0.61	(2.0)	2.44	(8.0)	1.49	(16.0)	1.56	(3.5)	2.11	(4.7)	3.13	(6.9)	4.22	(9.3)
GW20 DD 10 04	0.81	(2.7)	2.44	(8.0)	1.98	(21.3)	2.09	(4.6)	2.81	(6.2)	4.17	(9.2)	5.62	(12.4)
GW20 DD 10 05	1.02	(3.3)	2.44	(8.0)	2.48	(26.7)	2.61	(5.8)	3.52	(7.8)	5.22	(11.5)	7.03	(15.5)
GW20 DD 10 06	1.22	(4.0)	2.44	(8.0)	2.97	(32.0)	3.13	(6.9)	4.22	(9.3)	6.26	(13.8)	8.44	(18.6)
GW20 DD 10 07	1.42	(4.7)	2.44	(8.0)	3.47	(37.3)	3.65	(8.1)	4.92	(10.9)	7.30	(16.1)	9.84	(21.7)
GW20 DD 10 08	1.63	(5.3)	2.44	(8.0)	3.96	(42.7)	4.17	(9.2)	5.62	(12.4)	8.35	(18.4)	11.25	(24.8)
GW20 DD 10 09	1.83	(6.0)	2.44	(8.0)	4.46	(48.0)	4.69	(10.4)	6.33	(14.0)	9.39	(20.7)	12.66	(27.9)
GW20 DD 10 10	2.03	(6.7)	2.44	(8.0)	4.95	(53.3)	5.22	(11.5)	7.03	(15.5)	10.43	(23.0)	14.06	(31.0)
GW20 DD 10 11	2.24	(7.3)	2.44	(8.0)	5.45	(58.7)	5.74	(12.7)	7.73	(17.1)	11.48	(25.3)	15.47	(34.1)
GW20 DD 10 12	2.44	(8.0)	2.44	(8.0)	5.95	(64.0)	6.26	(13.8)	8.44	(18.6)	12.52	(27.6)	16.87	(37.2)
GW20 DD 10 13	2.64	(8.7)	2.44	(8.0)	6.44	(69.3)	6.78	(15.0)	9.14	(20.2)	13.56	(29.9)	18.28	(40.3)
GW20 DD 10 14	2.84	(9.3)	2.44	(8.0)	6.94	(74.7)	7.30	(16.1)	9.84	(21.7)	14.61	(32.2)	19.69	(43.4)
GW20 DD 10 15	3.05	(10.0)	2.44	(8.0)	7.43	(80.0)	7.82	(17.3)	10.55	(23.3)	15.65	(34.5)	21.09	(46.5)
GW20 DD 10 16	3.25	(10.7)	2.44	(8.0)	7.93	(85.3)	8.35	(18.4)	11.25	(24.8)	16.69	(36.8)	22.50	(49.6)
GW20 DD 10 17	3.45	(11.3)	2.44	(8.0)	8.42	(90.7)	8.87	(19.6)	11.95	(26.4)	17.74	(39.1)	23.90	(52.7)
GW20 DD 10 18	3.66	(12.0)	2.44	(8.0)	8.92	(96.0)	9.39	(20.7)	12.66	(27.9)	18.78	(41.4)	25.31	(55.8)
GW20 DD 10 19	3.86	(12.7)	2.44	(8.0)	9.41	(101.3)	9.91	(21.9)	13.36	(29.5)	19.82	(43.7)	26.72	(58.9)
GW20 DD 10 20	4.06	(13.3)	2.44	(8.0)	9.91	(106.7)	10.43	(23.0)	14.06	(31.0)	20.87	(46.0)	28.12	(62.0)
GW20 DD 10 21	4.27	(14.0)	2.44	(8.0)	10.41	(112.0)	10.95	(24.2)	14.76	(32.6)	21.91	(48.3)	29.53	(65.1)
GW20 DD 10 22	4.47	(14.7)	2.44	(8.0)	10.90	(117.3)	11.48	(25.3)	15.47	(34.1)	22.95	(50.6)	30.93	(68.2)
GW20 DD 10 23	4.67	(15.3)	2.44	(8.0)	11.40	(122.7)	12.00	(26.5)	16.17	(35.7)	24.00	(52.9)	32.34	(71.3)
GW20 DD 10 24	4.88	(16.0)	2.44	(8.0)	11.89	(128.0)	12.52	(27.6)	16.87	(37.2)	25.04	(55.2)	33.75	(74.4)
GW20 DD 10 25	5.08	(16.7)	2.44	(8.0)	12.39	(133.3)	13.04	(28.8)	17.58	(38.8)	26.08	(57.5)	35.15	(77.5)
GW20 DD 10 26	5.28	(17.3)	2.44	(8.0)	12.88	(138.7)	13.56	(29.9)	18.28	(40.3)	27.12	(59.8)	36.56	(80.6)
GW20 DD 10 27	5.49	(18.0)	2.44	(8.0)	13.38	(144.0)	14.08	(31.1)	18.98	(41.9)	28.17	(62.1)	37.97	(83.7)
GW20 DD 10 28	5.69	(18.7)	2.44	(8.0)	13.87	(149.3)	14.61	(32.2)	19.69	(43.4)	29.21	(64.4)	39.37	(86.8)
GW20 DD 10 29	5.89	(19.3)	2.44	(8.0)	14.37	(154.7)	15.13	(33.4)	20.39	(45.0)	30.25	(66.7)	40.78	(89.9)
GW20 DD 10 30	6.10	(20.0)	2.44	(8.0)	14.86	(160.0)	15.65	(34.5)	21.09	(46.5)	31.30	(69.0)	42.18	(93.0)
GW20 DD 10 31	6.30	(20.7)	2.44	(8.0)	15.36	(165.3)	16.17	(35.7)	21.80	(48.1)	32.34	(71.3)	43.59	(96.1)
GW20 DD 10 32	6.50	(21.3)	2.44	(8.0)	15.86	(170.7)	16.69	(36.8)	22.50	(49.6)	33.38	(73.6)	45.00	(99.2)
GW20 DD 10 33	6.71	(22.0)	2.44	(8.0)	16.35	(176.0)	17.21	(38.0)	23.20	(51.2)	34.43	(75.9)	46.40	(102.3)
GW20 DD 10 34	6.91	(22.7)	2.44	(8.0)	16.85	(181.3)	17.74	(39.1)	23.90	(52.7)	35.47	(78.2)	47.81	(105.4)
GW20 DD 10 35	7.11	(23.3)	2.44	(8.0)	17.34	(186.7)	18.26	(40.3)	24.61	(54.3)	36.51	(80.5)	49.21	(108.5)
GW20 DD 10 36	7.32	(24.0)	2.44	(8.0)	17.84	(192.0)	18.78	(41.4)	25.31	(55.8)	37.56	(82.8)	50.62	(111.6)
GW20 DD 10 37	7.52	(24.7)	2.44	(8.0)	18.33	(197.3)	19.30	(42.6)	26.01	(57.4)	38.60	(85.1)	52.03	(114.7)
GW20 DD 10 38	7.72	(25.3)	2.44	(8.0)	18.83	(202.7)	19.82	(43.7)	26.72	(58.9)	39.64	(87.4)	53.43	(117.8)
GW20 DD 10 39	7.92	(26.0)	2.44	(8.0)	19.32	(208.0)	20.34	(44.9)	27.42	(60.5)	40.69	(89.7)	54.84	(120.9)
GW20 DD 10 40	8.13	(26.7)	2.44	(8.0)	19.82	(213.3)	20.87	(46.0)	28.12	(62.0)	41.73	(92.0)	56.25	(124.0)
GW20 DD 10 41	8.33	(27.3)	2.44	(8.0)	20.31	(218.7)	21.39	(47.2)	28.83	(63.6)	42.77	(94.3)	57.65	(127.1)
GW20 DD 10 42	8.53	(28.0)	2.44	(8.0)	20.81	(224.0)	21.91	(48.3)	29.53	(65.1)	43.82	(96.6)	59.06	(130.2)
GW20 DD 10 43	8.74	(28.7)	2.44	(8.0)	21.31	(229.3)	22.43	(49.5)	30.23	(66.7)	44.86	(98.9)	60.46	(133.3)
GW20 DD 10 44	8.94	(29.3)	2.44	(8.0)	21.80	(234.7)	22.95	(50.6)	30.93	(68.2)	45.90	(101.2)	61.87	(136.4)
GW20 DD 10 45	9.14	(30.0)	2.44	(8.0)	22.30	(240.0)	23.47	(51.8)	31.64	(69.8)	46.95	(103.5)	63.28	(139.5)

NOTE: To obtain non-perforated Geoweb section weights increase table weights by approximately 16% ±1%.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Geoweb Section Properties – GW40 Cell

NOTE: All measurements are subject to manufacturing tolerances unless otherwise stated.

GW40 Geoweb Section

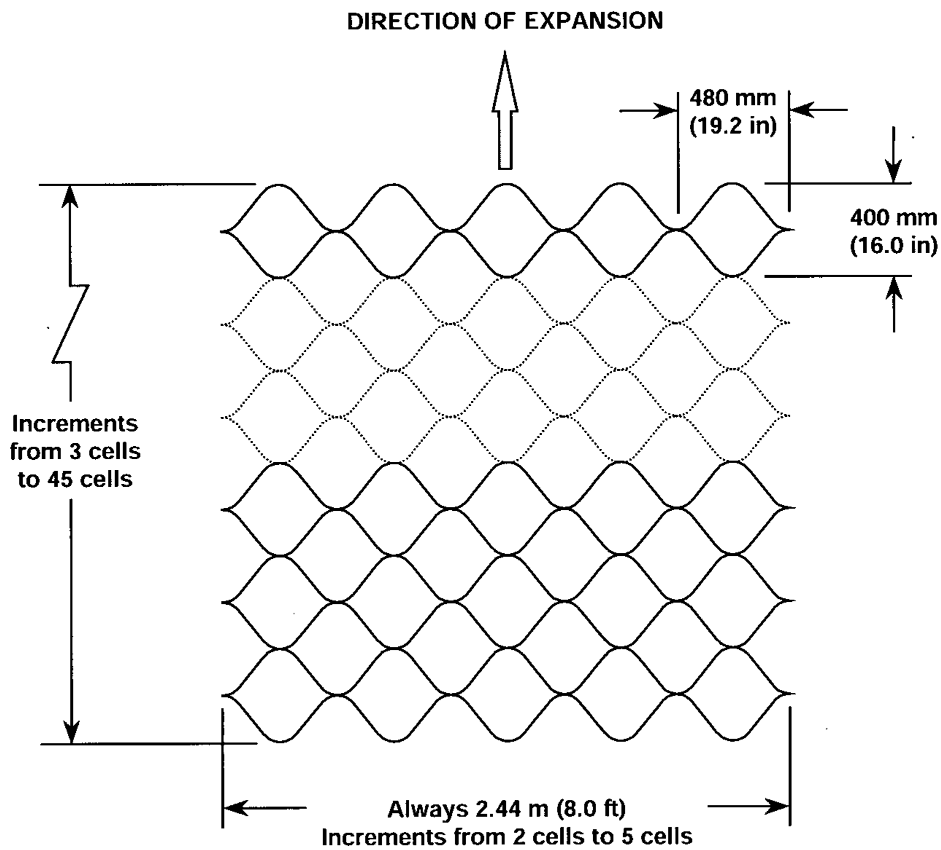

Figure 4 GW40 Geoweb Section

Presto Geoweb GW40 section dimensions shall be as indicated in Figure 4. Sections shall have a nomenclature of "GW40DDWWLL" where "GW40" indicates the cell size, "DD" indicates the cell depth in inches, "WW" indicates the number of cells wide, and "LL" indicates the number of cells long. Sections shall have expanded dimensions and weights per Table 3. An example of the GW40 Geoweb section nomenclature is GW40080530 where the section cell depth is 8.0 in or 200 mm and the section is 5 cells wide and 30 cells in length.

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Table 3 GW40 Perforated Geoweb Sections - Dimensions & Weights for Maximum Width Section

GW40	Length		Width (05 cells)		Area		Weight per Section, kg (lb)							
Geoweb Section	m	(ft)	m	(ft)	m²	(ft²)	Where DD = 03		Where DD = 04		Where DD = 06		Where DD = 08	
GW40 DD 5 03	0.61	(2.0)	2.44	(8.0)	1.49	(16.0)	1.56	(3.5)	2.11	(4.7)	3.13	(6.9)	4.22	(9.3)
GW40 DD 5 04	0.81	(2.7)	2.44	(8.0)	1.98	(21.3)	2.09	(4.6)	2.81	(6.2)	4.17	(9.2)	5.62	(12.4)
GW40 DD 5 05	1.02	(3.3)	2.44	(8.0)	2.48	(26.7)	2.61	(5.8)	3.52	(7.8)	5.22	(11.5)	7.03	(15.5)
GW40 DD 5 06	1.22	(4.0)	2.44	(8.0)	2.97	(32.0)	3.13	(6.9)	4.22	(9.3)	6.26	(13.8)	8.44	(18.6)
GW40 DD 5 07	1.42	(4.7)	2.44	(8.0)	3.47	(37.3)	3.65	(8.1)	4.92	(10.9)	7.30	(16.1)	9.84	(21.7)
GW40 DD 5 08	1.63	(5.3)	2.44	(8.0)	3.96	(42.7)	4.17	(9.2)	5.62	(12.4)	8.35	(18.4)	11.25	(24.8)
GW40 DD 5 09	1.83	(6.0)	2.44	(8.0)	4.46	(48.0)	4.69	(10.4)	6.33	(14.0)	9.39	(20.7)	12.66	(27.9)
GW40 DD 5 10	2.03	(6.7)	2.44	(8.0)	4.95	(53.3)	5.22	(11.5)	7.03	(15.5)	10.43	(23.0)	14.06	(31.0)
GW40 DD 5 11	2.24	(7.3)	2.44	(8.0)	5.45	(58.7)	5.74	(12.7)	7.73	(17.1)	11.48	(25.3)	15.47	(34.1)
GW40 DD 5 12	2.44	(8.0)	2.44	(8.0)	5.95	(64.0)	6.26	(13.8)	8.44	(18.6)	12.52	(27.6)	16.87	(37.2)
GW40 DD 5 13	2.64	(8.7)	2.44	(8.0)	6.44	(69.3)	6.78	(15.0)	9.14	(20.2)	13.56	(29.9)	18.28	(40.3)
GW40 DD 5 14	2.84	(9.3)	2.44	(8.0)	6.94	(74.7)	7.30	(16.1)	9.84	(21.7)	14.61	(32.2)	19.69	(43.4)
GW40 DD 5 15	3.05	(10.0)	2.44	(8.0)	7.43	(80.0)	7.82	(17.3)	10.55	(23.3)	15.65	(34.5)	21.09	(46.5)
GW40 DD 5 16	3.25	(10.7)	2.44	(8.0)	7.93	(85.3)	8.35	(18.4)	11.25	(24.8)	16.69	(36.8)	22.50	(49.6)
GW40 DD 5 17	3.45	(11.3)	2.44	(8.0)	8.42	(90.7)	8.87	(19.6)	11.95	(26.4)	17.74	(39.1)	23.90	(52.7)
GW40 DD 5 18	3.66	(12.0)	2.44	(8.0)	8.92	(96.0)	9.39	(20.7)	12.66	(27.9)	18.78	(41.4)	25.31	(55.8)
GW40 DD 5 19	3.86	(12.7)	2.44	(8.0)	9.41	(101.3)	9.91	(21.9)	13.36	(29.5)	19.82	(43.7)	26.72	(58.9)
GW40 DD 5 20	4.06	(13.3)	2.44	(8.0)	9.91	(106.7)	10.43	(23.0)	14.06	(31.0)	20.87	(46.0)	28.12	(62.0)
GW40 DD 5 21	4.27	(14.0)	2.44	(8.0)	10.41	(112.0)	10.95	(24.2)	14.76	(32.6)	21.91	(48.3)	29.53	(65.1)
GW40 DD 5 22	4.47	(14.7)	2.44	(8.0)	10.90	(117.3)	11.48	(25.3)	15.47	(34.1)	22.95	(50.6)	30.93	(68.2)
GW40 DD 5 23	4.67	(15.3)	2.44	(8.0)	11.40	(122.7)	12.00	(26.5)	16.17	(35.7)	24.00	(52.9)	32.34	(71.3)
GW40 DD 5 24	4.88	(16.0)	2.44	(8.0)	11.89	(128.0)	12.52	(27.6)	16.87	(37.2)	25.04	(55.2)	33.75	(74.4)
GW40 DD 5 25	5.08	(16.7)	2.44	(8.0)	12.39	(133.3)	13.04	(28.8)	17.58	(38.8)	26.08	(57.5)	35.15	(77.5)
GW40 DD 5 26	5.28	(17.3)	2.44	(8.0)	12.88	(138.7)	13.56	(29.9)	18.28	(40.3)	27.12	(59.8)	36.56	(80.6)
GW40 DD 5 27	5.49	(18.0)	2.44	(8.0)	13.38	(144.0)	14.08	(31.1)	18.98	(41.9)	28.17	(62.1)	37.97	(83.7)
GW40 DD 5 28	5.69	(18.7)	2.44	(8.0)	13.87	(149.3)	14.61	(32.2)	19.69	(43.4)	29.21	(64.4)	39.37	(86.8)
GW40 DD 5 29	5.89	(19.3)	2.44	(8.0)	14.37	(154.7)	15.13	(33.4)	20.39	(45.0)	30.25	(66.7)	40.78	(89.9)
GW40 DD 5 30	6.10	(20.0)	2.44	(8.0)	14.86	(160.0)	15.65	(34.5)	21.09	(46.5)	31.30	(69.0)	42.18	(93.0)
GW40 DD 5 31	6.30	(20.7)	2.44	(8.0)	15.36	(165.3)	16.17	(35.7)	21.80	(48.1)	32.34	(71.3)	43.59	(96.1)
GW40 DD 5 32	6.50	(21.3)	2.44	(8.0)	15.86	(170.7)	16.69	(36.8)	22.50	(49.6)	33.38	(73.6)	45.00	(99.2)
GW40 DD 5 33	6.71	(22.0)	2.44	(8.0)	16.35	(176.0)	17.21	(38.0)	23.20	(51.2)	34.43	(75.9)	46.40	(102.3)
GW40 DD 5 34	6.91	(22.7)	2.44	(8.0)	16.85	(181.3)	17.74	(39.1)	23.90	(52.7)	35.47	(78.2)	47.81	(105.4)
GW40 DD 5 35	7.11	(23.3)	2.44	(8.0)	17.34	(186.7)	18.26	(40.3)	24.61	(54.3)	36.51	(80.5)	49.21	(108.5)
GW40 DD 5 36	7.32	(24.0)	2.44	(8.0)	17.84	(192.0)	18.78	(41.4)	25.31	(55.8)	37.56	(82.8)	50.62	(111.6)
GW40 DD 5 37	7.52	(24.7)	2.44	(8.0)	18.33	(197.3)	19.30	(42.6)	26.01	(57.4)	38.60	(85.1)	52.03	(114.7)
GW40 DD 5 38	7.72	(25.3)	2.44	(8.0)	18.83	(202.7)	19.82	(43.7)	26.72	(58.9)	39.64	(87.4)	53.43	(117.8)
GW40 DD 5 39	7.92	(26.0)	2.44	(8.0)	19.32	(208.0)	20.34	(44.9)	27.42	(60.5)	40.69	(89.7)	54.84	(120.9)
GW40 DD 5 40	8.13	(26.7)	2.44	(8.0)	19.82	(213.3)	20.87	(46.0)	28.12	(62.0)	41.73	(92.0)	56.25	(124.0)
GW40 DD 5 41	8.33	(27.3)	2.44	(8.0)	20.31	(218.7)	21.39	(47.2)	28.83	(63.6)	42.77	(94.3)	57.65	(127.1)
GW40 DD 5 42	8.53	(28.0)	2.44	(8.0)	20.81	(224.0)	21.91	(48.3)	29.53	(65.1)	43.82	(96.6)	59.06	(130.2)
GW40 DD 5 43	8.74	(28.7)	2.44	(8.0)	21.31	(229.3)	22.43	(49.5)	30.23	(66.7)	44.86	(98.9)	60.46	(133.3)
GW40 DD 5 44	8.94	(29.3)	2.44	(8.0)	21.80	(234.7)	22.95	(50.6)	30.93	(68.2)	45.90	(101.2)	61.87	(136.4)
GW40 DD 5 45	9.14	(30.0)	2.44	(8.0)	22.30	(240.0)	23.47	(51.8)	31.64	(69.8)	46.95	(103.5)	63.28	(139.5)

NOTE: To obtain non-perforated Geoweb section weights increase table weights by approximately 16% ±1%.

Specifier Choice for Section Properties

The specifier shall state the desired Geoweb section type(s) and size(s). Refer to *THE GEOWEB SYSTEM TECHNICAL OVERVIEW* documents for recommendations.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Geoweb Section Special Features

NOTE: All measurements are subject to manufacturing tolerances unless otherwise stated.

Geoweb Sections with ATRA™ Notches

Geoweb sections shall have ATRA™ notches to allow the driving of the ATRA™ Anchors and/or J-Pin anchors below the top of the cell wall. ATRA™ notches shall be a 20 mm wide x 20 mm deep (¾ in x ¾ in) notch cut into the Geoweb section at the primary weld locations. The vertical center of the notch with respect to the weld shall be located ±10 mm (3/8 in) off the weld line. See Figure 5.

Tendoned Geoweb Sections

Geoweb sections shall be provided with a series of aligned holes through the cell walls for the insertion of tendons. Tendons are inserted in the field such that they pass through the Geoweb section in the direction of expansion. Hole diameter shall be 10 mm (0.375 in) and positioned according to the requirements of the tendon design. See Figure 6.

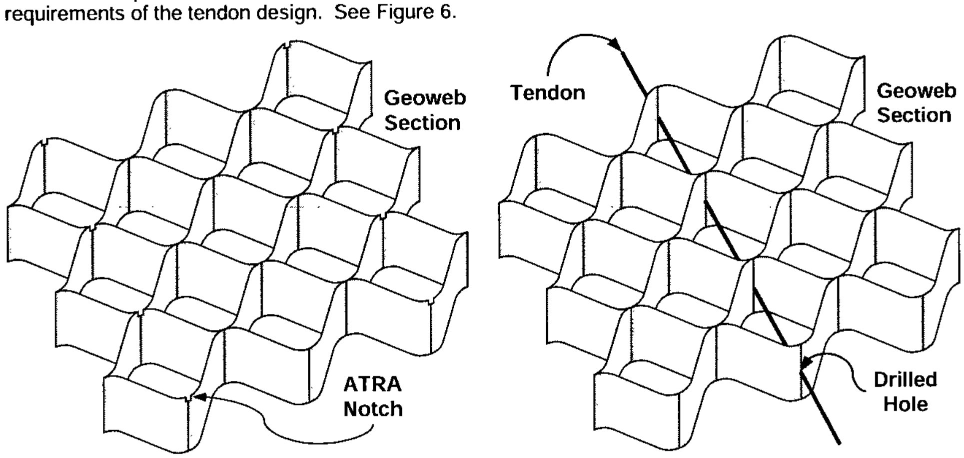

Figure 5 Geoweb Section with ATRA Notch **Figure 6 Drilled Geoweb Section with Tendon**

Specifier Choice for Special Features

The specifier shall state which of the special Geoweb section features are required for the application. Refer to *THE GEOWEB SYSTEM TECHNICAL OVERVIEW* documents for recommendations.

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GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Tendons

Polyester Tendons – Polyethylene Coated

The polyester tendon shall be manufactured from bright, high-tenacity, industrial-continuous-filament polyester yarn woven into a round braided cord consisting of a parallel filament inner core covered with 32 strands of braided polyester. The overall mass shall be 12 kg/1000 m (8.1 lb/1000 ft). Elongation shall be approximately 10% at 450 kg (1000 lbf) load. The coating over the polyester tendon shall be low-density polyethylene with a thickness of 0.4-0.6 mm (15-25 mils). The tendon reference name, diameter / width and minimum-break-strength shall be per Table 4.

Polyester Tendons – Uncoated

The polyester tendon shall be manufactured from bright, high-tenacity, industrial-continuous-filament polyester yarn woven into a braided strap. Elongation shall be 9-15% at break. The tendon reference name, diameter / width and minimum break-strength shall be per Table 4.

Table 4 Polyester Tendon - Coated and Uncoated

Reference Name	Tendon Diameter / Width		Tendon Minimum Break-strength	
	mm	in	kN	lbf
TPC-71 (coated)	5 dia	0.180 dia	7.12	1600
TP-31 (uncoated)	13	0.500	3.11	700
TP-67 (uncoated)	19	0.750	6.70	1506
TP-93 (uncoated)	19	0.750	9.30	2090

Kevlar® Aramid Tendons

The Kevlar® aramid tendon shall be a woven strap having the reference name, width and minimum break-strength per Table 5.

Table 5 Kevlar® Aramid Tendon

Reference Name	Tendon Diameter / Width		Tendon Minimum Break-strength	
	mm	in	kN	lbf
TK-89	10	0.375	8.90	2000
TPP-133	16	0.625	13.34	3000

C-UCP-E-08001, R6
ATTACHMENT G
PAGE 614 OF 616

GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Polypropylene Tendons

The polypropylene tendon shall be 3-strand twisted rope having the reference name, diameter and minimum break-strength per Table 6.

Table 6 Polypropylene Tendon

Reference Name	Tendon Diameter / Width		Tendon Minimum Break-strength	
	mm	in	kN	lbf
TPP-44	6 dia	0.25 dia	4.40	990

The ATRA® Clip Restraint Pin

The ATRA® Clip shall be used as a load transfer pin within the tendoned Geoweb® system. The ATRA® Clip Restraint Pin shall transfer load from the infilled Geoweb cells to the tendon. The ATRA® Clip shall be molded from high-strength polyethylene.

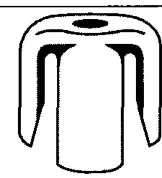

Figure 7 ATRA® Clip

Specifier Choice for Tendons and Restraint Pins

The specifier shall state which tendon is to be used. Tendon strength must meet design requirements for the application. The specifier shall also state if the ATRA® Clip restraint pin is needed. Refer to *THE GEOWEB SYSTEM TECHNICAL OVERVIEW* documents for recommendations

Geoweb Section Anchoring Components

NOTE: All measurements are subject to manufacturing tolerances unless otherwise stated.

Anchoring Requirements

Geoweb sections, with or without tendons, shall be anchored in accordance with construction drawings. Rows of ATRA™ Anchors or stake anchors shall engage and bear against the cell walls, or engage and hold the integral tendons against the foundation soil. The size, type and distribution of ATRA™ Anchor (stake anchors) shall be in accordance with the construction drawings.

C-DCP-E-00081, R18
ATTACHMENT 6
PAGE 615 OF 616

GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

Anchor Systems

ATRA™ GFRP Anchor

The ATRA™ GFRP Anchor shall be a pre-assembled unit consisting of the ATRA® Clip inserted onto the ATRA™ GFRP Stake so that the end of the Stake is flush with or 3 mm (1/8 in) maximum above the top of the ATRA® Clip. Prior to inserting the ATRA® Clip on the end of the stake, the stake end shall be ground or filed so it has a bevel and is free from all burrs.

ATRA™ GFRP Stake

The ATRA™ GFRP Stake shall be composed of glass fiber reinforced polymer with a sand-coating. Glass reinforcement content shall be 75% minimum by weight and shall be continuous longitudinal filament. The use of non-continuous filament is strictly prohibited. Polymer shall be vinyl ester, isopthalic polyester, or other matrix material. The outer surface of the Stake shall be sand coated and deformed by a helical wrap of glass. The ATRA™ GFRP Stake shall have a minimum tensile strength of 655 MPa (95 ksi) per ASTM D638. The Stake shall be non-magnetic, non-conducting and corrosion resistant. The Stake diameter shall be 12-13 mm (1/2 in). The length shall be per construction drawings. Prior to inserting the ATRA® Clip on the end of the stake, the stake end shall be ground or filed so it has a bevel and is free from all burrs.

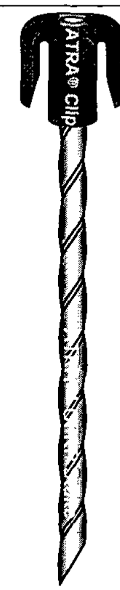

Figure 8
ATRA™ GFRP Anchor

ATRA™ Anchor

The ATRA™ Anchor shall be made by properly inserting the ATRA® Clip onto the ATRA™ Stake so that the end of the Stake is flush with or 3 mm (1/8 in) maximum above the top of the ATRA® Clip. Prior to inserting the ATRA® Clip on the end of the stake, the stake end shall be ground or filed so it has a bevel and is free from all burrs.

Other ATRA™ Stakes

1. The ATRA™ Stake shall consist of straight 12-13 mm (#4) steel reinforcing rod. The Stake length shall be per construction drawings. Prior to inserting the ATRA® Clip on the end of the stake, the stake end shall be ground or filed so it has a bevel and is free from all burrs.
2. The ATRA™ Stake shall consist of straight 12-13 mm (#4) steel reinforcing rod hot dipped galvanized per AASHTO M-218. The Stake length shall be per construction drawings. Prior to inserting the ATRA® Clip on the end of the stake, the stake end shall be ground or filed so it has a bevel and is free from all burrs.
3. The ATRA™ Stake shall consist of straight 12-13 mm (½ in) ____________________ (state metal type) rod. The Stake length shall be per construction drawings. Prior to inserting the ATRA® Clip on the end of the stake, the stake end shall be ground or filed so it has a bevel and is free from all burrs.

ATTACHMENT G
PAGE G16 OF G16

GEOWEB® CELLULAR CONFINEMENT SYSTEM MATERIAL SPECIFICATION

GFRP Stakes

The GFRP Stake shall be composed of glass fiber reinforced polymer with a sand-coating. Glass reinforcement content shall be 75% minimum by weight and shall be continuous longitudinal filament. The use of non-continuous filament is strictly prohibited. Polymer shall be vinyl ester, isopthalic polyester, or other matrix material. The outer surface of the stake shall be sand coated and deformed by a helical wrap of glass. The stake shall have a minimum tensile strength of 655 MPa (95 ksi) per ASTM D638. The stake shall be non-magnetic, non-conducting and corrosion resistant. The stake diameter and length shall be per construction drawings.

Steel J-pin Stakes

Steel J-pin stakes shall be fabricated from mild steel or reinforcing steel rod. Each stake shall have a minimum-radius, 180-degree return at one end. Rod diameter shall be 8 mm (0.3125 in), 10 mm (0.375 in), 12 mm (0.50 in), 16 mm (0.625 in) or 20 mm (0.75 in). Stake length shall be per the construction drawings. When specified, galvanizing shall be per AASHTO M-218.

Straight Steel Stakes

Straight steel stakes shall be fabricated from mild steel or reinforcing steel rod. Rod diameter shall be 8 mm (0.3125 in), 10 mm (0.375 in), 12 mm (0.50 in), 16 mm (0.625 in) or 20 mm (0.75 in). Stake length shall be per the construction drawings. When specified, galvanizing shall be per AASHTO M-218.

Straight Metal Stakes

Straight metal shall be fabricated from ____________________ *(state metal type) rod. Rod diameter* shall be 8 mm (0.3125 in), 10 mm (0.375 in), 12 mm (0.50 in), 16 mm (0.625 in) or 20 mm (0.75 in). Stake length shall be per the construction drawings.

Wood Stakes

Wood stakes shall be made from _________________ (state wood type) and shall be free from knots that effect the strength of the stake. The stakes shall have a cross section of _______________ by __________________ and be _________________ long.

Specifier Choice for Anchoring Systems

The specifier shall state which of the anchoring methods are required for the application and choose from the stated options. Refer to *THE GEOWEB SLOPE PROTECTION SYSTEM* and/or *CHANNEL PROTECTION SYSTEM TECHNICAL OVERVIEW* for recommendations. Note, the glass fiber reinforced polymer ATRA™ GFRP Stake is available from Presto separately or with the ATRA® Clip already attached to form the ATRA™ GFRP Anchor. Other ATRA™ Stakes are not available from Presto.

APPENDIX B

GEOTECHNICAL DATA SUMMARY
FOR
MEGA-TRENCH SITE

May 2001

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This document summarizes the geotechnical data for the Savannah River Site (SRS) E-Area Low Level Waste Mega-trench site. Figure 1 shows the location of the Mega-trench along with the geotechnical exploration locations.

Engineering layers were identified based on piezocone penetration test (CPTU) results and substantiated with a geotechnical borehole log as well as other CPTU results in the vicinity. Figure 2 shows the geotechnical profile at the Mega-trench site. Geotechnical profile also shows the CPTU tip stress and friction ratio, Standard Penetration Test blow count, and soil sample locations.

Geotechnical investigation results including piezocone penetration test soundings, geotechnical boreholes, groundwater monitoring wells, and laboratory tests are described in the following sections.

A. Piezocone Penetration Test Soundings

Ten piezocone penetration test (CPTU) soundings were conducted in the vicinity of the Mega-trench site. The coordinates, elevations, and depths of these CPTU soundings are:

CPTU No.	North Coordinate (feet)	East Coordinate (feet)	Ground Elevation (feet MSL)	Depth (feet)
MEGA-CPT-1	75,830	59,625	276.7	67.7
MEGA-CPT-2	75,830	59,350	281.3	71.3
MEGA-CPT-3	75,830	59,000	286.8	74.9
MEGA-CPT-4	76,050	59,200	289.9	76.9
MEGA-CPT-5	76,050	59,600	278.1	70.0
MEGA-CPT-6	75,930	59,450	279.6	65.9
MEGA-CPT-7	75,930	59,100	285.0	72.0
At North	76,041	59,484	281.4	63.0
At East	75,919	59,621	277.0	60.0
At South	75,814	59,500	278.7	60.0

Appendix A contains the CPTU sounding results including the sleeve resistance, tip resistance, pore pressure, friction ratio, and resistivity.

B. Geotechnical Boreholes

Ten geotechnical boreholes were drilled for a previous investigation near the Mega-trench site. The coordinates, elevations, and depths of these boreholes are:

Borehole No.	North Coordinate (feet)	East Coordinate (feet)	Ground Elevation (feet MSL)	Depth (feet)
B10	75,580	58,895	291.4	65.5
B11	75,557	59,400	286.8	61.5
B12	75,600	59,743	283.1	65.5
B13	75,990	58,950	295.7	51.5
B14	76,000	59,408	289.9	140
B15	75,998	59,742	284.9	61.5
EMTUD1	75,919	59,355	281.3	50.0
EMTUD2	76,013	59,484	280.3	36.0
EMTUD3	75,919	59,609	277.2	16.0
EMTUD4	75,826	59,484	278.8	27.0

Appendix B contains the geotechnical borehole logs including the SPT blow counts, field classifications, and soil descriptions.

C. Groundwater Monitoring Wells

Groundwater level data from WSRC-TR-98-0045, *The Regional Water Table of the Savannah River Site and Related Coverages*, September 1998, and monitoring wells near the Mega-trench site were used to determine the groundwater elevation. Wells monitoring Aquifer D were used to estimate the groundwater elevation at the Mega-trench site. The coordinates of these wells are:

Well No.	Northing (feet)	Easting (feet)
BG30	75,550	58,809
BG31	75,950	58,804
BG32	76,350	58,804
BGO3D	75,351	58,809
BGO3DR	75,512	58,820
BGO4D	76,150	58,804
BGO5D	76,478	58,785
BGX10D	76,183	59,766
BGX11D	75,301	59,581

Appendix C contains a map showing ground water monitoring wall locations and a plot showing ground water elevation readings from these wells. Groundwater elevations at the Mega-trench site were obtained by interpolating the groundwater elevations in the surrounding area. The maximum groundwater elevation at the Mega-trench site was estimated to be 240 feet Mean Sea Level (MSL).

D. Laboratory Tests

Laboratory tests were performed for the Mega-trench site from the following seven undisturbed samples:

Sample No.	Northing (ft)	Easting (ft)	Surface (ft, msl)	Elevation (ft, msl)		Depth (feet)	
				From	To	From	to
EMTUD1-ST1	75,919	59,355	281.3	276.3	274.3	5.0	7.0
EMTUD1-ST2	75,919	59,355	281.3	268.3	266.3	13.0	15.0
EMTUD1-ST3	75,919	59,355	281.3	233.3	231.3	48.0	50.0
EMTUD2-ST1	76,013	59,484	280.3	273.3	271.3	7.0	9.0
EMTUD2-ST2	76,013	59,484	280.3	246.3	244.3	34.0	36.0
EMTUD3-ST1	75,919	59,609	277.2	263.2	261.2	14.0	16.0
EMTUD4-ST1	75,826	59,484	278.8	253.8	251.8	25.0	27.0

Tests for a previous investigation were performed on the following sample:

Sample No.	Northing (ft)	Easting (ft)	Surface (ft, msl)	Elevation (ft, msl)		Depth (feet)	
				From	To	From	to
B-14-ST-1	76,000	59,408	289.9	231.8	230.6	58.1	59.3

Appendix D provides the detailed laboratory test results including sieve analyses, moisture contents, Atterberg limits, and strength tests.

(1) Sieve Analysis

Sieve Analyses were performed per ASTM D 421. The results are:

Sample No.	Depth		U.S. Standard Sieve Sizes / Opening Sizes (mm)								
	from (feet)	to (feet)	3/4 19.05	3/8 9.525	4 4.750	10 2.000	20 0.850	40 0.425	60 0.250	140 0.106	200 0.075
EMTUD1-ST1	5	7	100	98	95.6	91	77	54	40	30	28.2
EMTUD1-ST2	13	15	-	-	-	100	94	82	74	50	34.5
EMTUD1-ST3	48	50	-	100	99.4	99	90	72	47	13	12.5
EMTUD2-ST1	7	9	-	-	-		100	99	97	91	88.3
EMTUD2-ST2	34	36	-	-	-	100	91	72	56	19	15.9
EMTUD3-ST1	14	16	-	-	-	100	93	77	68	47	33.1
EMTUD4-ST1	25	7	-	-	-	100	90	63	48	24	21.9

Sieve analysis was performed for a previous investigation using slightly different sieve sizes:

Sample No.	Depth from (feet)	Depth to (feet)	U.S. Standard Sieve Sizes / Opening Sizes (mm) 3/4 19.05	3/8 9.525	4 4.750	10 2.000	20 0.850	40 0.425	60 0.250	100 0.150	200 0.075
B-14 ST-1	53	55	-	-	-	100	91	77	50	18	12.0

A figure showing the grain size distribution of the soils for various layers and a figure showing the plasticity chart per ASTM D2487 are also included in Appendix D.

(2) Atterberg Limits, Moisture Content, and Classifications

Atterberg Limits and moisture content were determined per ASTM D4318 and ASTM D2216, respectively. The results are:

Sample No.	Depth		Atterberg Limits			Moisture Content (%)	USCS
	from (feet)	to (feet)	LL (%)	PL (%)	PI (%)		
EMTUD1-ST1	5	7	53	25	28	11.4	SC
EMTUD1-ST2	13	15	44	26	18	15.8	SC
EMTUD1-ST3	48	50	29	25	4	14.1	SM
EMTUD2-ST1	7	9	90	35	55	27.0	CH
EMTUD2-ST2	34	36	40	24	16	16.3	SC
EMTUD3-ST1	14	16	49	26	23	15.0	SC
EMTUD4-ST1	25	7	44	23	21	14.8	SC
B-14 ST-1	53	55	NP	NP	NP	21.2	SM

(3) Soil density

Soil density tests were performed for a previous investigation. The results are:

Boring No.	Sample No.	Sample Depth (feet)	USCS Soil Class	Moisture Content (%)	Unit dry weight (pcf)	Unit total weight (pcf)
B-10	C-3	16.90	CH	25.7	98.1	123.3
B-14	ST-1	58.70	SM	21.2	100.5	211.8

(4) Soil Strength

Strength properties obtained from laboratory tests for each layer are summarized as follows:

Layer No.	Sample No.	Total friction angle ϕ (degrees)	Total cohesion c (psf)	Effective friction angle ϕ' (degrees)	Effective cohesion c' (psf)
A	EMTUD2-ST1	31.7	390	42.6	0
B	EMTUD1-ST2	28.4	520	34.0	0
B	EMTUD3-ST1	30.2	720	34.0	0
C	EMTUD2-ST2	36.1	210	34.3	20
C	EMTUD4-ST1	28.5	970	28.6	930
D	EMTUD1-ST3	40.3	0	34.5	0

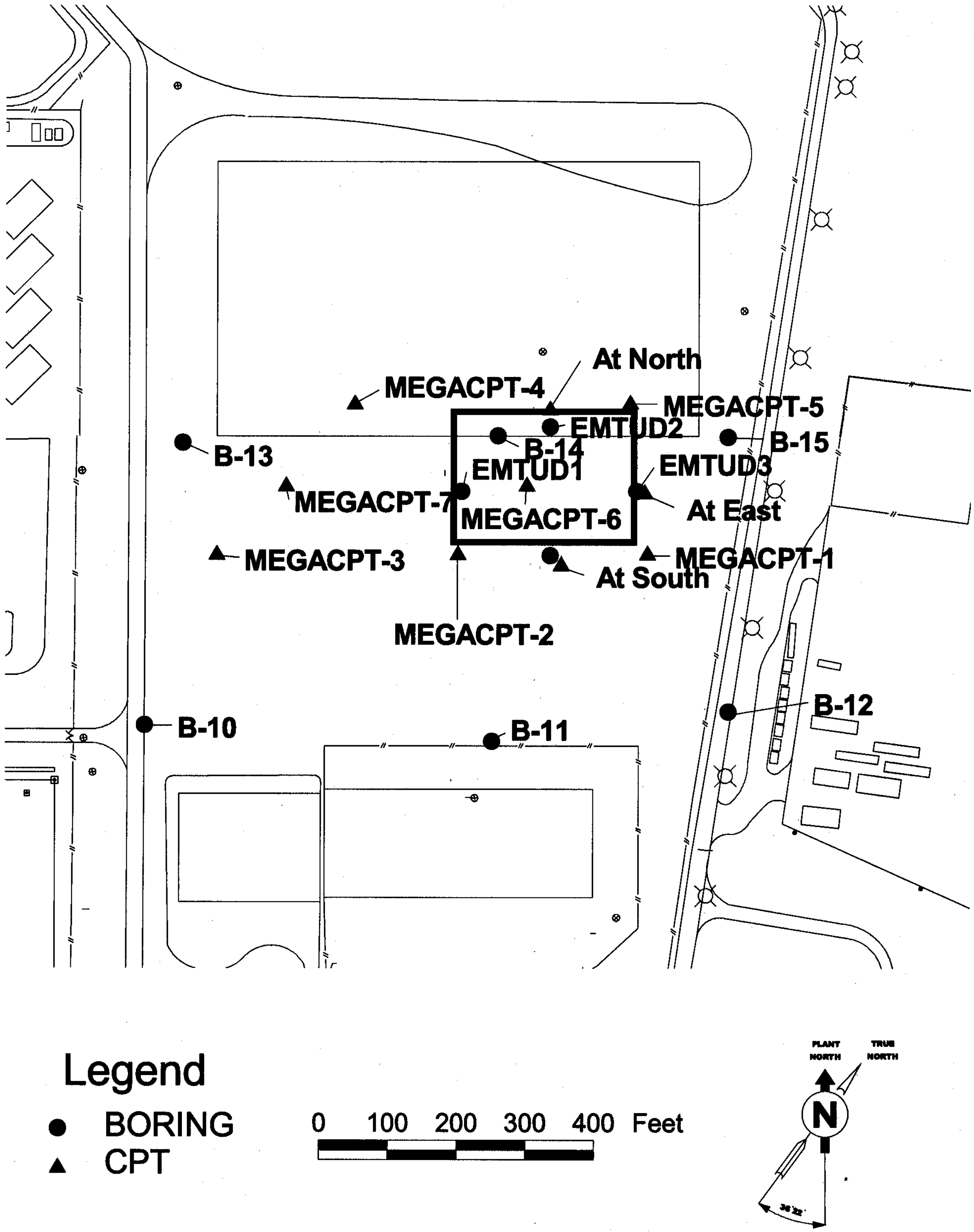

Figure 1. Geotechnical exploratory locations

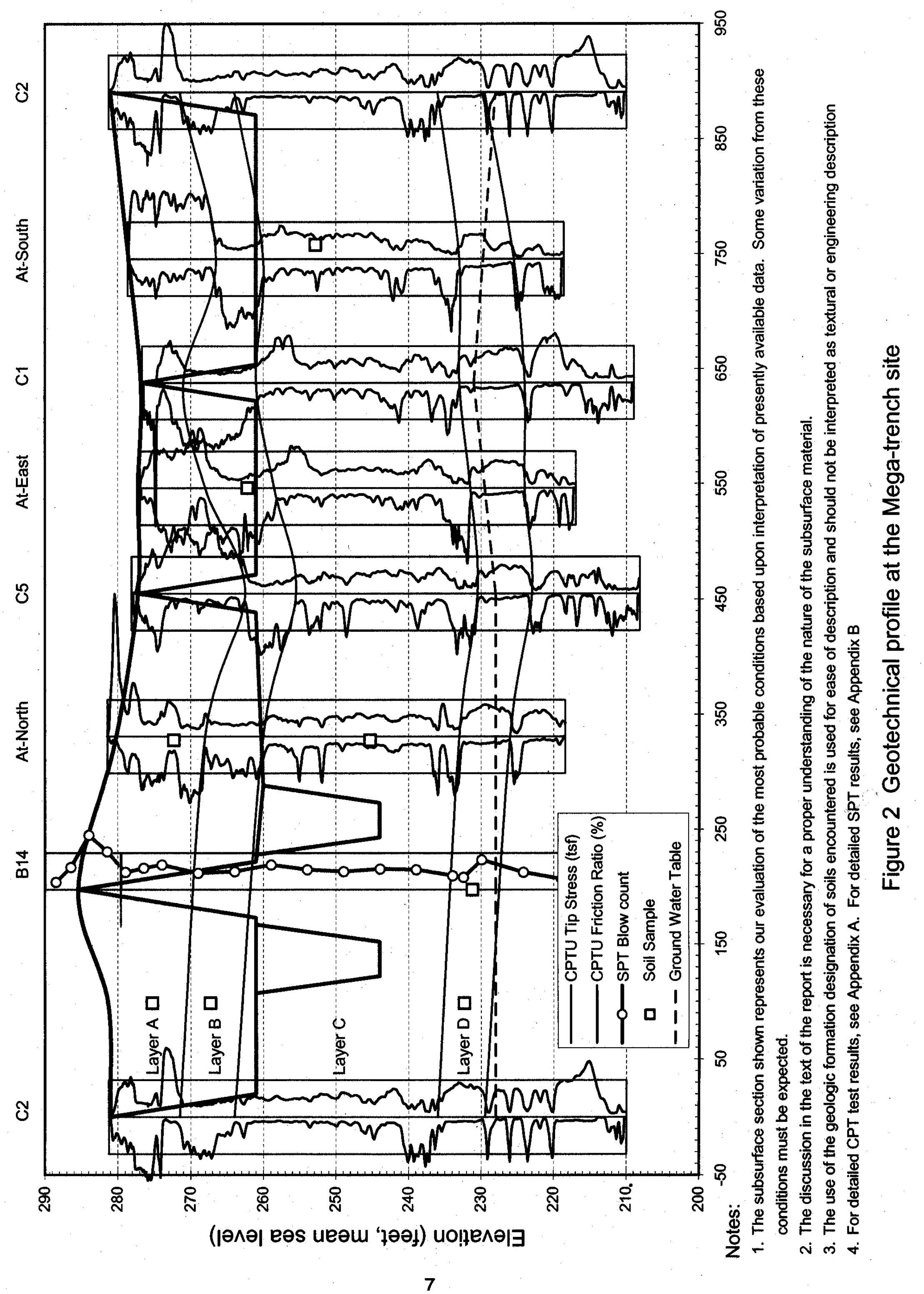

Figure 2. Geotechnical profile at the Mega-trench site

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Appendix A

Piezocone Penetration Test Soundings

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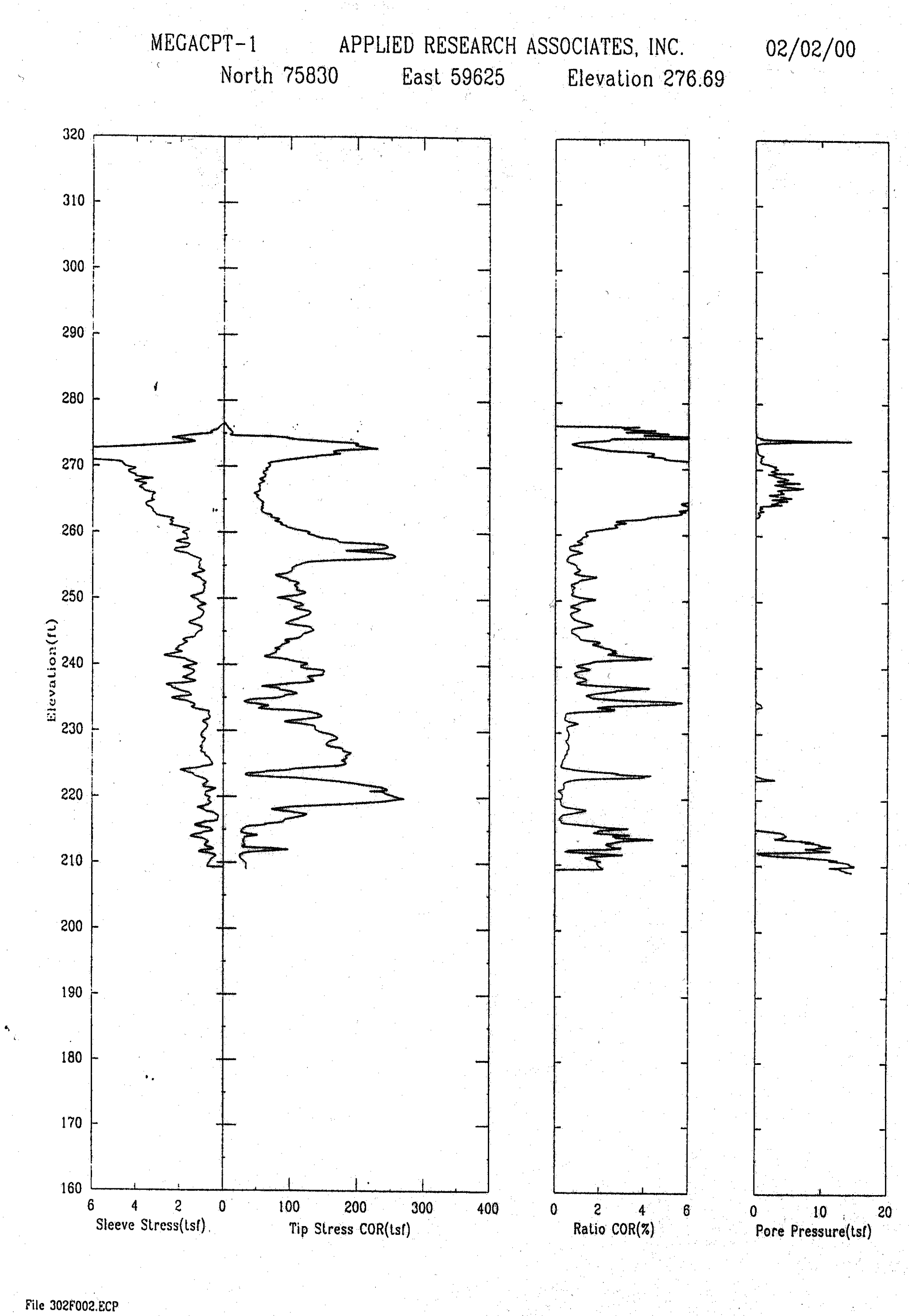
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200
190
180
170
160
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Tip Stress COR(tsf)
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Ratio COR(%)
0 10 20
Pore Pressure(tsf)
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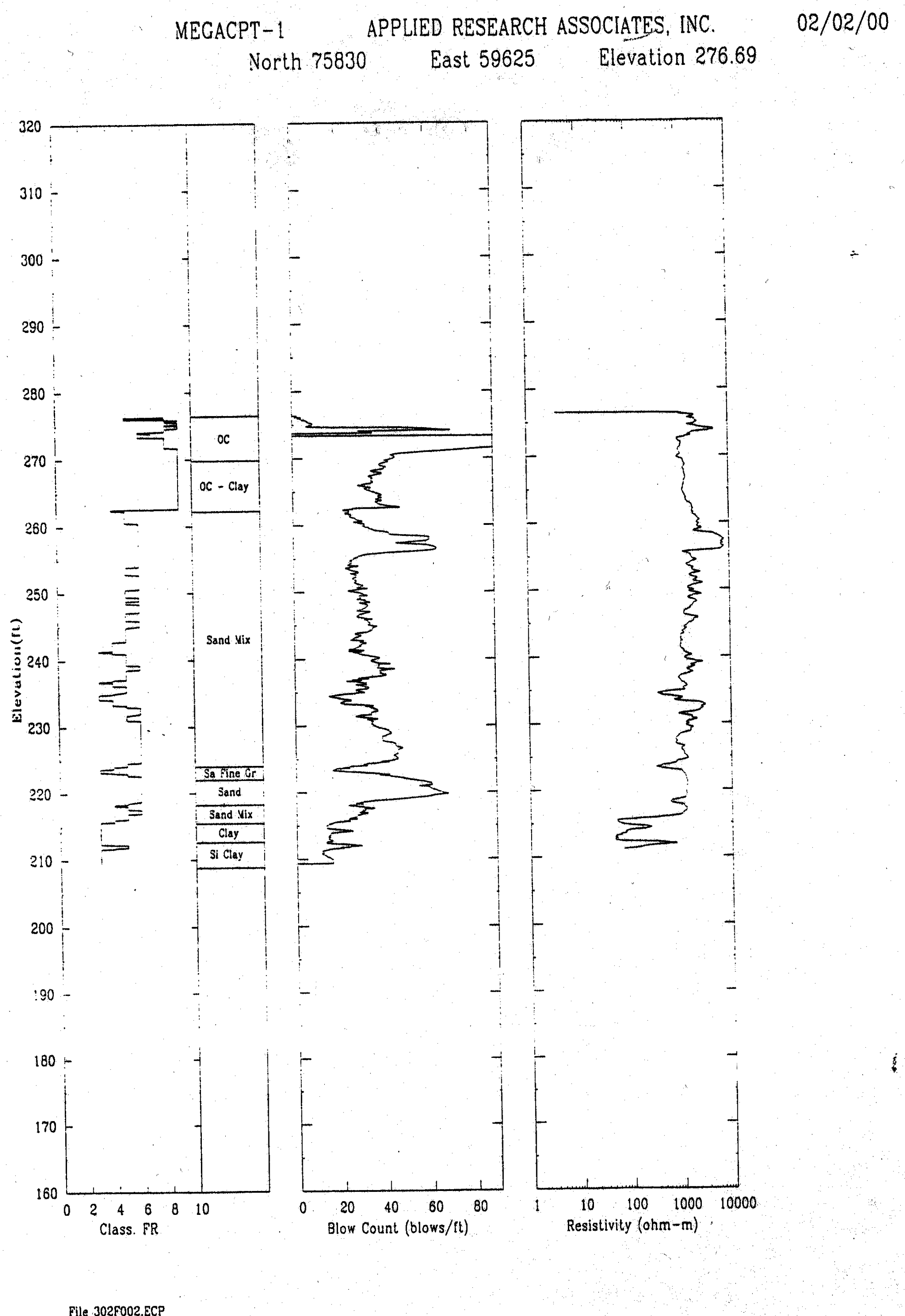

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Elevation 276.69
Elevation(ft)
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Sa Fine Gr
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Sand Mix
Clay
Si Clay
Class. FR
Blow Count (blows/ft)
Resistivity (ohm-m)
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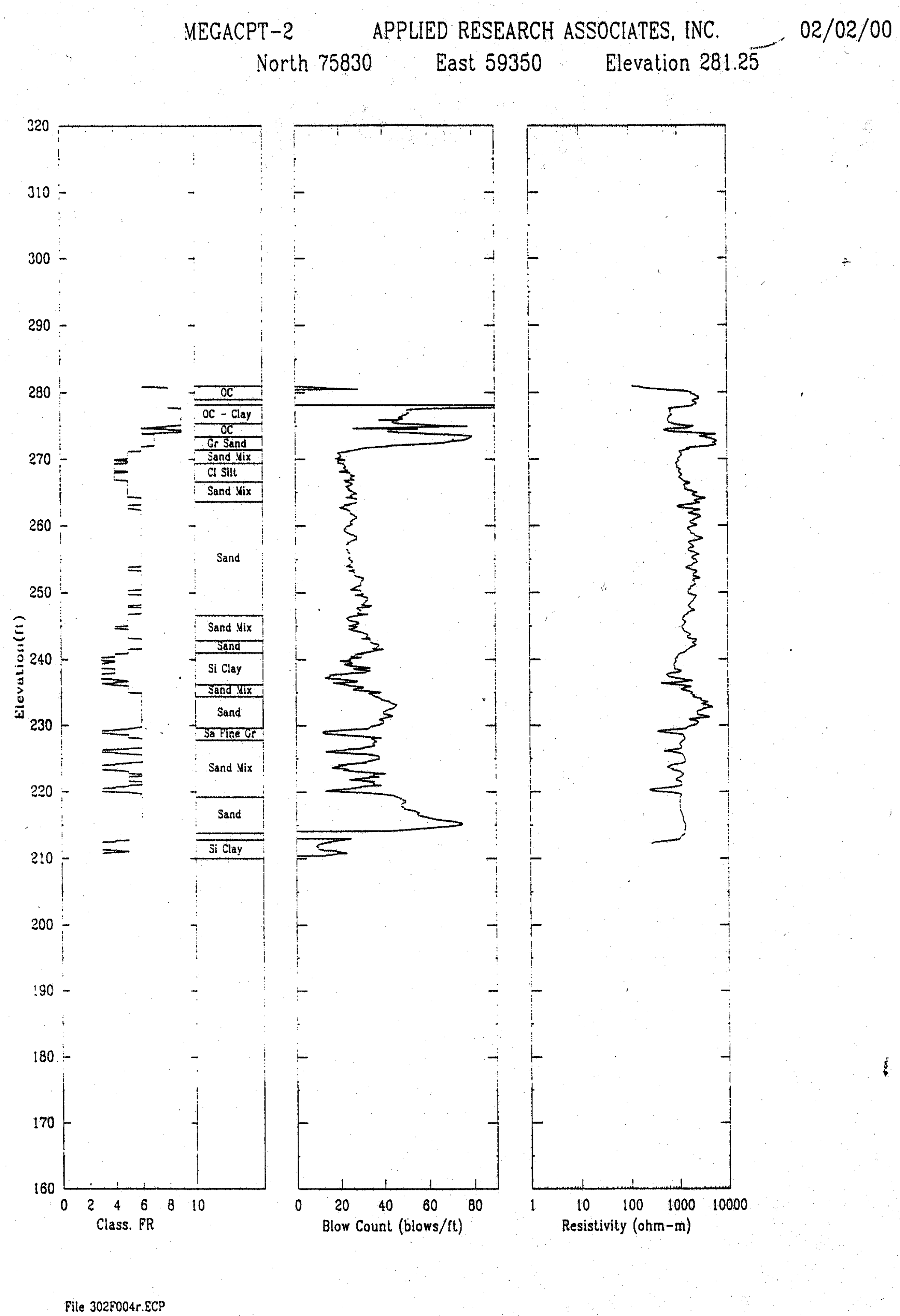
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Sand Mix
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Sand Mix
Sand
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Sand Mix
Sand
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Sand Mix
Sand
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Class. FR
Blow Count (blows/ft)
Resistivity (ohm-m)
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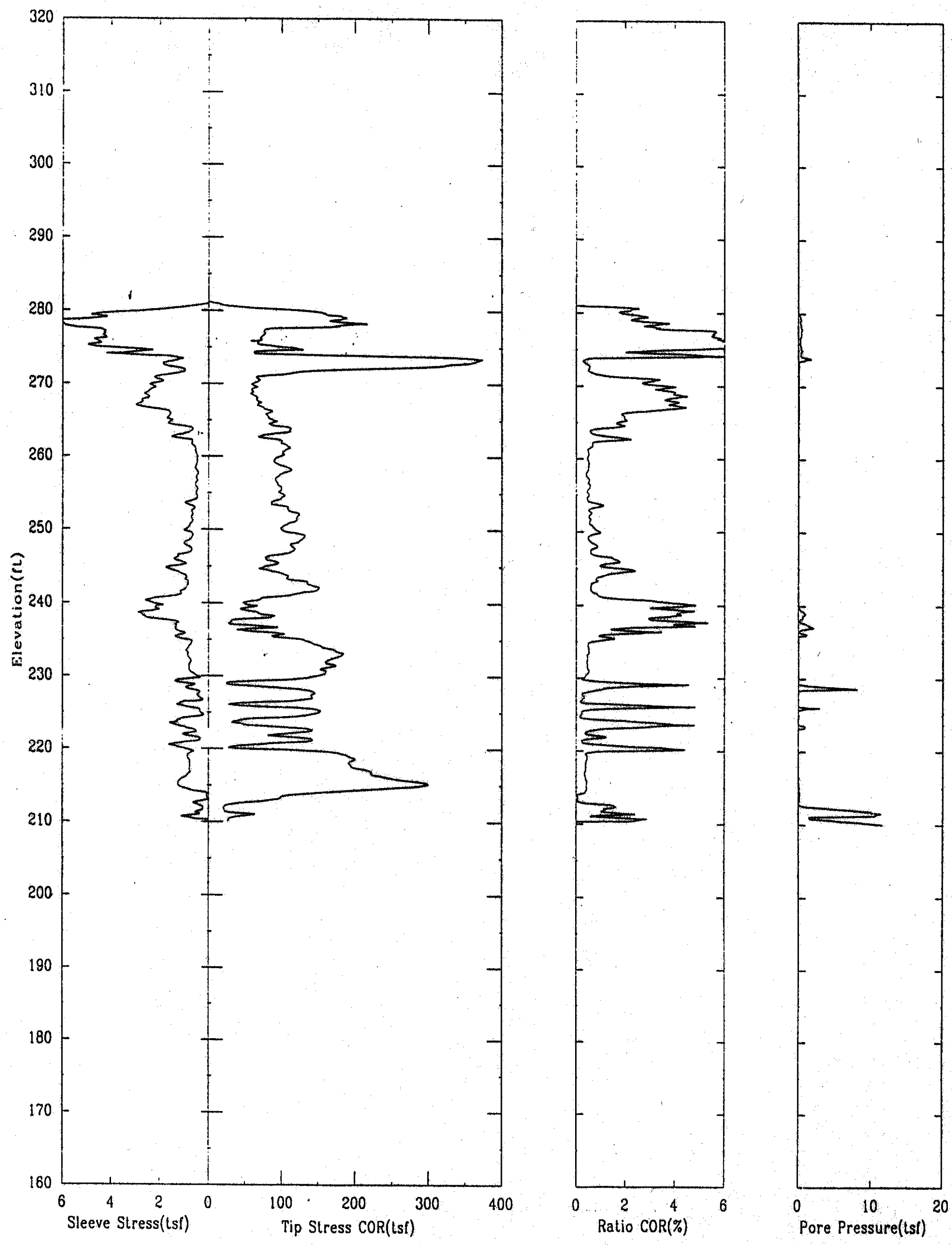

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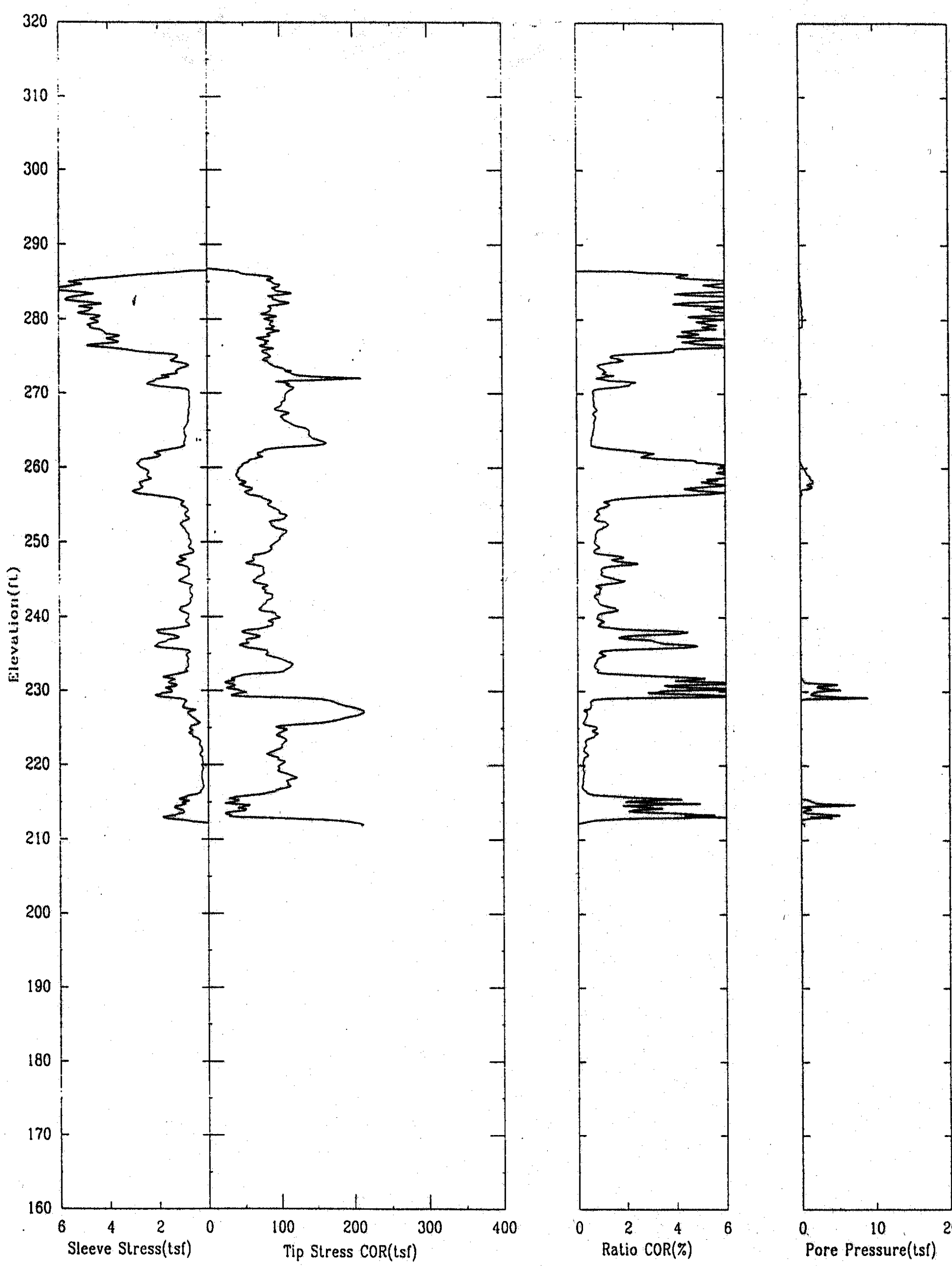

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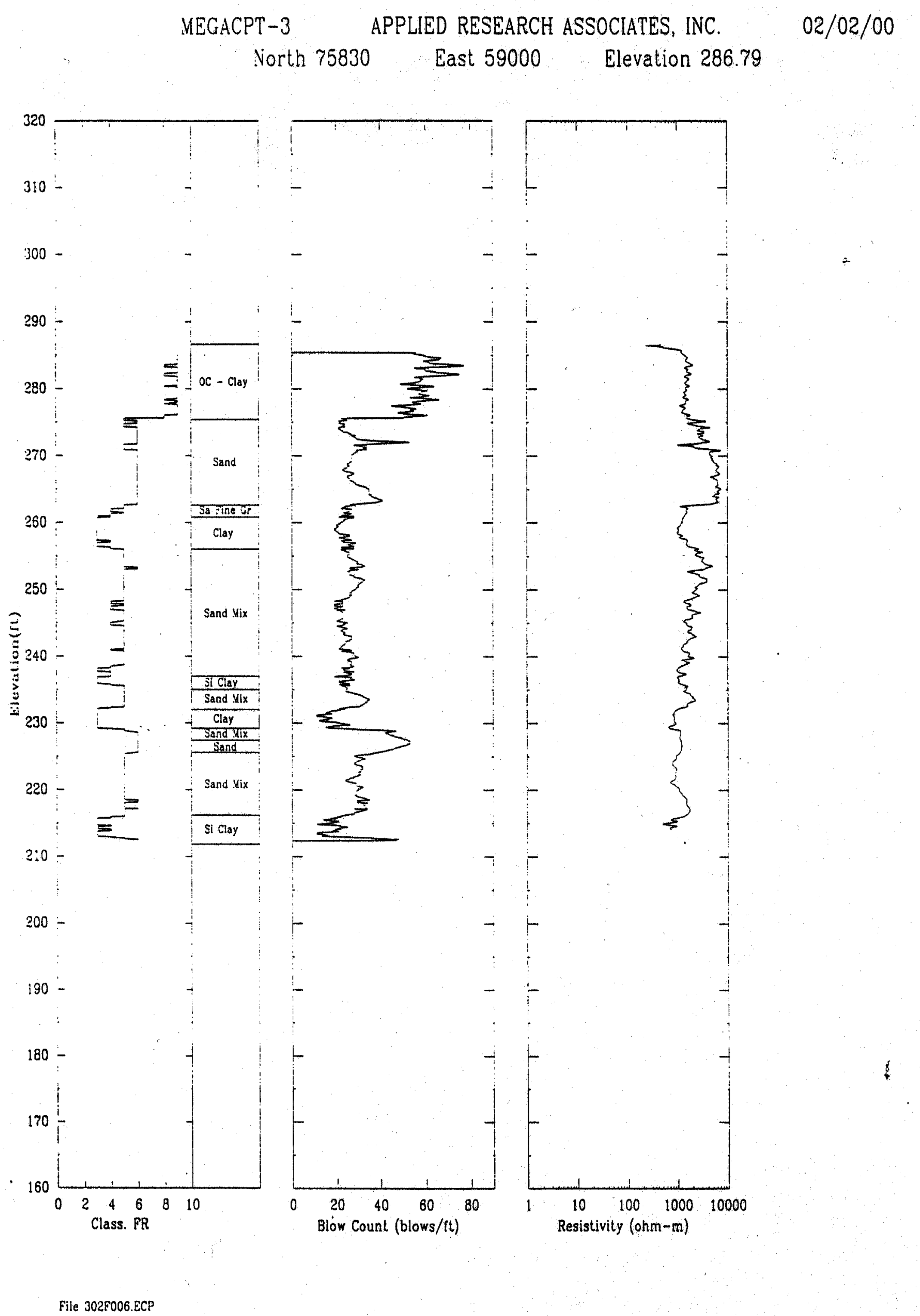
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Clay
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Si Clay
Sand Mix
Clay
Sand Mix
Sand
Sand Mix
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Class. FR
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Resistivity (ohm-m)
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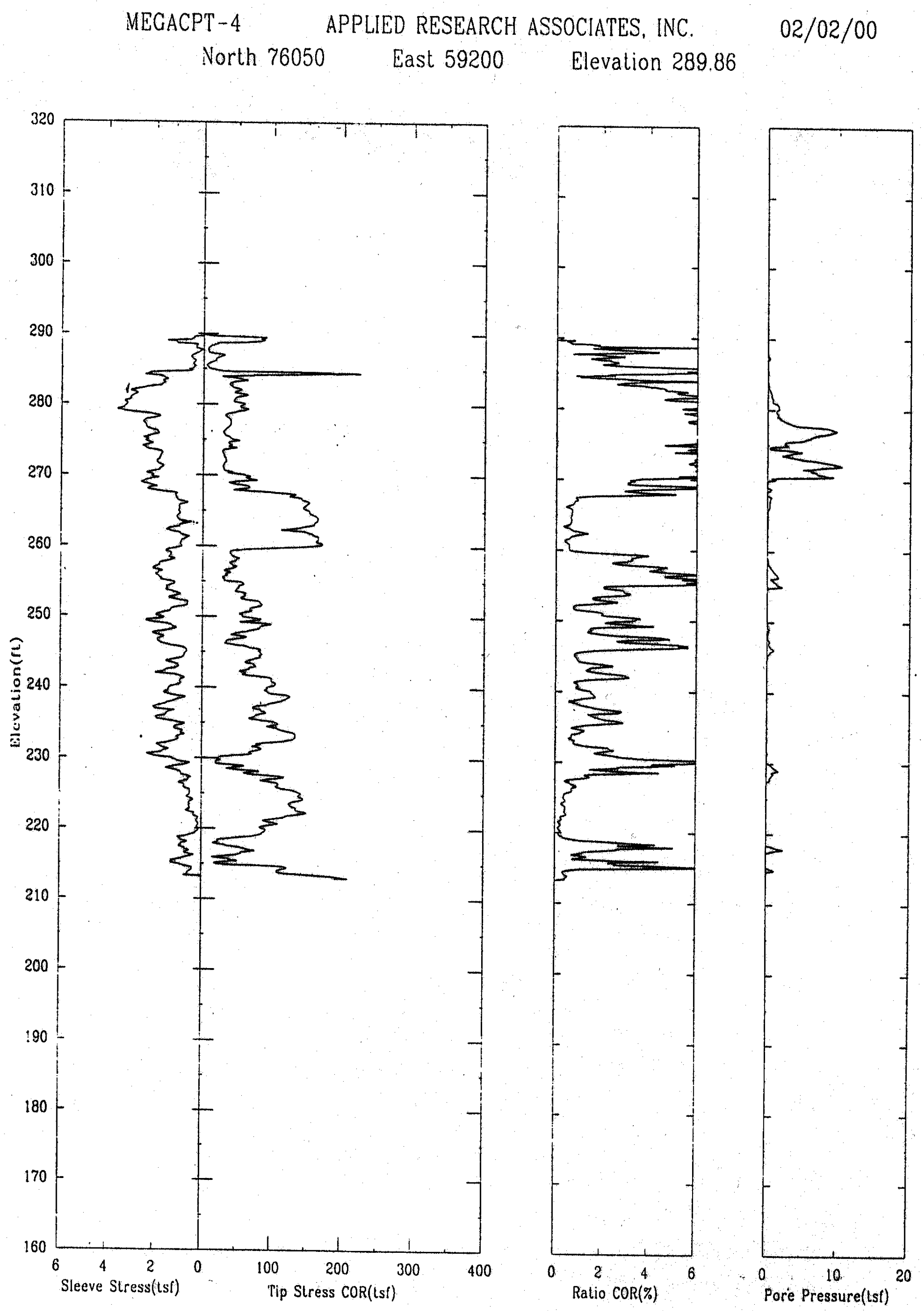

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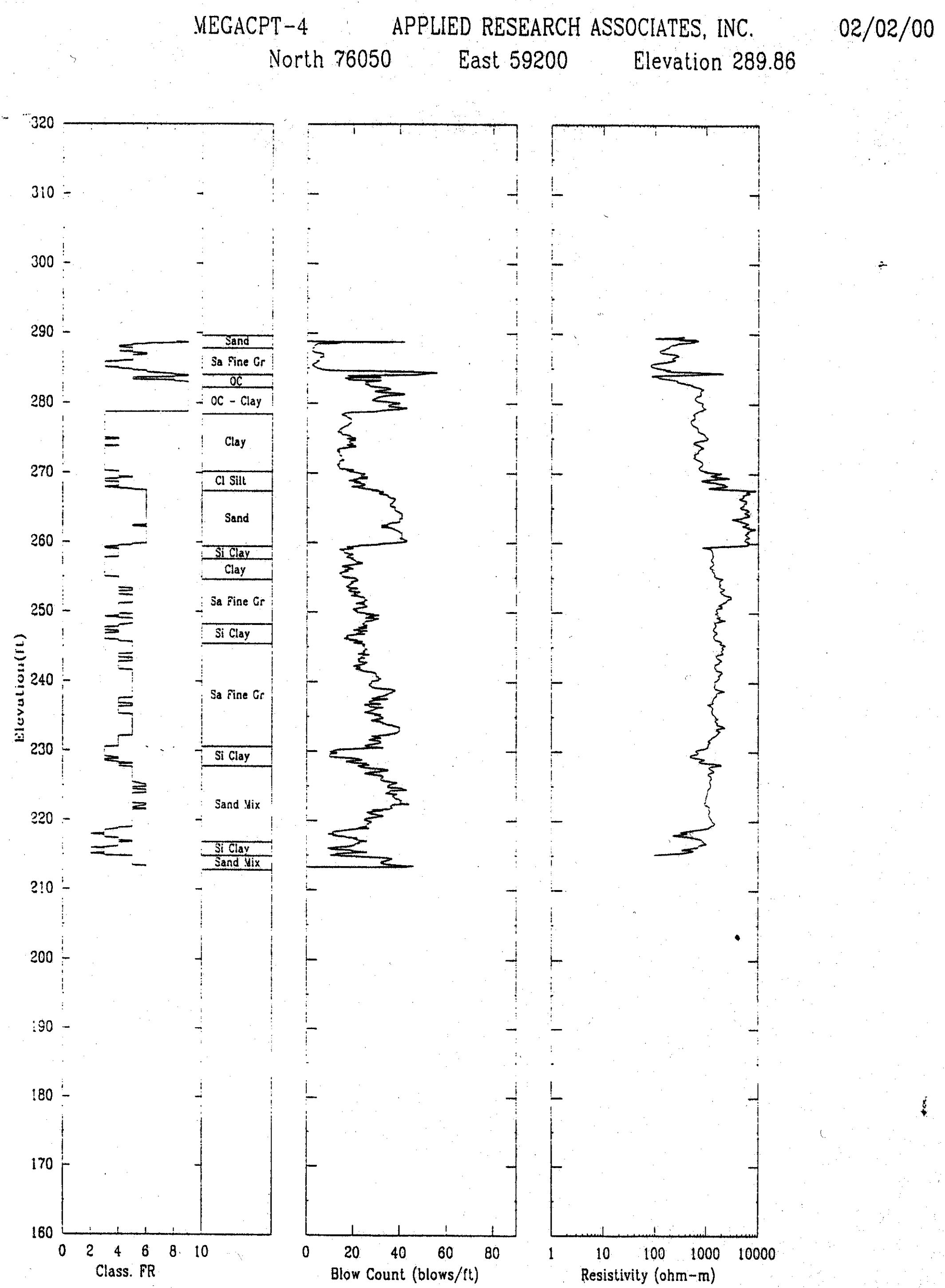

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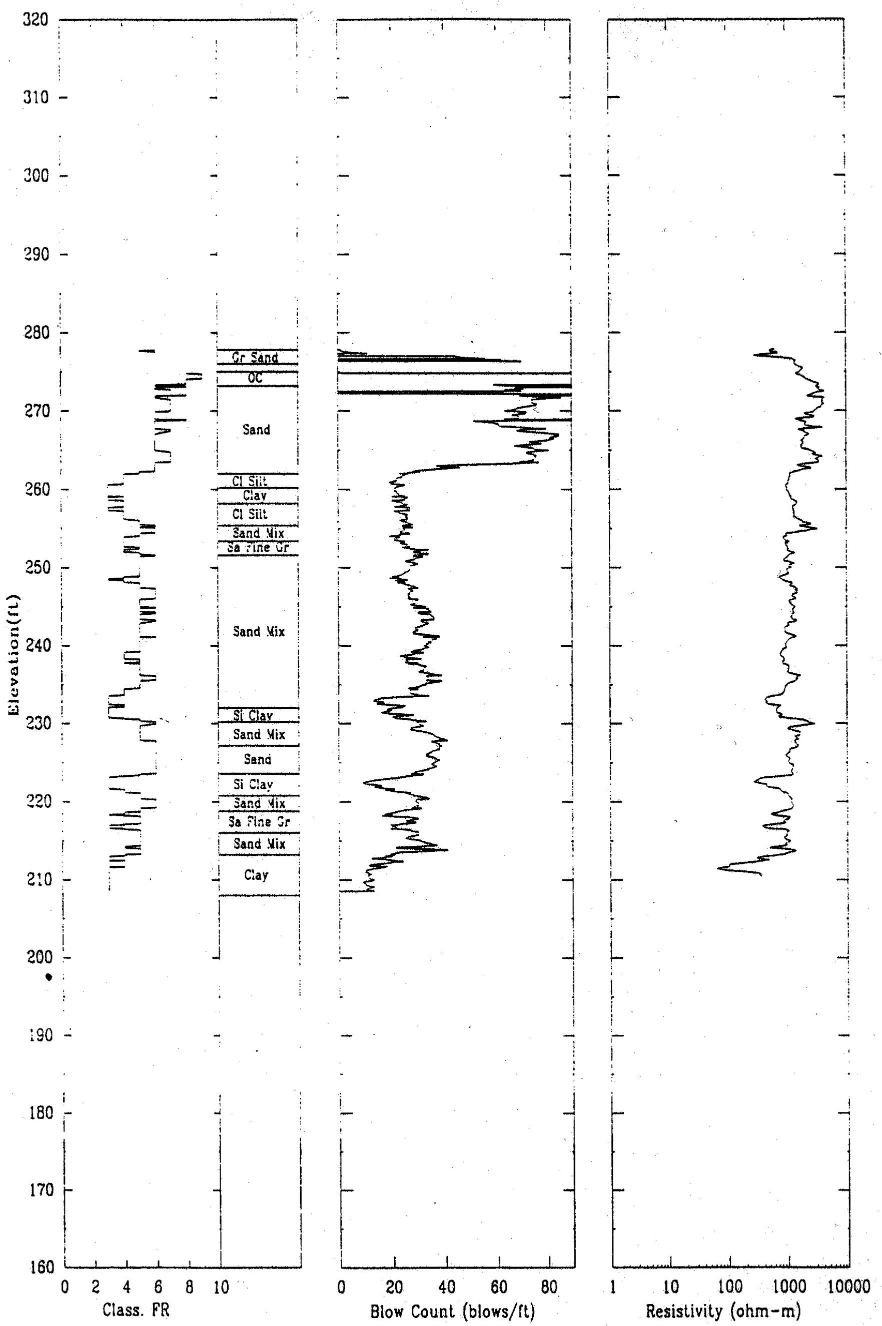

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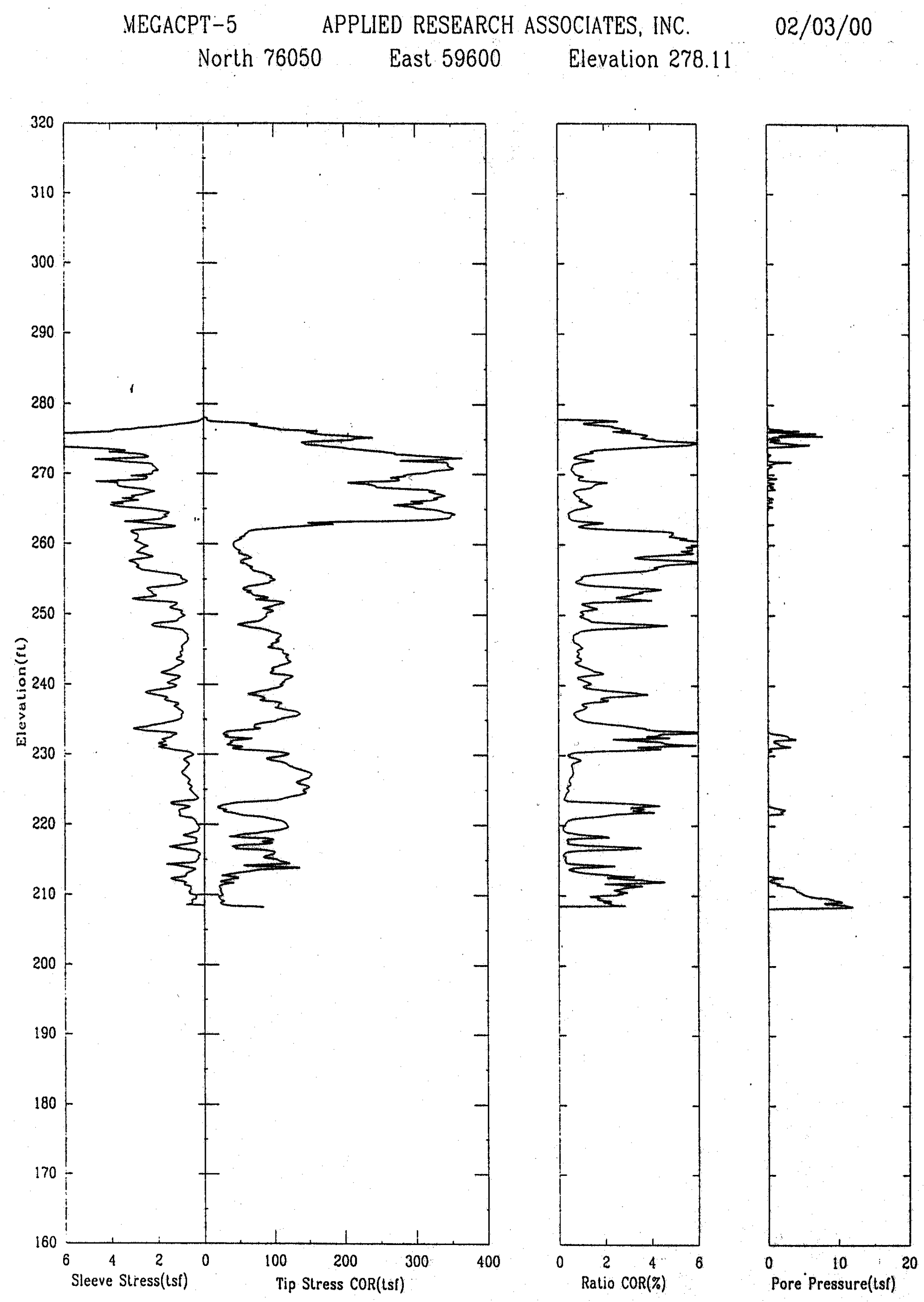

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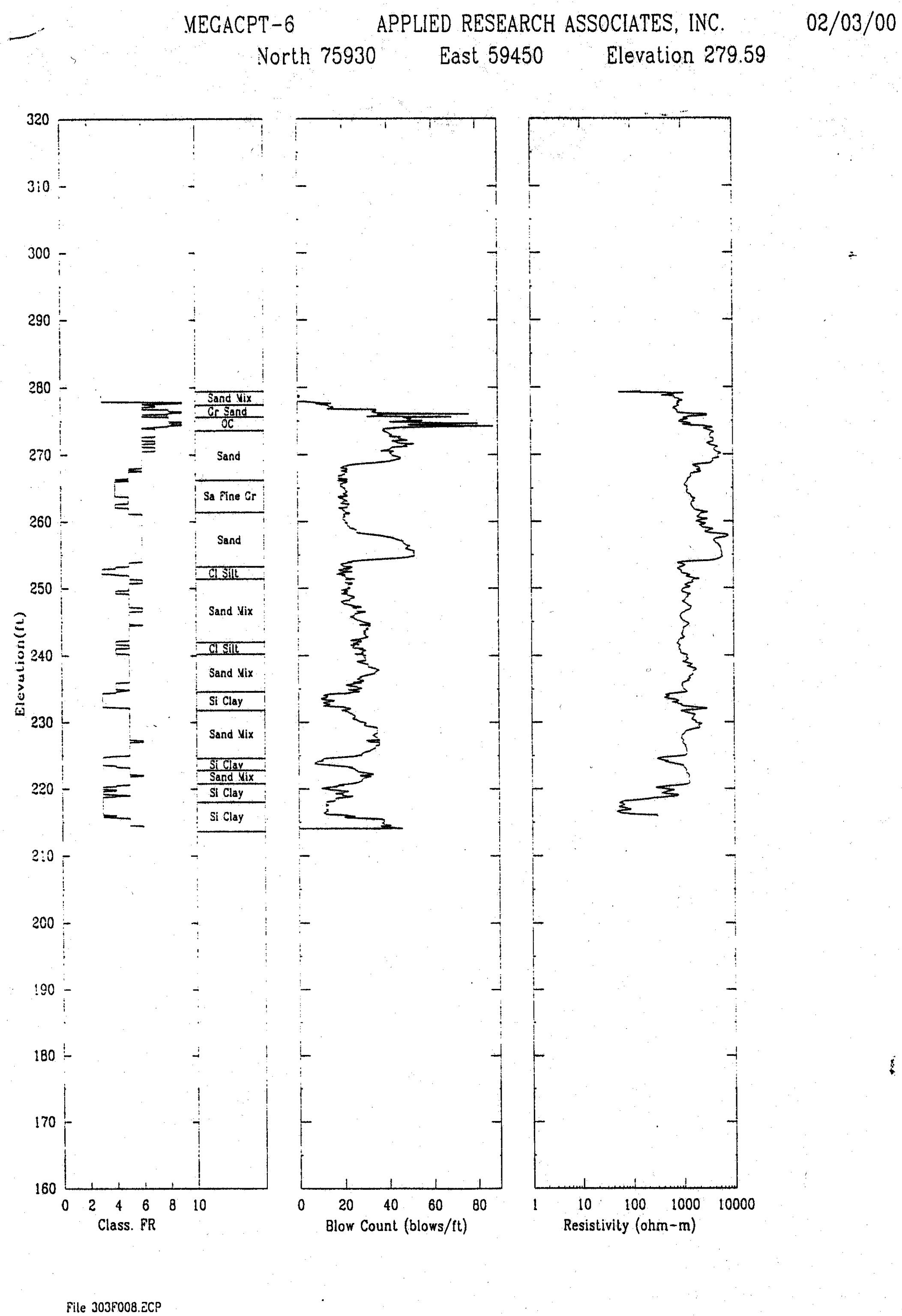
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Sand
Cl Silt
Sand Mix
Cl Silt
Sand Mix
Si Clay
Sand Mix
Si Clay
Sand Mix
Si Clay
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Blow Count (blows/ft)
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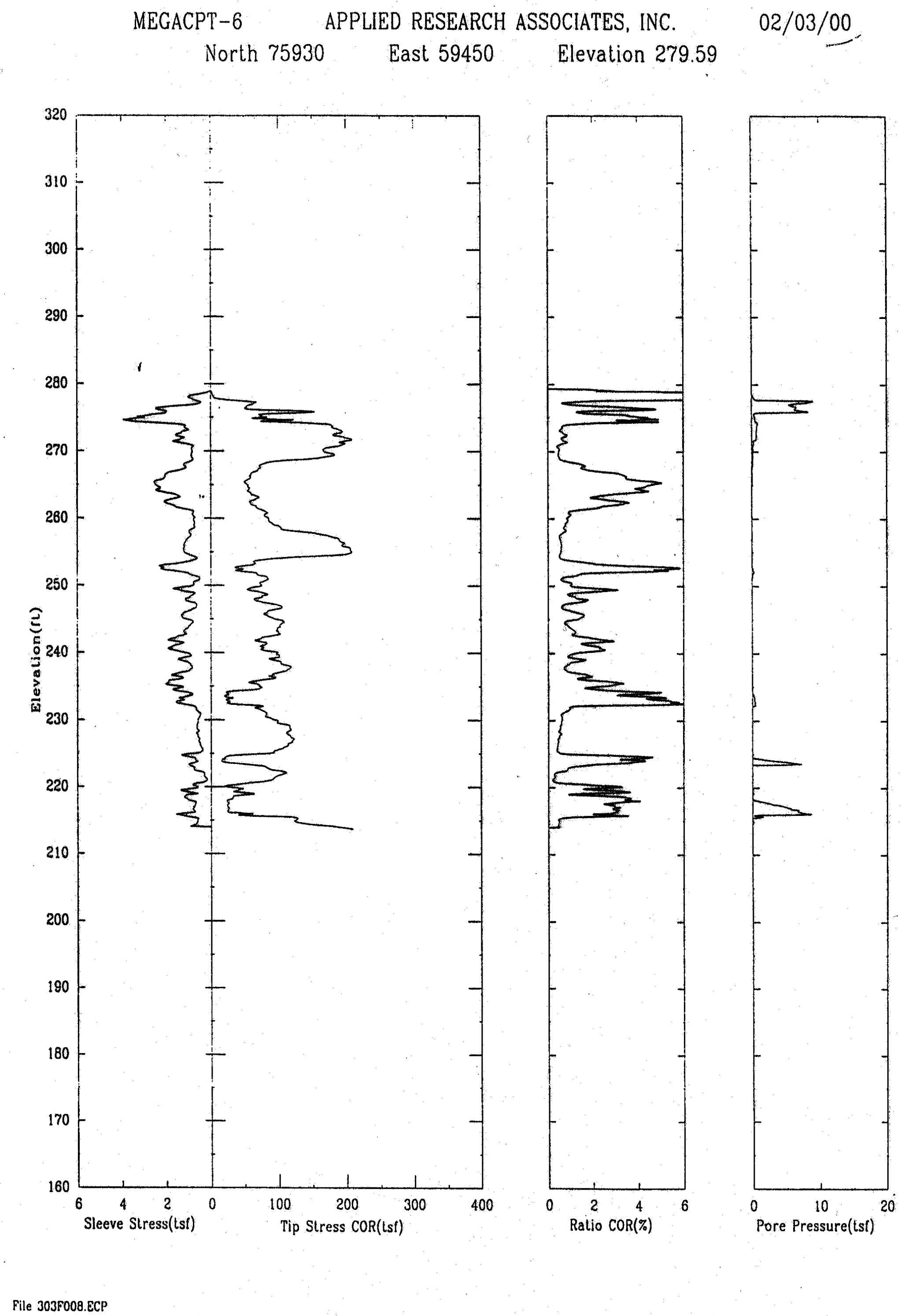
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Ratio COR(%)
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Pore Pressure(tsf)
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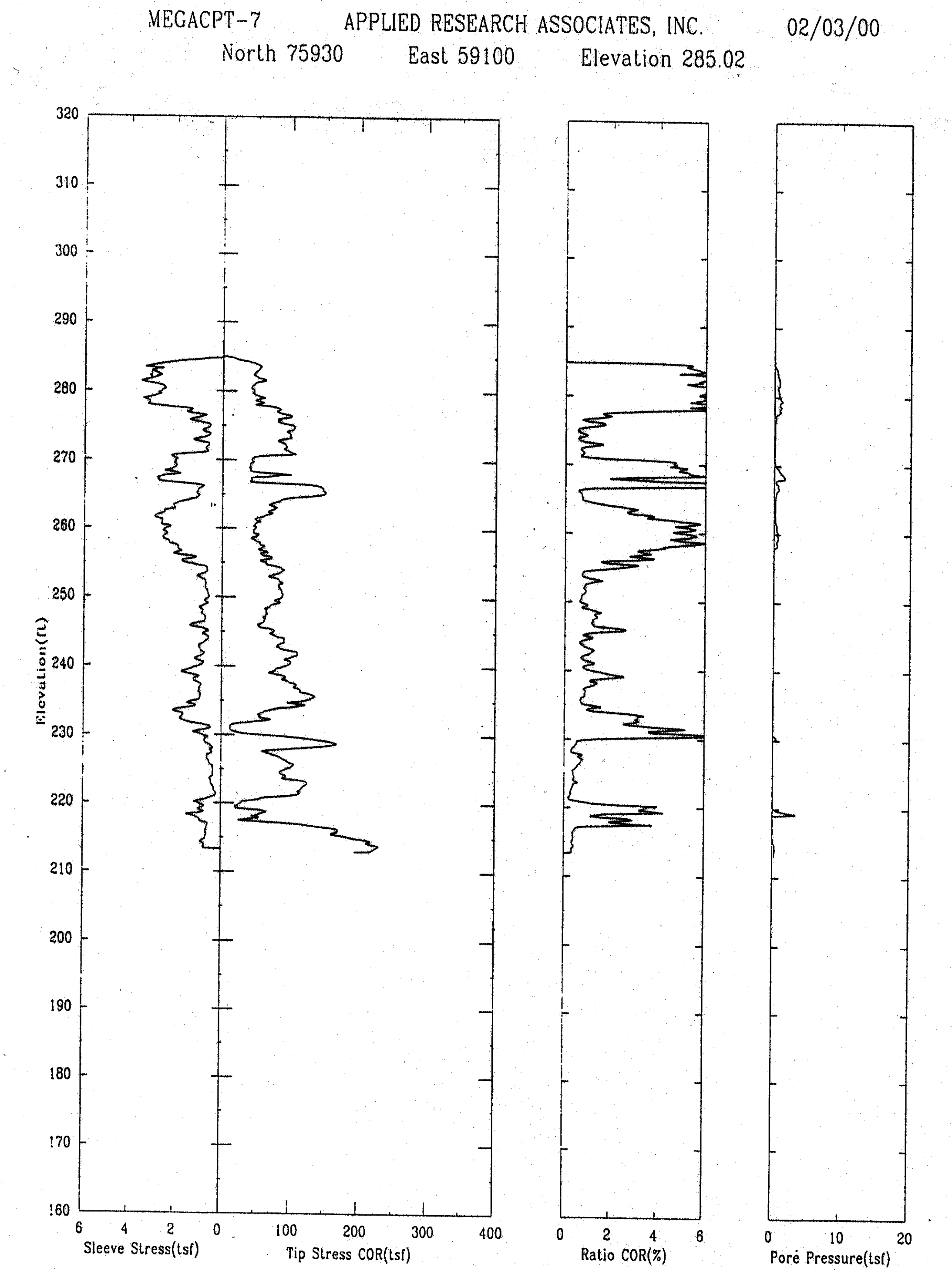

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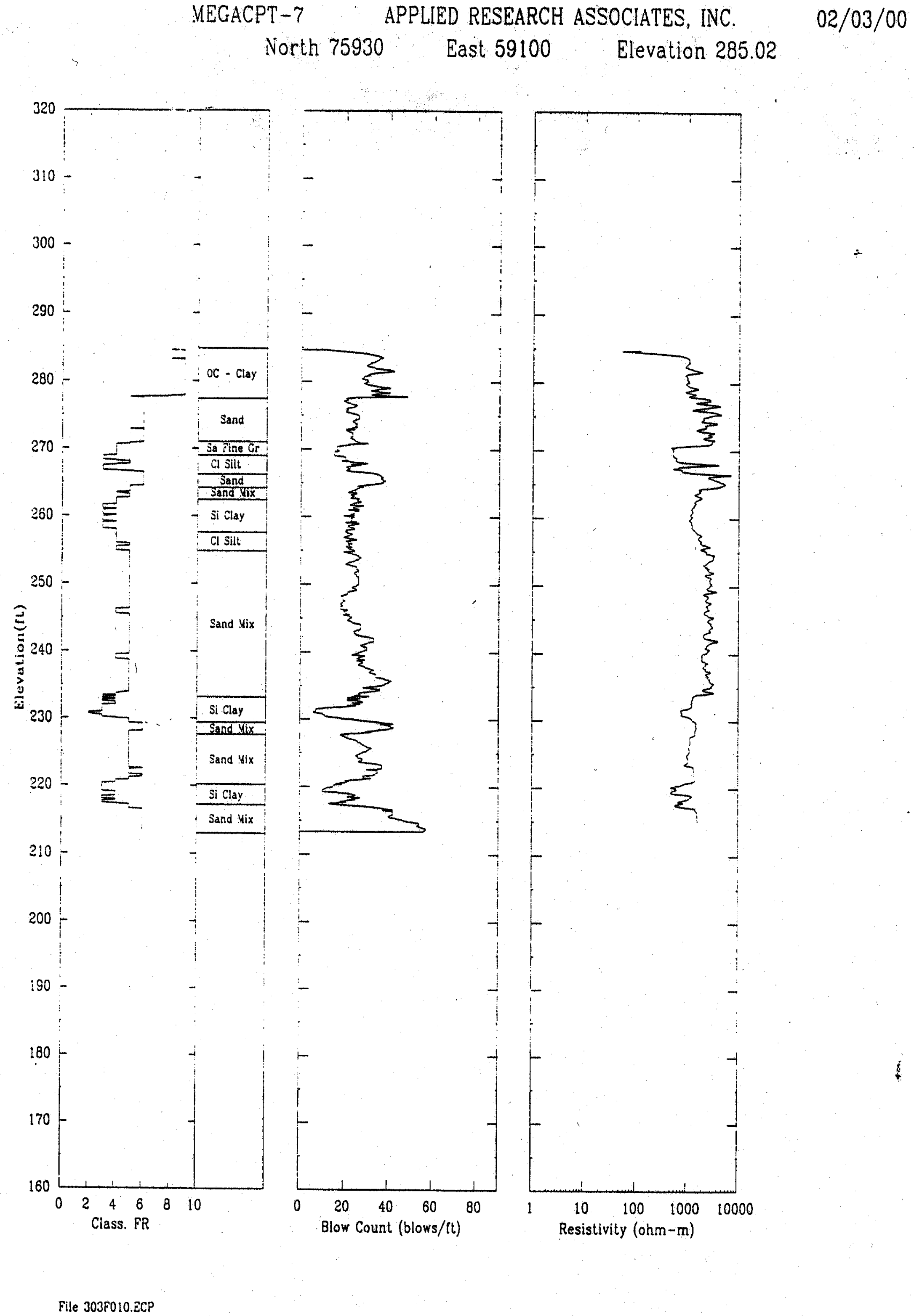
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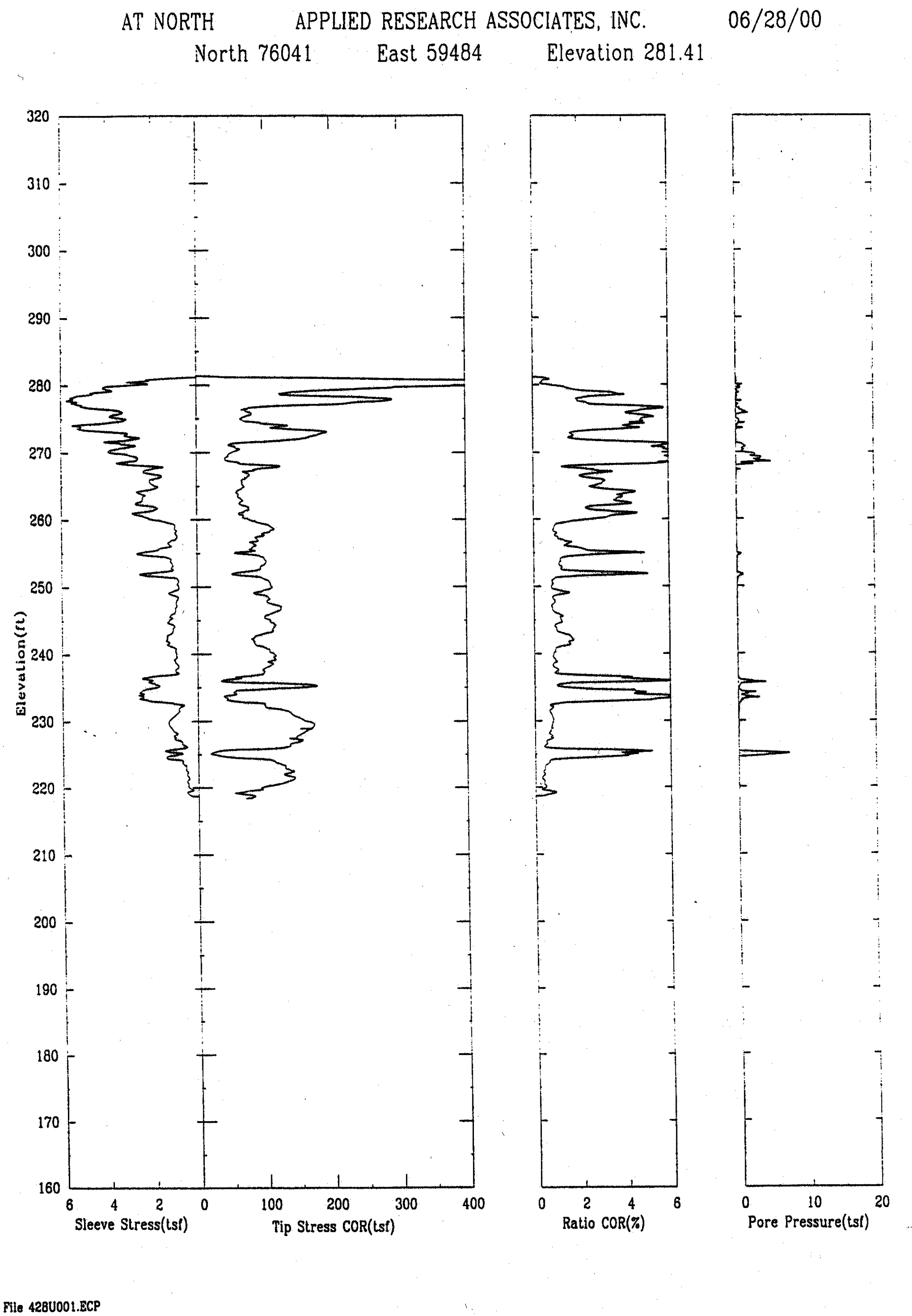
Cl Silt
Sand
Sand Mix
Si Clay
Cl Silt
Sand Mix
Si Clay
Sand Mix
Sand Mix
Si Clay
Sand Mix
Class. FR
Blow Count (blows/ft)
Resistivity (ohm-m)
File 303F010.ECP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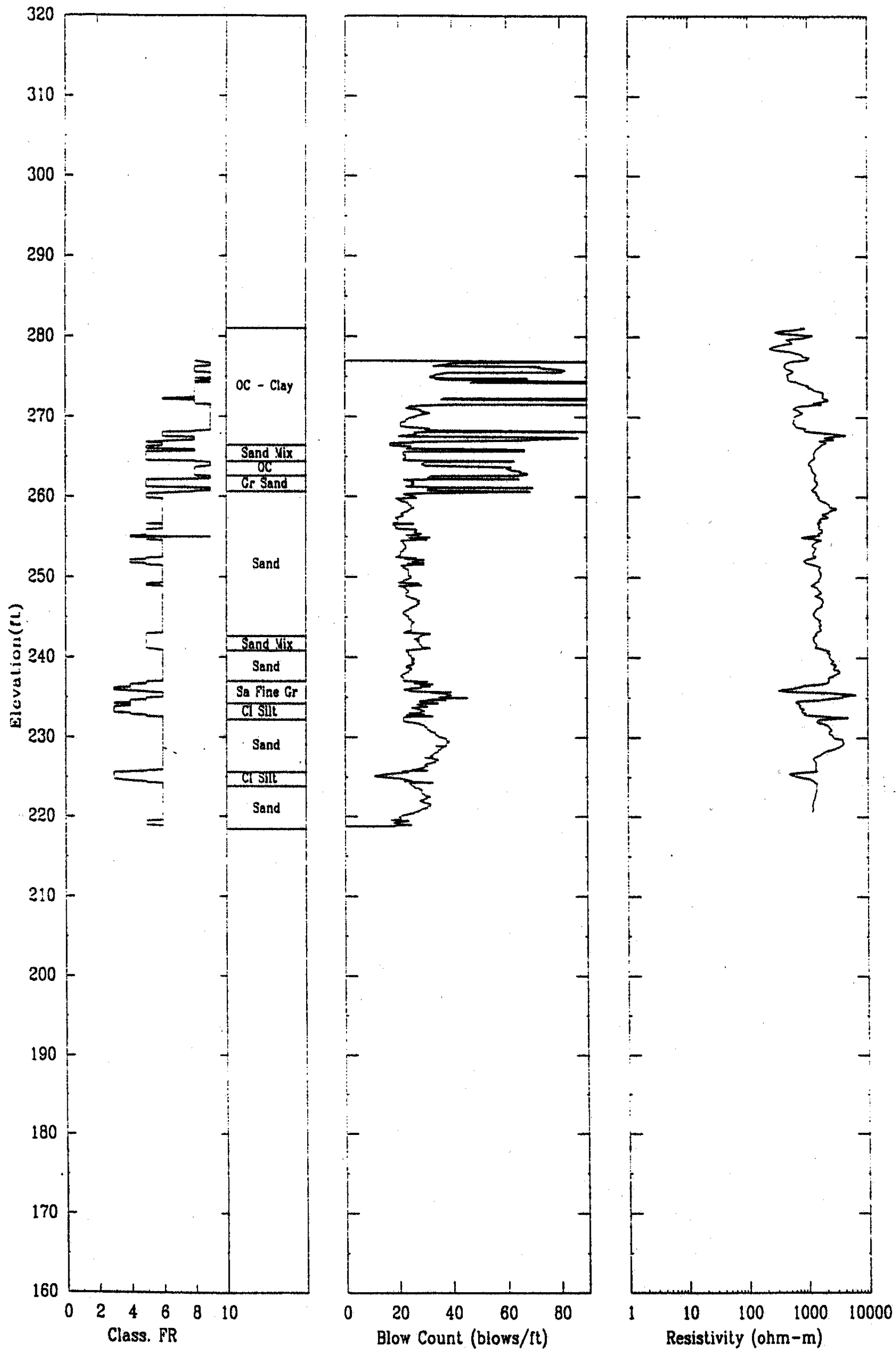
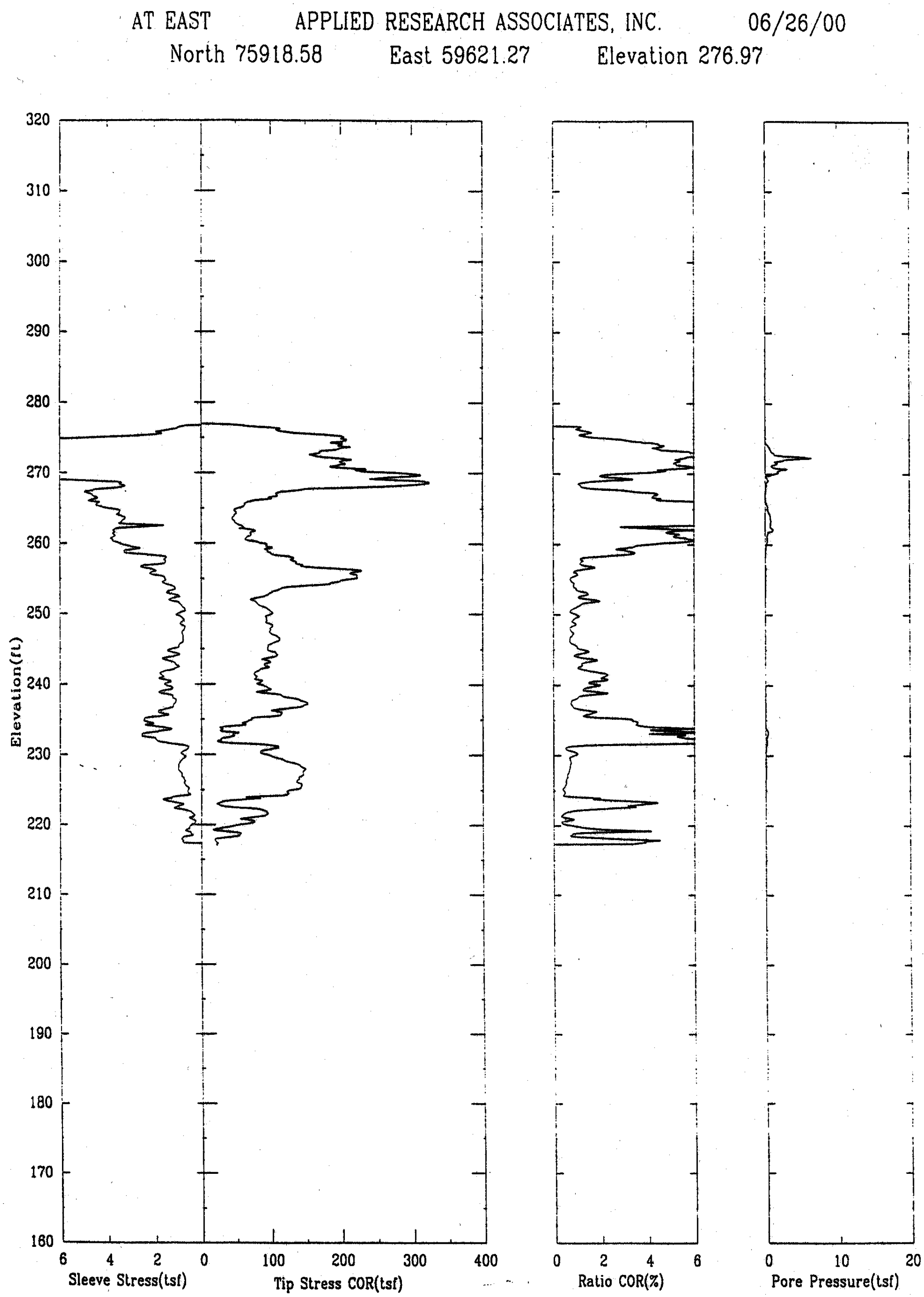
Elevation(ft)
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
6 4 2 0
Sleeve Stress(tsf)
0 100 200 300 400
Tip Stress COR(tsf)
0 2 4 6
Ratio COR(%)
0 10 20
Pore Pressure(tsf)
File 428U001.ECP

AT NORTH APPLIED RESEARCH ASSOCIATES, INC. 06/28/00

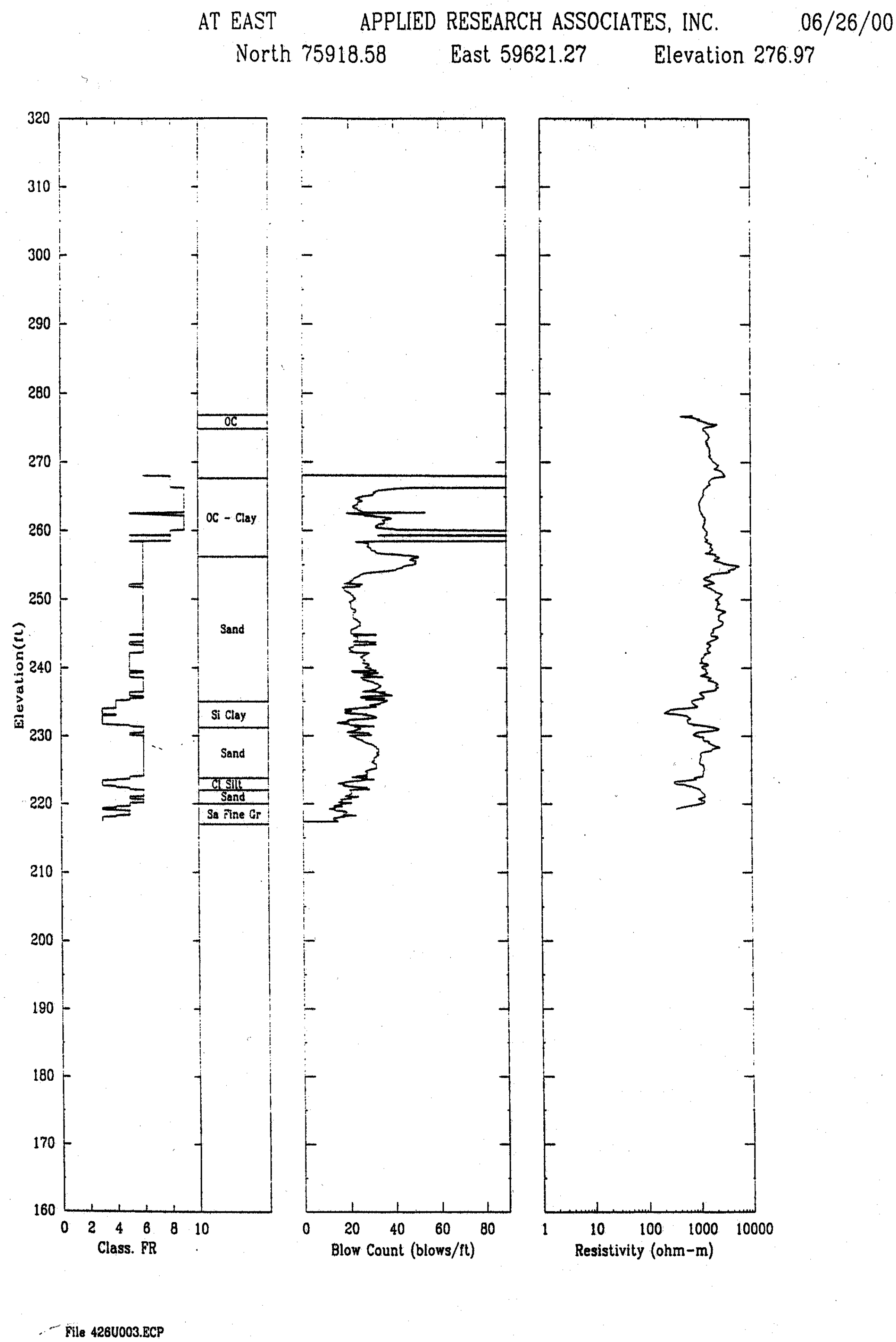
North 76041 East 59484 Elevation 281.41

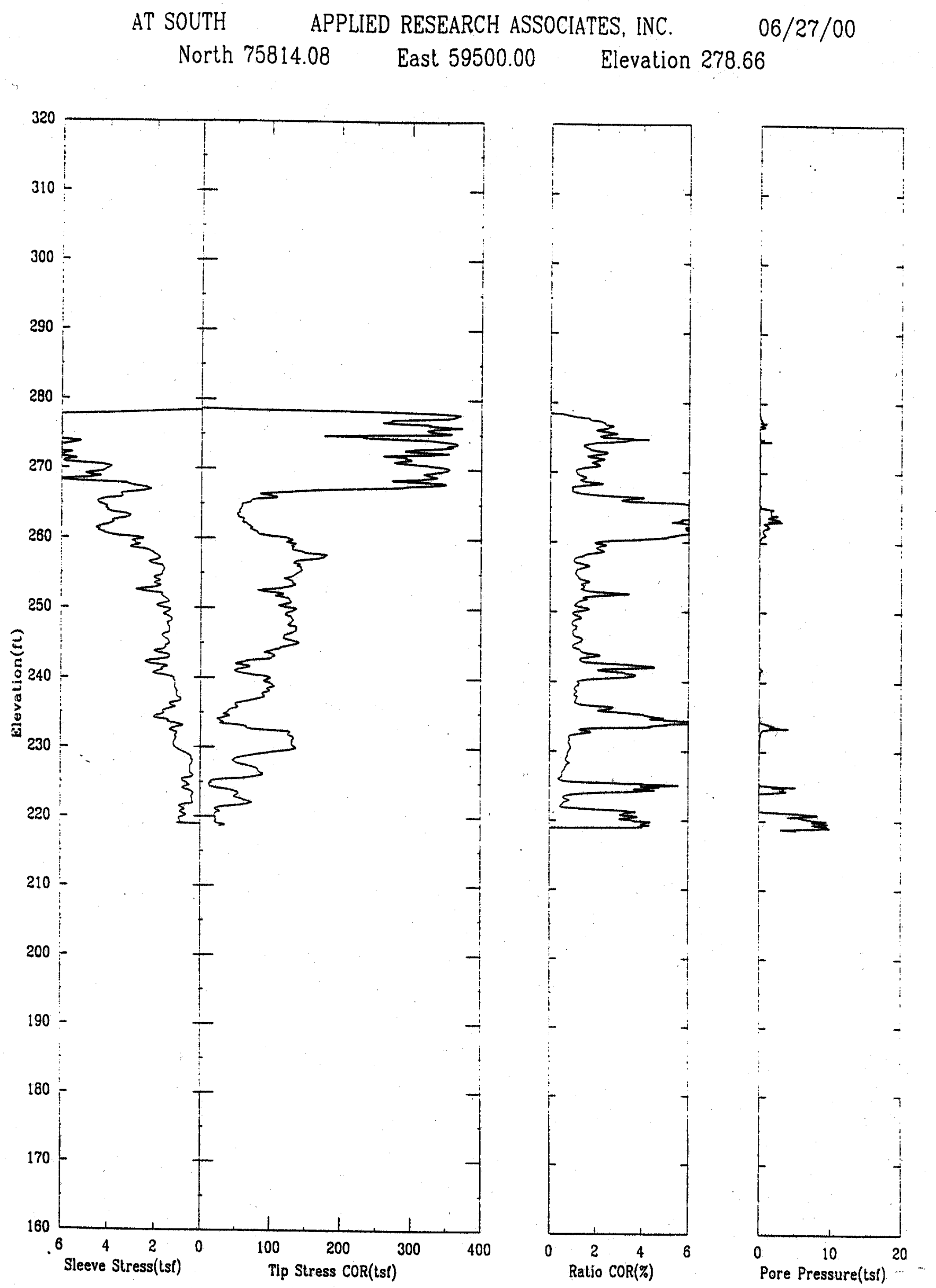


File 428U001.ECP

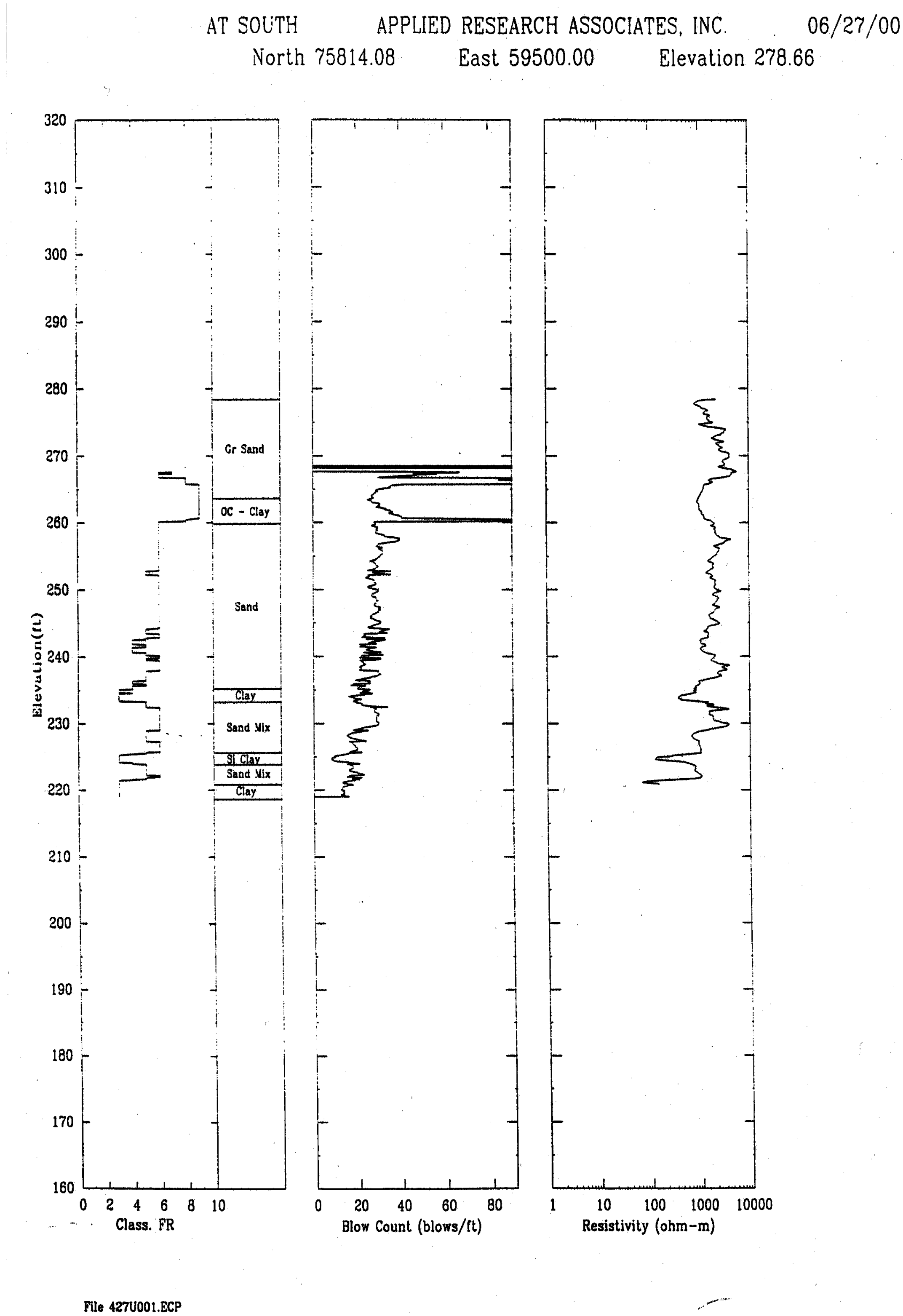


File 428U003.ECP


AT EAST APPLIED RESEARCH ASSOCIATES, INC. 06/26/00
North 75918.58 East 59621.27 Elevation 276.97
Elevation(ft)
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
OC
OC - Clay
Sand
Si Clay
Sand
Cl Silt
Sand
Sa Fine Gr
0 2 4 6 8 10
Class. FR
0 20 40 60 80
Blow Count (blows/ft)
1 10 100 1000 10000
Resistivity (ohm-m)
File 426U003.ECP



File 427U001.ECP


AT SOUTH
APPLIED RESEARCH ASSOCIATES, INC.
06/27/00
North 75814.08
East 59500.00
Elevation 278.66
Elevation(ft)
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
Gr Sand
OC - Clay
Sand
Clay
Sand Mix
Si Clay
Sand Mix
Clay
0 2 4 6 8 10
Class. FR
0 20 40 60 80
Blow Count (blows/ft)
1 10 100 1000 10000
Resistivity (ohm-m)
File 427U001.ECP

Appendix B

Geotechnical Borehole Logs

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LOG of BORING No. B-10

1 of 2

DATE 10/7/85 SURFACE ELEVATION 291.4 LOCATION N 75,580 E 58,895

DEPTH, ft.	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
0	22	Very dense brown silty fine SAND	290.9				
	18	Very stiff orange-brown and yellow-brown clayey coarse to fine SAND					
5	25						
	C						
	73	-becoming pale-red, orange-brown, dark-red and gray, trace fine gravel					
10	51						
	C	-becoming yellow-brown					
	54						
15	45	-also coarse to fine quartz gravel					
	C			23.2	65	27	M,K, T
	35	-micaceous					
20			266.9				
25	21	Medium-dense white with red mottled micaceous clayey SILT, trace fine sand					
30	22		259.4				
35	23	Medium-dense pale-red and white mottled micaceous clayey medium to fine SAND					
40	18						
45	26						

Continued on Sheet 2

Completion Depth 65.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

A-24

LOG of BORING No. B-10

2 of 2

DATE 10/7/85 SURFACE ELEVATION 291.4 LOCATION N 75,580 E 58,895

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
45			Medium dense white with pale-red and yellow-brown mottled clayey medium to fine SAND					
50	■	13						
	■	P						
	■	30						
55	■	33						
60	■	38	-becoming orange-brown					
65	■	34		225.9				
70								

Completion Depth 65.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

1 of 2

LOG of BORING No. B-11

DATE 9/9/85 SURFACE ELEVATION 286.8 LOCATION N 75,557 E 59,400

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
0		14	Very dense orange-brown, red-brown, and light gray clayey coarse to fine SAND					
		24						
5		56						
		41						
10		39						
		37	-fine sandy silty clay lense from 12.5 to 13.0 feet					
15		28						
20		24		263.8				
25		21	Very stiff lavender with red micaceous clayey fine sandy SILT					
30		18		253.8				
35		23	Medium dense orange-brown and red-brown with light gray micaceous clayey coarse to fine SAND					
40		23						
45			Continued on Sheet 2					

Completion Depth 61.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

2 of 2

LOG of BORING No. B-11

DATE 9/9/85 SURFACE ELEVATION 286.8 LOCATION N 75,557 E 59,400

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
45		27	Loose to medium dense orange-brown and red-brown with light gray micaceous clayey coarse to fine SAND					
50		11						
55		13						
60		16		225.3				
65								

Completion Depth 61.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

LOG of BORING No. B-12

1 of 2

DATE 9/9-10/85 SURFACE ELEVATION 283.1 LOCATION N 75,600 E 59,743

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
0		8	Medium dense gray becoming orange-brown medium to fine sandy SILT	280.6				
		29						
5		81						
		64						
10		60						
		78						
15		44						
20		30	Dense to very dense orange-brown, green-yellow, light gray, and lavender clayey medium to fine SAND with intermittent lenses of medium to fine sandy clay					
25		25						
30		24						
35		31						
40		31						
45		31						

Continued on Sheet 2

Completion Depth 65.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

LOG of BORING No. B-12

2 of 2

DATE 9/9-10/85 SURFACE ELEVATION 283.1 LOCATION N 75,600 E 59,743

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
45								
50	■	23						
55	■	26	Medium dense orange-brown, orange-red, and light gray clayey medium to fine SAND					
60	■	5						
	■	23						
65	■	52	-becoming red-brown	217.6				
70								

Completion Depth 65.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

LOG of BORING No. B-15

1 of 2

DATE 9/10/85 SURFACE ELEVATION 284.9 LOCATION N 75,998 E 59,742

DEPTH, ft.	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
0	7	Medium dense dark gray silty medium to fine SAND	283.4	5.5			
	5			15.3			
5	5	Loose to very dense orange-brown, red-brown, and light gray clayey coarse to fine SAND		15.1			
	9			11.7			
10	15			11.5			M
	67	-trace coarse to fine gravel		12.4			
15	64			16.4			
20	67			13.6			
25	24			20.9			
30	38			17.1			
35	40			20.1			
40	29			14.5			
45		Continued on Sheet 2					

Completion Depth 61.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

A-36

LOG of BORING No. B-15

2 of 2

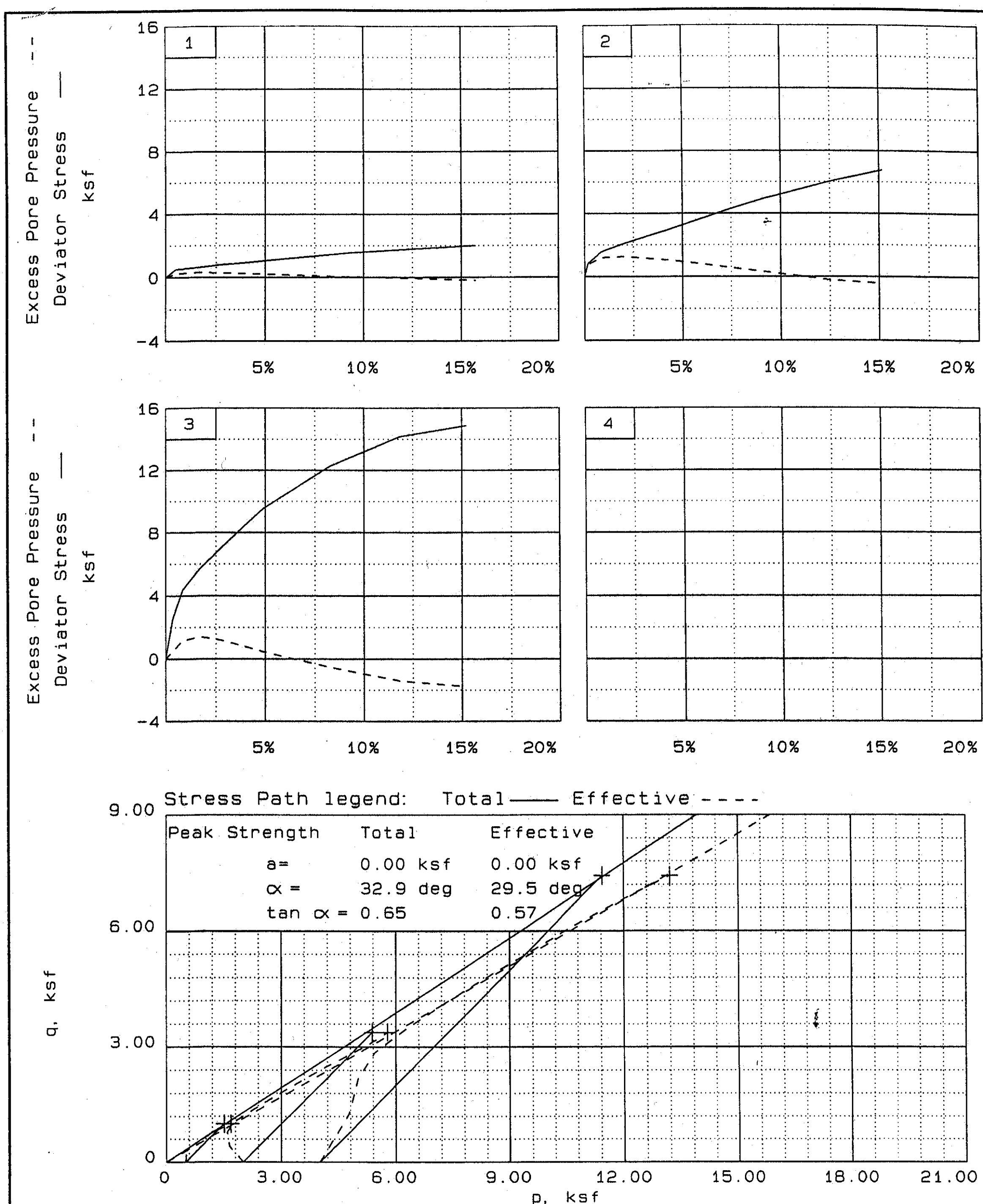
DATE 9/10/85 SURFACE ELEVATION 284.9 LOCATION N 75,998 E 59,742

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
45		30			17.7			
			Medium dense red-brown and orange-brown micaceous silty medium to fine SAND					
50		27			24.5			
55		15	-clayey fine SAND/sandy CLAY		59.6			
60		34		223.4	25.4			
65								

Completion Depth 61.5 Feet Water Depth NA Feet Date

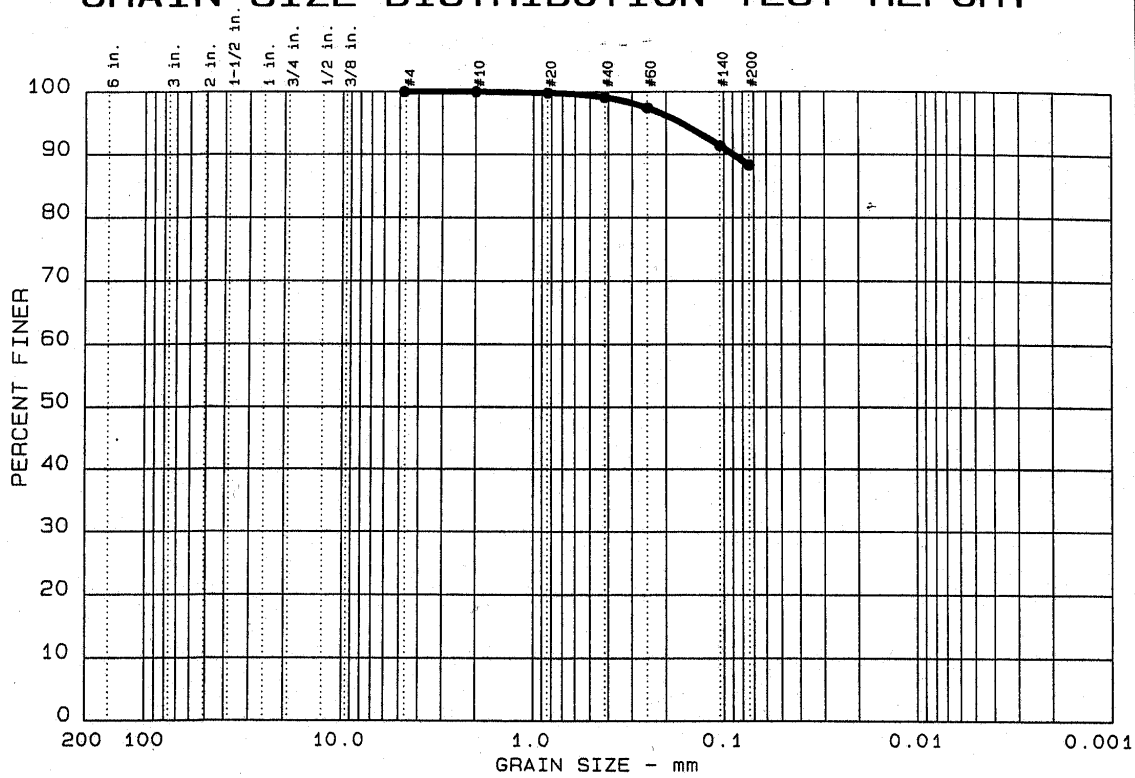
Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants



Client:
Project: Mega Trench Slope Study
Location: EMTUD-1 St-3 @ 48-50 Ft.
File: TASK55A Project No.: 5016170108 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	11.7	88.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	90	55								

MATERIAL DESCRIPTION	USCS	AASHTO
● Red Brown & Purple Fat Clay	CH	A-7-5 (56.7)

Project No.: 50161-7-0108 Task 55
Project: MEGA Trench Slope Study
● Location: EMTUD2 ST-1 @ 7-9 Ft.

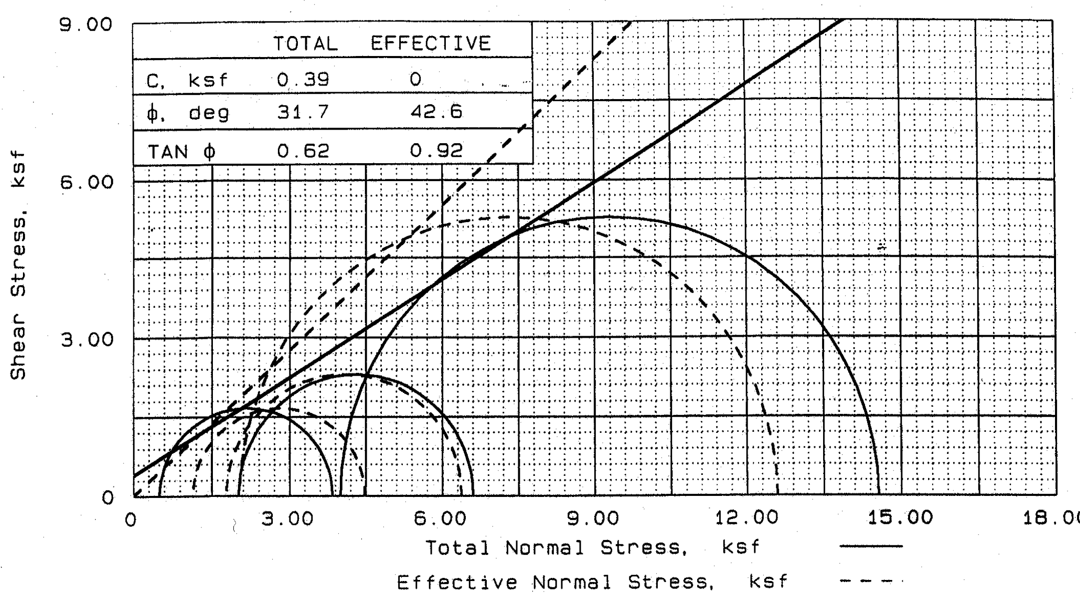
Date: June 1, 2000

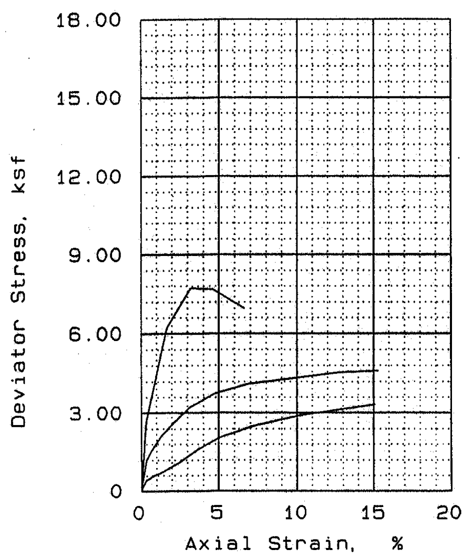
GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

Remarks:
Tested by: Sc
Reviewed by: Hb
ASTM D422, D2216 & D4318
Moisture Content 27.0%

Figure No.





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	15.9	11.1	24.8
	DRY DENSITY, pcf	99.0	101.1	97.9
	SATURATION, %	61.1	44.8	92.8
	VOID RATIO	0.703	0.667	0.721
	DIAMETER, in	2.87	2.86	2.88
	HEIGHT, in	5.97	5.98	5.97
AT TEST	WATER CONTENT, %	25.8	23.7	25.7
	DRY DENSITY, pcf	99.3	102.7	99.6
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.697	0.641	0.693
	DIAMETER, in	2.87	2.85	2.86
	HEIGHT, in	5.96	5.95	5.92
BACK PRESSURE, ksf		4.35	5.08	4.36
CELL PRESSURE, ksf		4.85	7.08	8.36
FAILURE STRESS, ksf		3.33	4.60	10.57
PORE PRESSURE, ksf		3.72	5.31	6.34
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		4.47	6.37	12.59
$\bar{\sigma}_3$ FAILURE, ksf		1.14	1.77	2.02

TYPE OF TEST:
CU with pore pressures

SAMPLE TYPE: Ud

DESCRIPTION: Red Brown & Purple Fat Clay

LL= 90 PL= 35 PI= 55.0

SPECIFIC GRAVITY= 2.70

REMARKS: Tested by: JTM

Reviewed by: HJ

FIG. NO.

CLIENT:

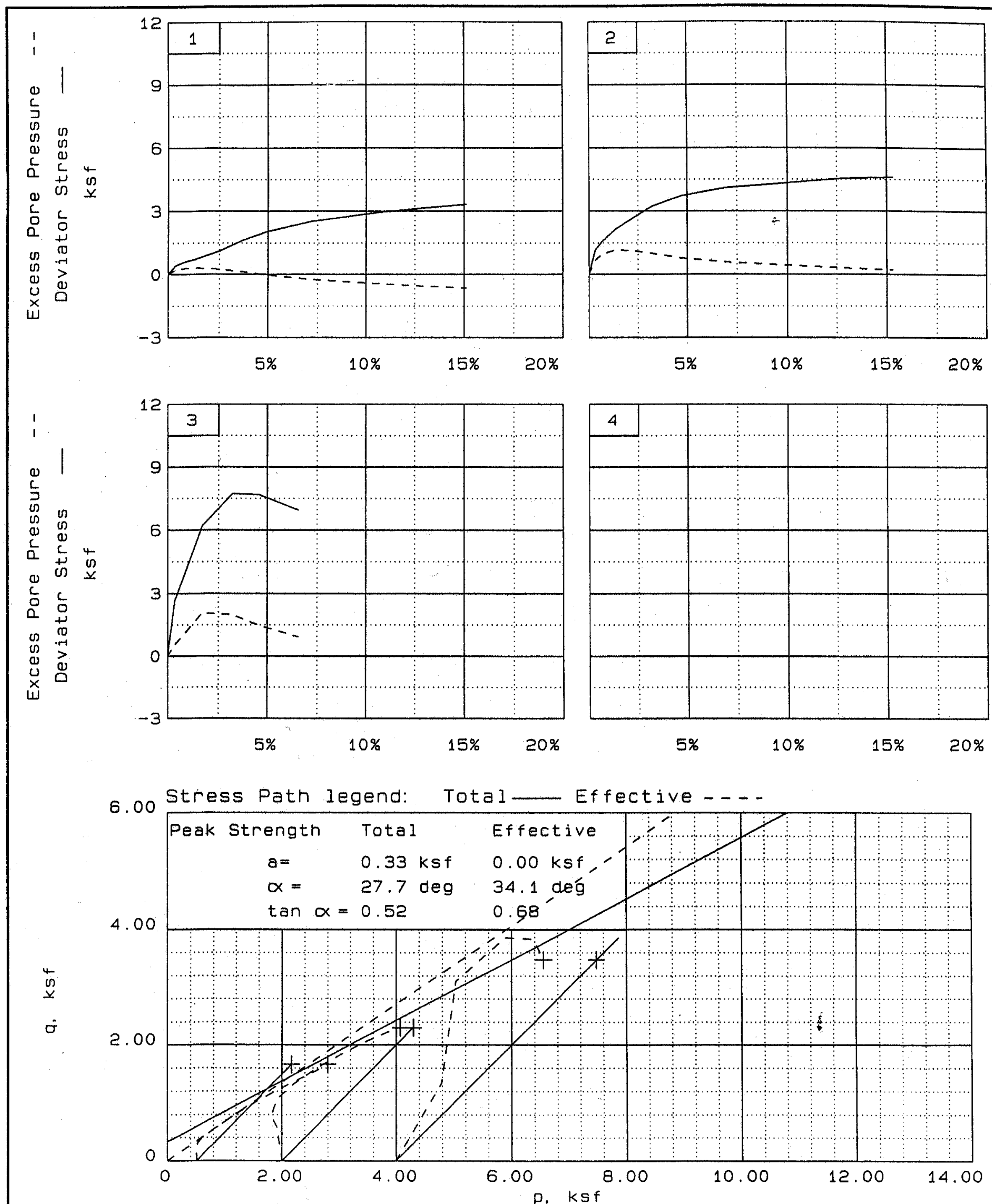
PROJECT: Mega Trench Slope Study

SAMPLE LOCATION: EMTUD-2
St-1 @ 7-9 Ft.

PROJ. NO.: 5016170108 DATE: June 12, 2000

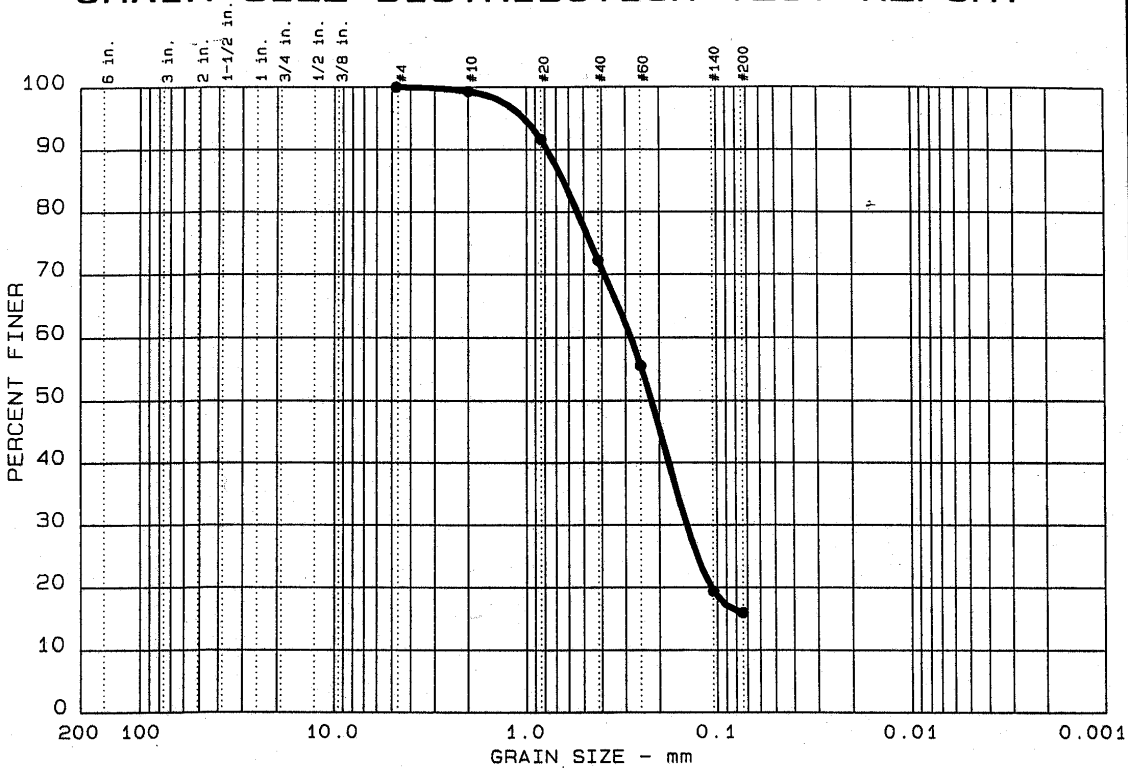
TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.



Client:
Project: Mega Trench Slope Study
Location: EMTUD-2 St-1 @ 7-9 Ft.
File: TASK55B Project No.: 5016170108 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	0.0	84.1	15.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	40	16	0.64	0.28	0.22	0.143				

MATERIAL DESCRIPTION	USCS	AASHTO
● Red Brown & Tan Clayey Sand	SC	A-2-6(0.1)

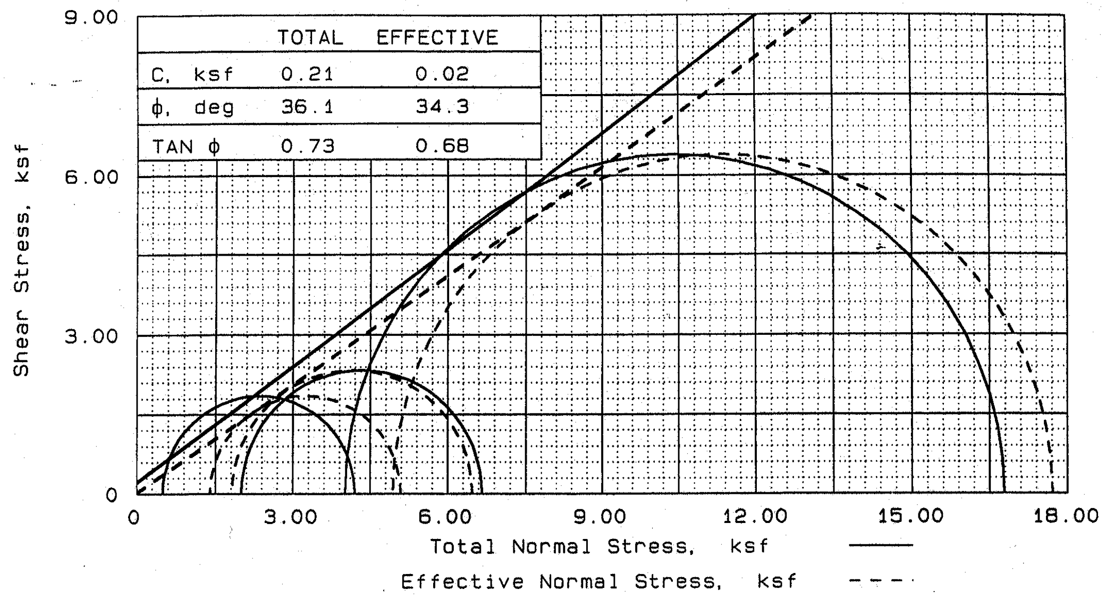
Project No.: 50161-7-0108 Task 55
Project: MEGA Trench Slope Study
● Location: EMTUD2 ST-2 @ 34-36 Ft.

Date: June 1, 2000

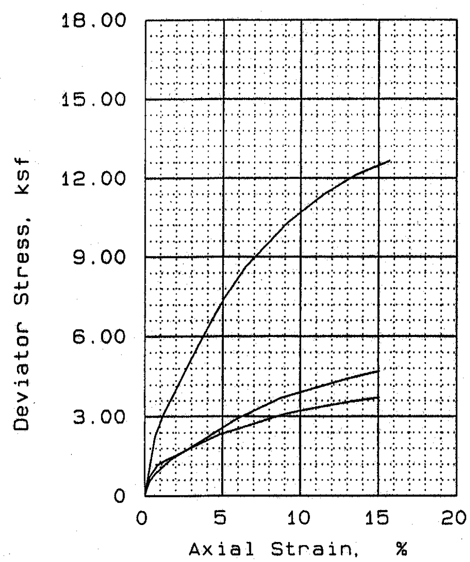
GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
Tested by: SC
Reviewed by: HD
ASTM D422, D2216 & D4318
Moisture Content = 16.3%

Figure No.



	TOTAL	EFFECTIVE
C, ksf	0.21	0.02
ϕ, deg	36.1	34.3
TAN ϕ	0.73	0.68



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	12.9	17.4	16.0
	DRY DENSITY, pcf	99.0	97.3	102.2
	SATURATION, %	49.7	64.2	66.5
	VOID RATIO	0.702	0.732	0.650
	DIAMETER, in	2.87	2.86	2.85
	HEIGHT, in	5.98	6.00	5.98
AT TEST	WATER CONTENT, %	25.5	25.8	22.9
	DRY DENSITY, pcf	99.8	99.4	104.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.689	0.696	0.617
	DIAMETER, in	2.86	2.84	2.84
	HEIGHT, in	5.97	5.97	5.92
BACK PRESSURE, ksf		4.41	4.33	4.42
CELL PRESSURE, ksf		4.91	6.33	8.42
FAILURE STRESS, ksf		3.70	4.67	12.78
PORE PRESSURE, ksf		3.51	4.52	3.48
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		5.09	6.48	17.71
$\bar{\sigma}_3$ FAILURE, ksf		1.39	1.81	4.94

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Ud
DESCRIPTION: Red Brown & Tan Clayey Sand
LL= 40 PL= 24 PI= 16.0
SPECIFIC GRAVITY= 2.70
REMARKS: Tested by: JTM

Reviewed by: HP

FIG. NO.

CLIENT:

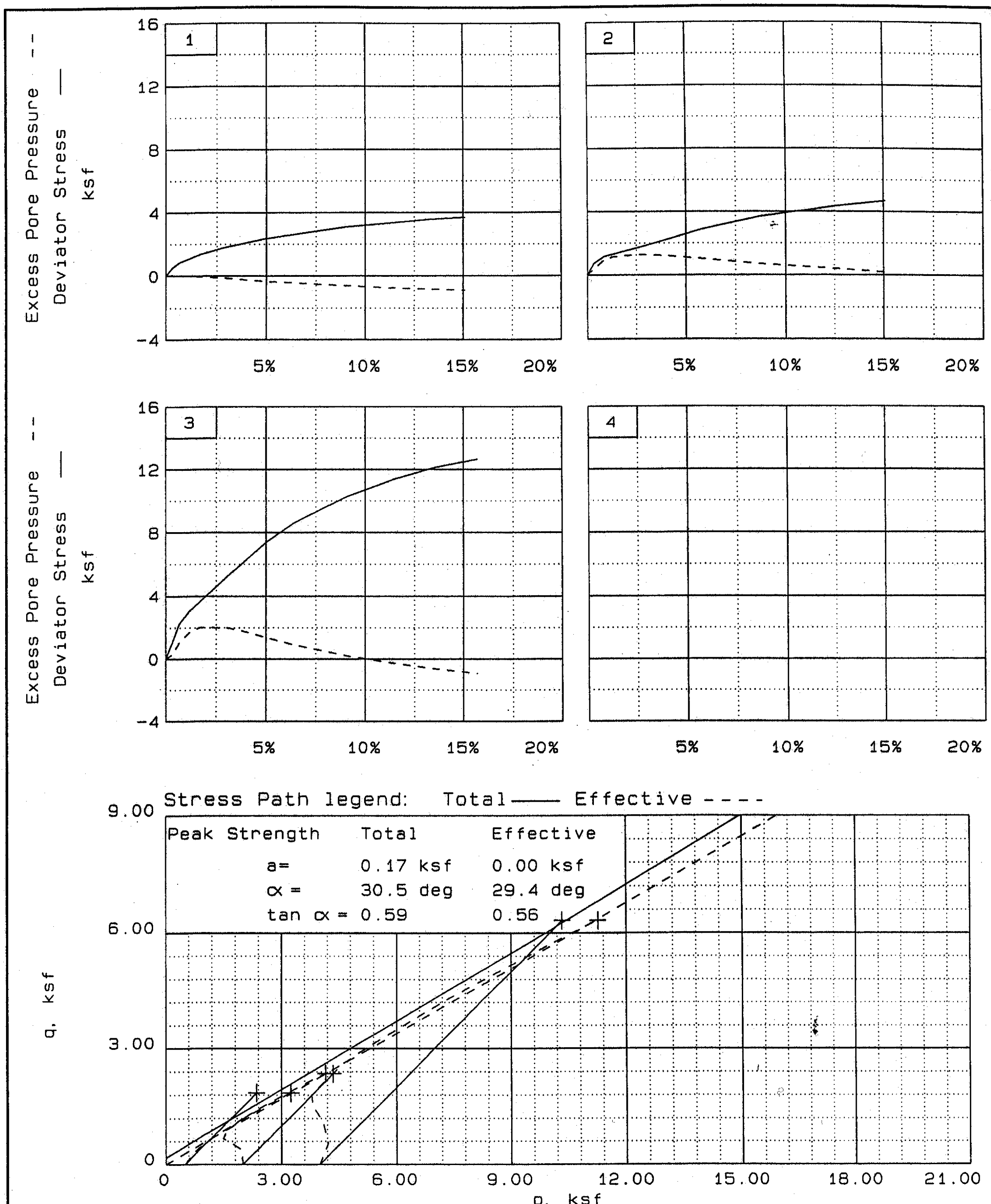
PROJECT: Mega Trench Slope Study

SAMPLE LOCATION: EMTUD-2
St-2 34-36 Ft.

PROJ. NO.: 5016170108 DATE: June 15, 2000

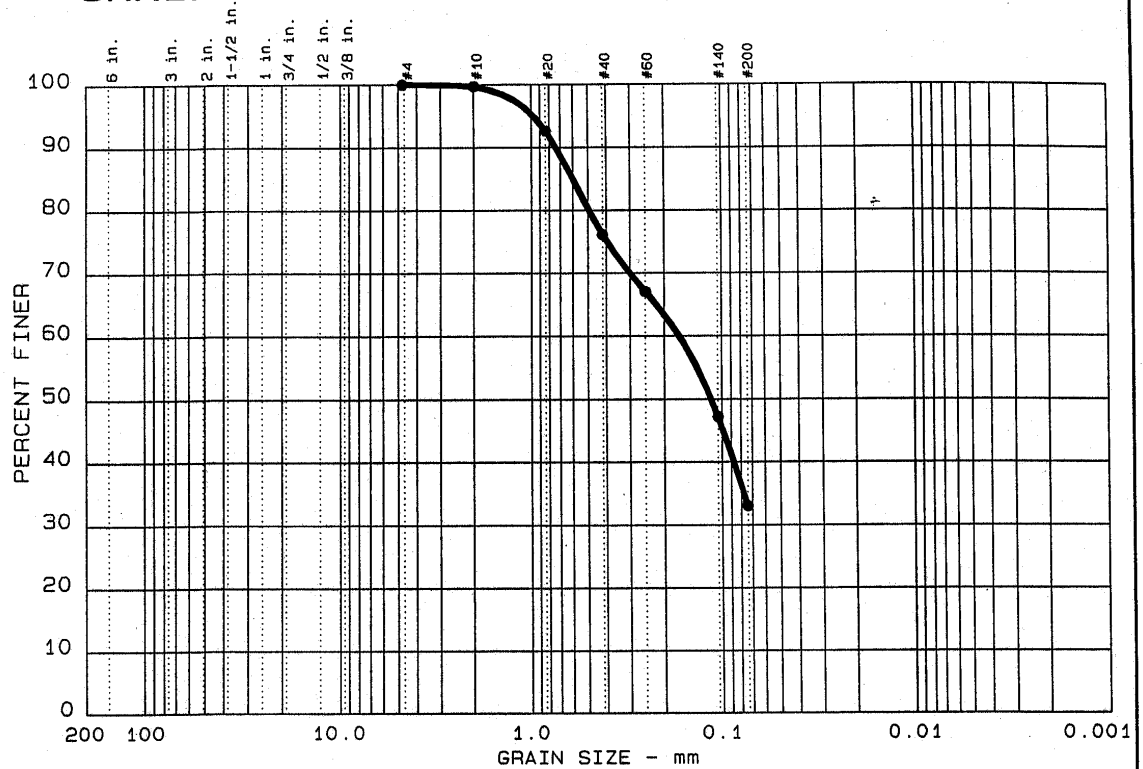
TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.



Client:
Project: Mega Trench Slope Study
Location: EMTUD-2 St-2 34-36 Ft.
File: TASK55D Project No.: 5016170108 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	0.0	66.9	33.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	49	23	0.60	0.17	0.11					

MATERIAL DESCRIPTION	USCS	AASHTO
● Red Brown & Tan Clayey Sand	SC	A-2-7 (2.3)

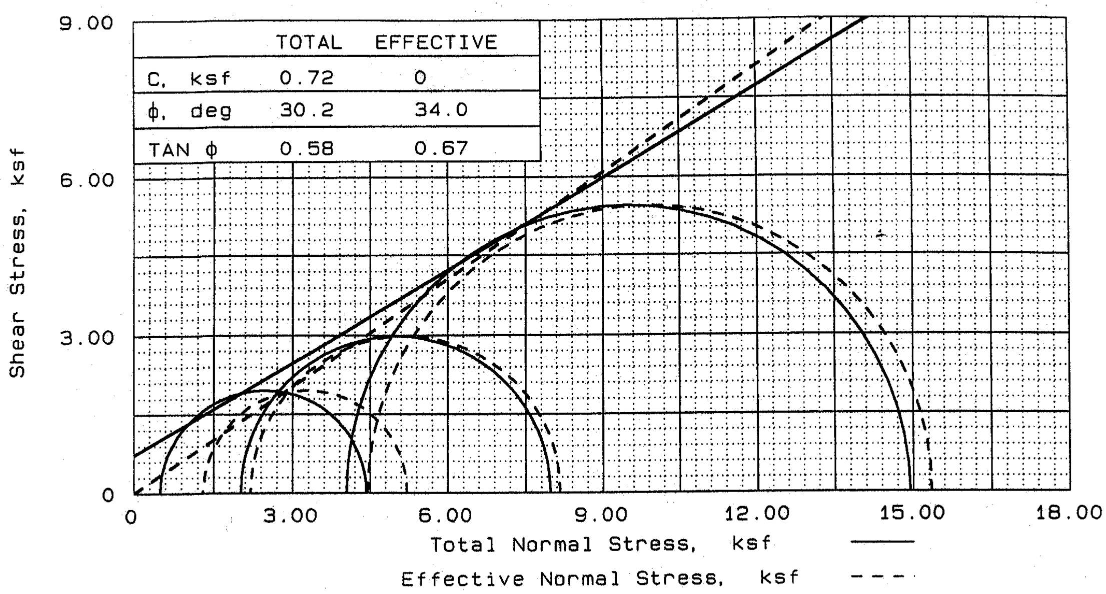
Project No.: 50161-7-0108 Task 55
Project: MEGA Trench Slope Study
● Location: EMTUD3 ST-1 @ 14-16 Ft.

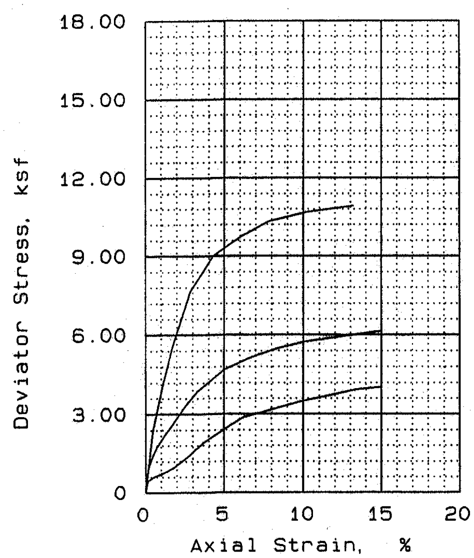
Date: June 1, 2000

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
Tested by:
Reviewed by:
ASTM D422, D2216 & D4318
Moisture Content = 15.0%

Figure No.





SAMPLE NO.	1	2	3
INITIAL			
WATER CONTENT, %	18.6	15.8	15.8
DRY DENSITY, pcf	102.6	104.2	111.6
SATURATION, %	80.4	71.3	87.1
VOID RATIO	0.613	0.587	0.482
DIAMETER, in	2.87	2.83	2.85
HEIGHT, in	6.00	6.06	6.36
AT TEST			
WATER CONTENT, %	21.2	19.6	16.8
DRY DENSITY, pcf	105.9	108.9	114.5
SATURATION, %	100.0	100.0	100.0
VOID RATIO	0.562	0.520	0.445
DIAMETER, in	2.83	2.78	2.82
HEIGHT, in	5.99	6.03	6.31
BACK PRESSURE, ksf	2.88	2.88	2.88
CELL PRESSURE, ksf	3.38	4.90	6.91
FAILURE STRESS, ksf	3.91	5.97	10.90
PORE PRESSURE, ksf	2.09	2.69	2.46
STRAIN RATE, %/min.	0.100	0.100	0.100
ULTIMATE STRESS, ksf			
PORE PRESSURE, ksf			
$\bar{\sigma}_1$ FAILURE, ksf	5.21	8.17	15.35
$\bar{\sigma}_3$ FAILURE, ksf	1.3	2.2	4.45

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Ud
DESCRIPTION: Red Brown & Tan Clayey Sand
LL= 49 PL= 23 PI= 26.0
SPECIFIC GRAVITY= 2.65
REMARKS: Tested by: JTM

Reviewed by: HG

FIG. NO.

CLIENT: SRS

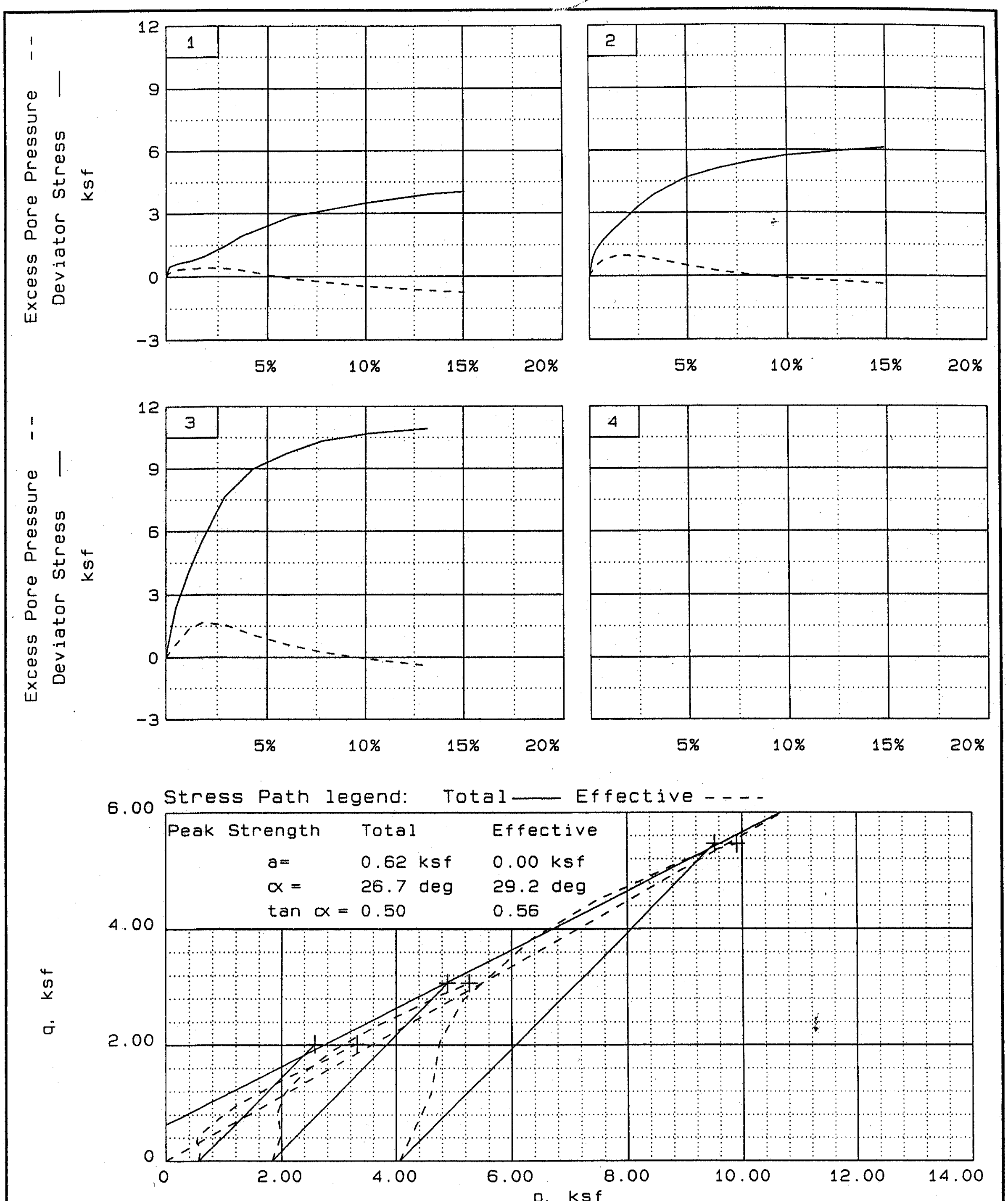
PROJECT: Mega Trench Slope Study

SAMPLE LOCATION: EMTUD-3 ST-1 @ 14-16 Ft.

PROJ. NO.: 5016170108 DATE: June 1, 2000

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.



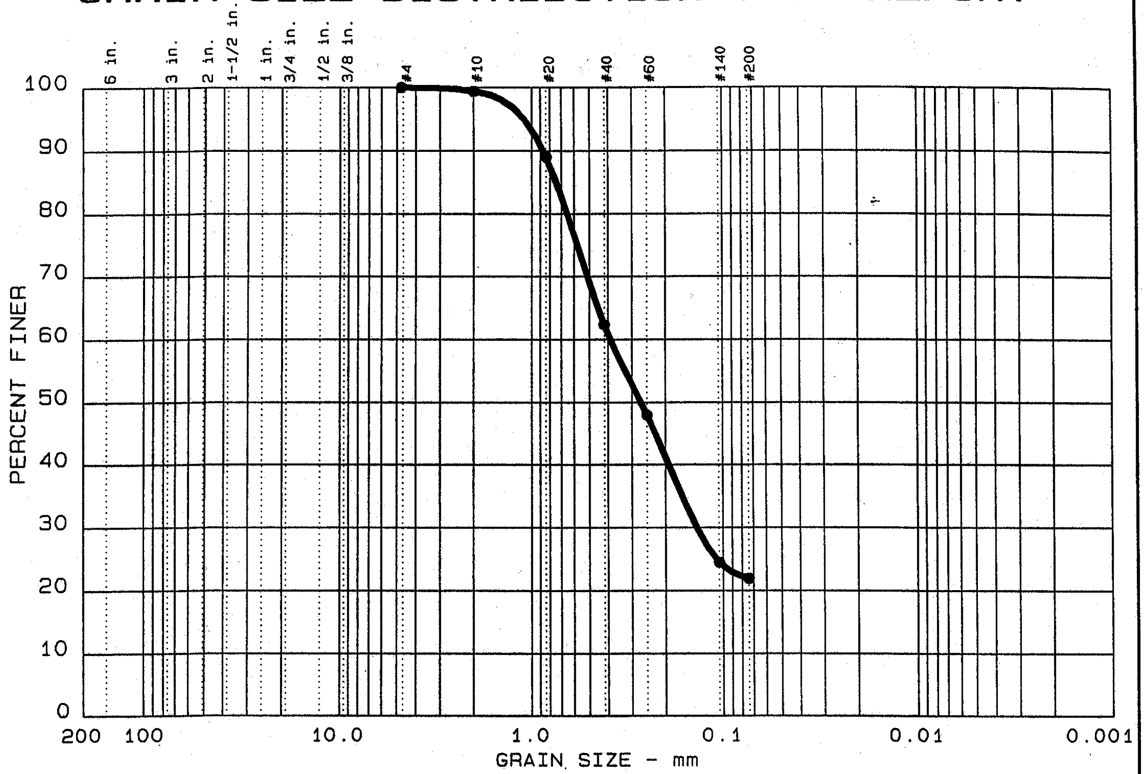
Client: SRS

Project: Mega Trench Slope Study

Location: EMTUD-3 ST-1 @ 14-16 Ft.

File: TASK55 Project No.: 5016170108 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	0.0	78.1	21.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	44	21	0.74	0.39	0.27	0.136				

MATERIAL DESCRIPTION	USCS	AASHTO
● Tan & White Clayey Sand	SC	A-2-7 (0.8)

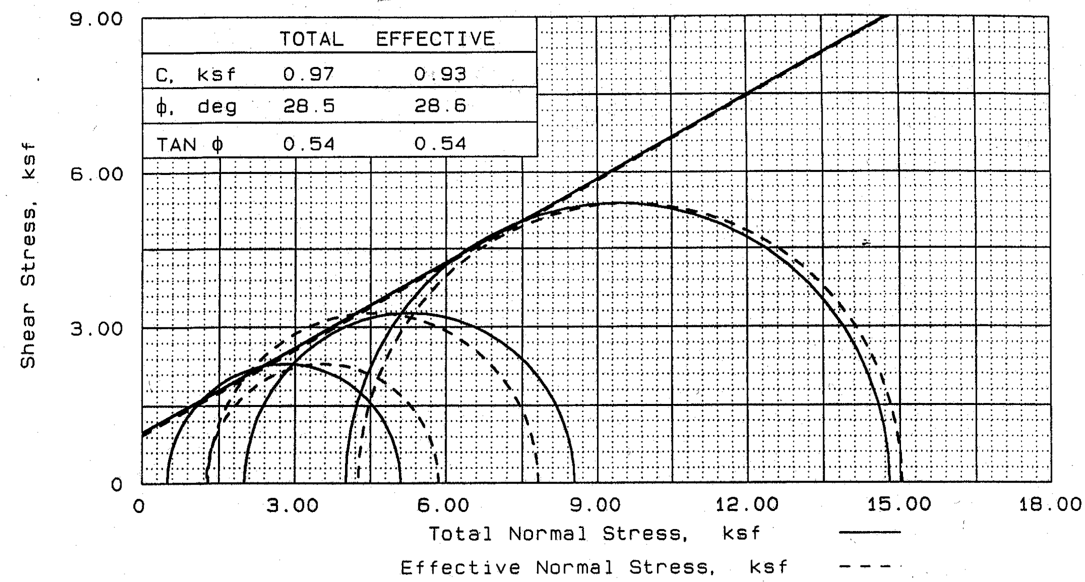
Project No.: 50161-7-0108 Task 55
Project: MEGA Trench Slope Study
● Location: EMTUD4 ST-1 @ 25-27 Ft.

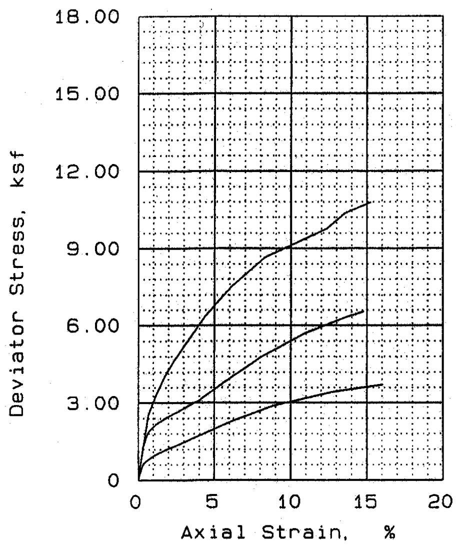
Date: June 1, 2000

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
Tested by: SC
Reviewed by: HB
ASTM D422, D2216 & D4318
Moisture Content = 14.8%

Figure No.





	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	13.5	13.2	16.1
	DRY DENSITY, pcf	100.6	106.0	97.6
	SATURATION, %	53.8	60.3	59.9
	VOID RATIO	0.675	0.591	0.727
	DIAMETER, in	2.86	2.86	2.88
	HEIGHT, in	5.99	5.97	5.99
AT TEST	WATER CONTENT, %	23.8	20.1	16.1
	DRY DENSITY, pcf	102.6	109.3	117.4
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.643	0.542	0.436
	DIAMETER, in	2.83	2.83	2.62
	HEIGHT, in	5.96	5.91	5.99
	BACK PRESSURE, ksf	4.44	4.48	4.35
	CELL PRESSURE, ksf	6.43	8.48	4.85
	FAILURE STRESS, ksf	6.53	10.79	4.60
	PORE PRESSURE, ksf	5.16	4.23	3.60
	STRAIN RATE, %/min.	0.100	0.100	0.100
	ULTIMATE STRESS, ksf			
	PORE PRESSURE, ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	7.81	15.03	5.85
	$\bar{\sigma}_3$ FAILURE, ksf	1.28	4.25	1.25

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Ud
DESCRIPTION: Tan & White Clayey Sand
LL= 44 PL= 23 PI= 21.0
SPECIFIC GRAVITY= 2.70
REMARKS: Tested by TM

Reviewed by: HD

FIG. NO.

CLIENT:

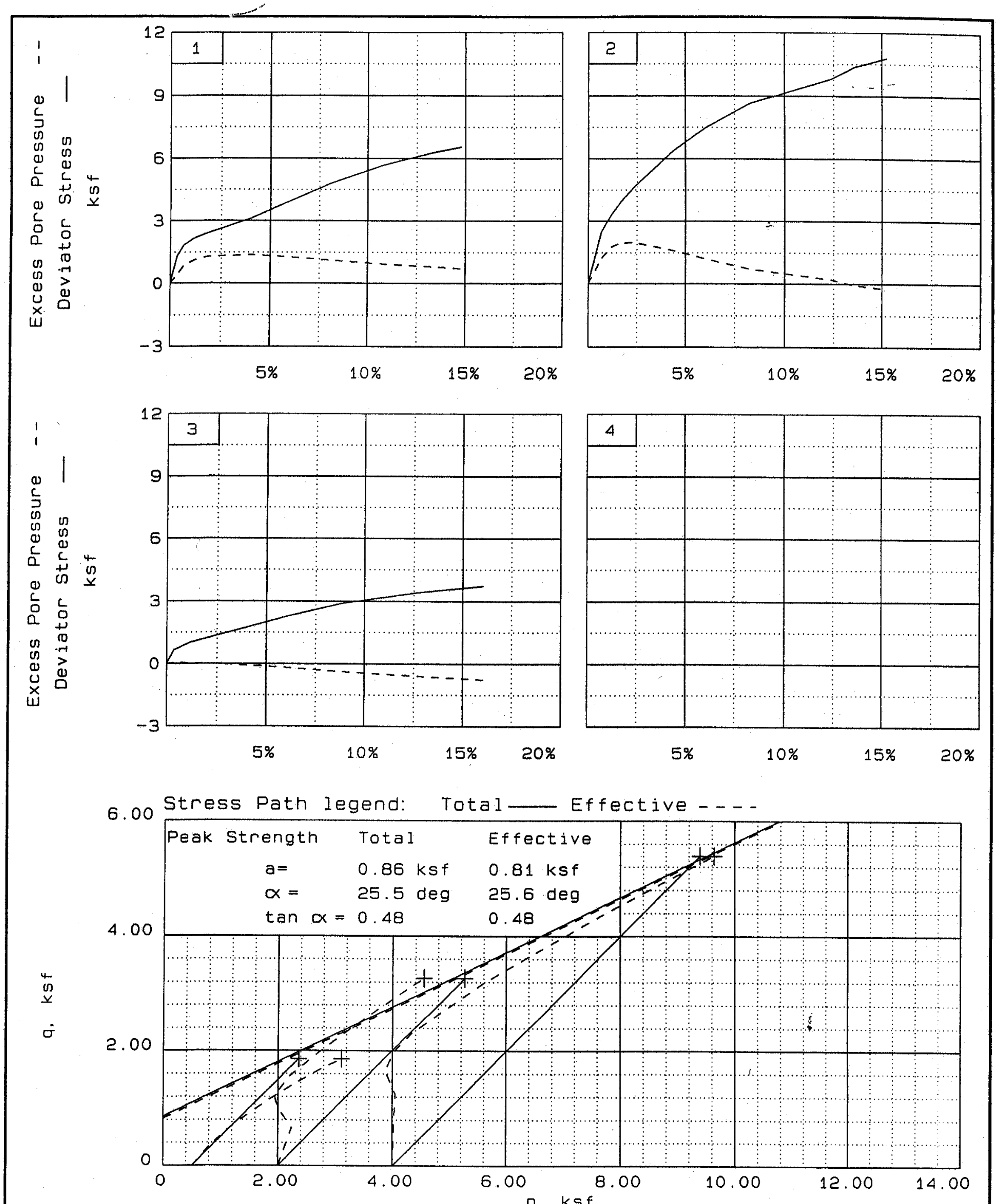
PROJECT: Mega Trench Slope Study

SAMPLE LOCATION: EMTUD-4
St-1 @ 25-27 Ft.

PROJ. NO.: 5016170108 DATE: June 14, 2000

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.



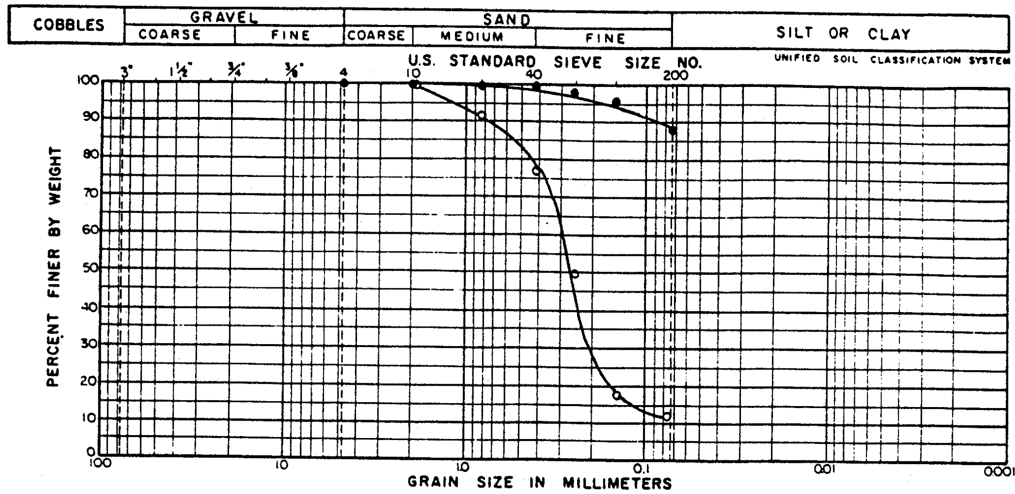
Client:
Project: Mega Trench Slope Study
Location: EMTUD-4 St-1 @ 25-27 Ft.
File: TASK55C Project No.: 5016170108 Page 2/2 Fig. No. ____

B-13

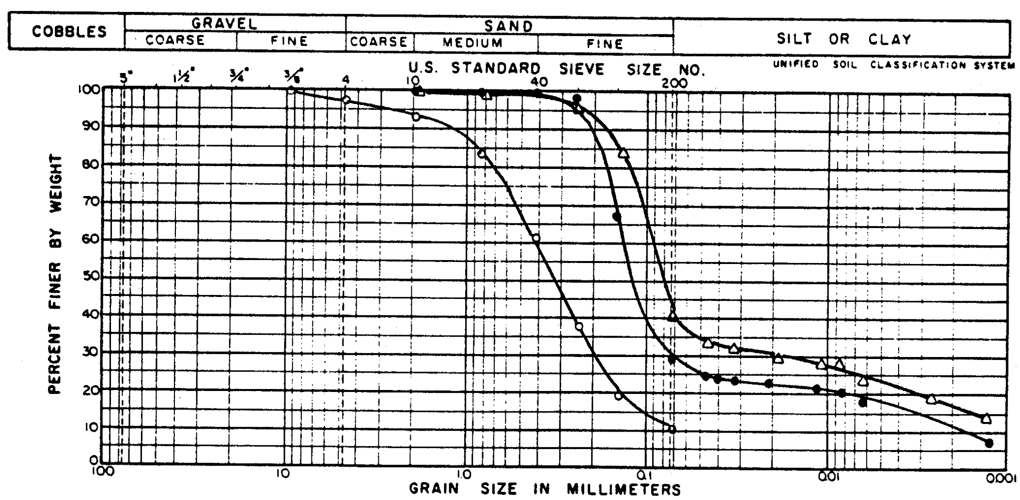
GRADATION CURVES

PROJECT NO.:85C2445

PROJECT: Savannah River Plant - Area 600G Burial Ground, Expansion



BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	MC	LL	PL
B-10	C-3	16.9	•	Red-brown fine sandy silty CLAY	25.7	65	27
B-14	ST-1	58.7	○	Brown silty medium to fine SAND	21.2	NP	NP



BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	MC	LL	PL
B-14	S-43	138.5-140.0	•	Light tan silty fine SAND	37.9		
B-15	S-5	10.0-11.5	○	Light brown silty medium to fine SAND, trace coarse sand	11.5		
B-16	ST-1	20.5-22.5	△	Reddish-brown silty fine SAND	19.3	NP	NP

Woodward-Clyde Consultants

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project: Savannah River Plant - Area 600G Project No.:

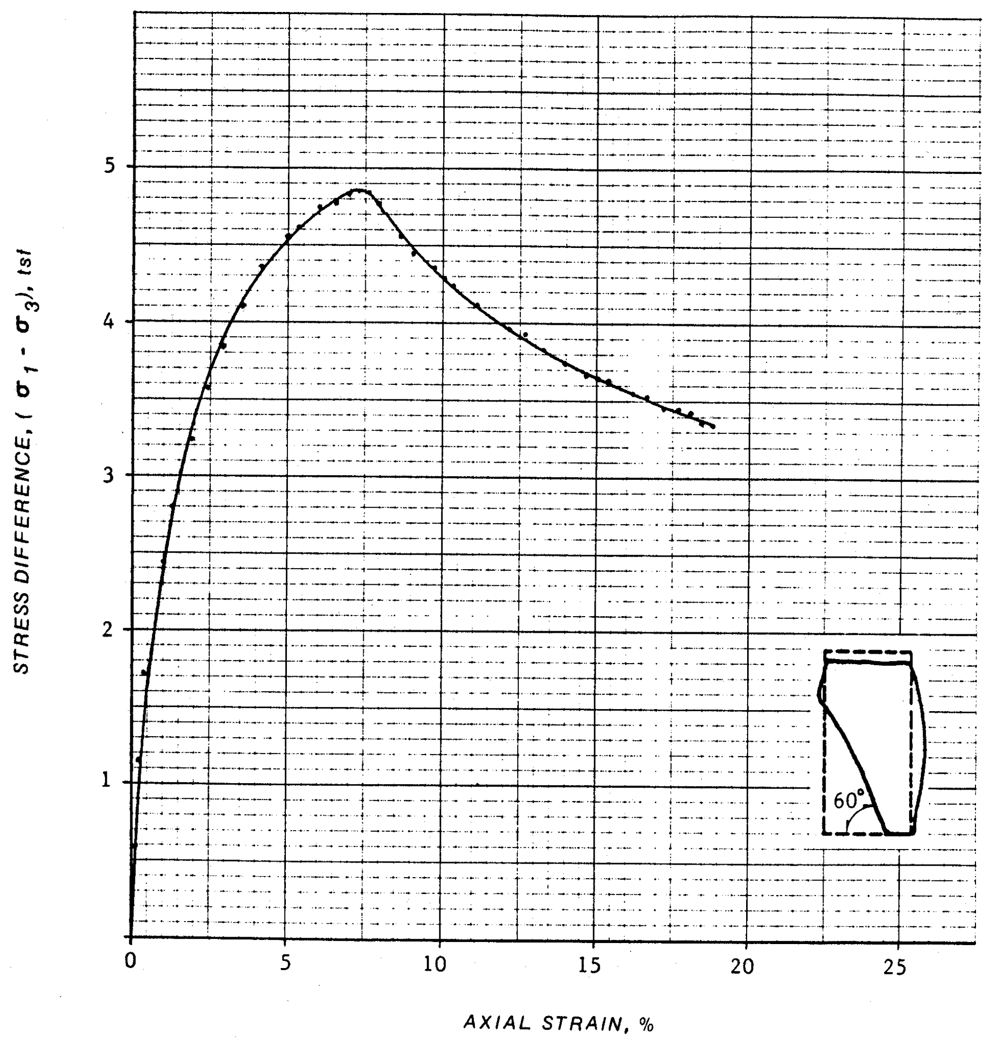
Boring No.: B-10 Sample No.: C-3 Depth: 16.90 ft.

Description: Red-brown fine sandy silty CLAY

Moisture Content: 25.7 % Dry Density: 98.1 pcf

Liquid Limit: 65 % Plastic Limit: 27 %

$(\sigma_1 - \sigma_3)$ max. = 4.83 tsf at 7.2 % Strain Confining Pressure, σ_c = 1.08 tsf



Woodward-Clyde Consultants

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project: Savannah River Plant - Area 600G *Project No.:* 85C2445

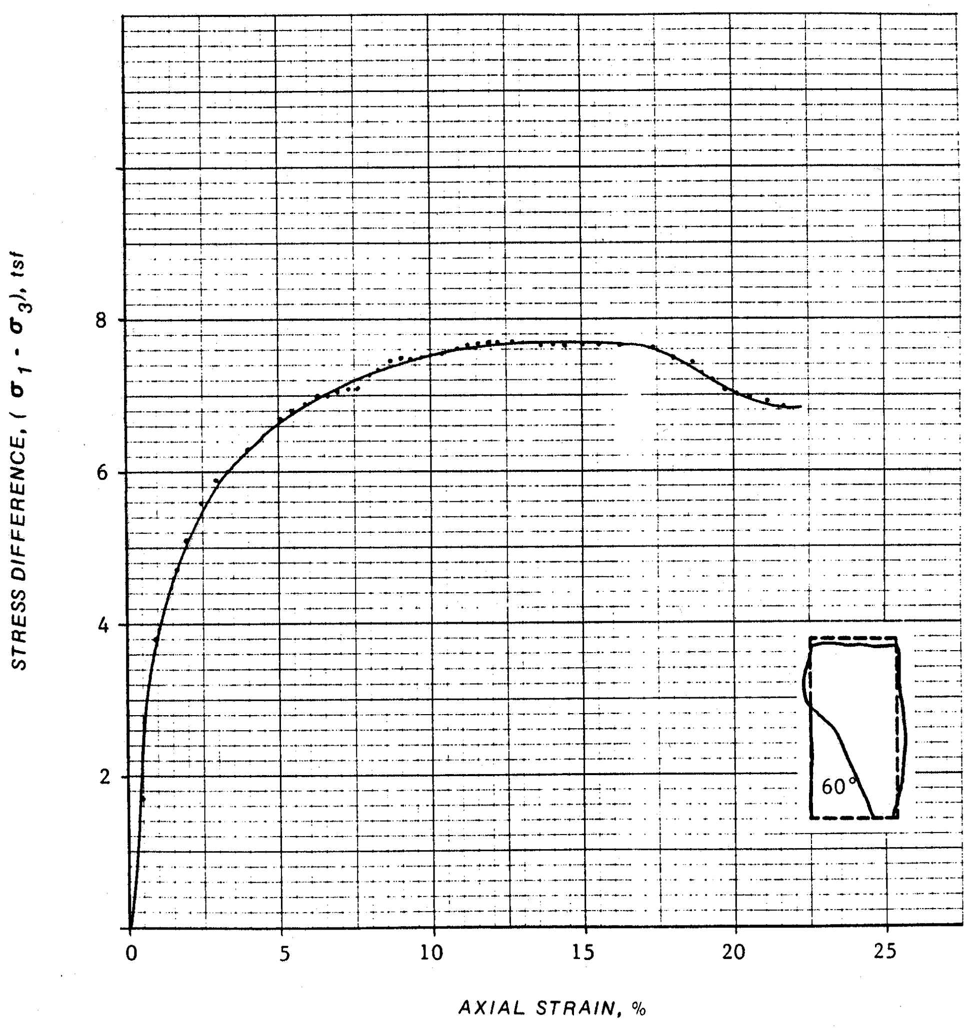
Boring No.: B-14 *Sample No.:* ST-1 *Depth:* 58.7 *ft.*

Description: Brown silty medium to fine SAND

Moisture Content: 21.2 % *Dry Density:* 100.5 *pcf*

Liquid Limit: NP % *Plastic Limit:* NP %

$(\sigma_1 - \sigma_3)$ *max.* = 7.77 *tsf at* 13.3 *% Strain* *Confining Pressure,* σ_c = 3.46 *tsf*



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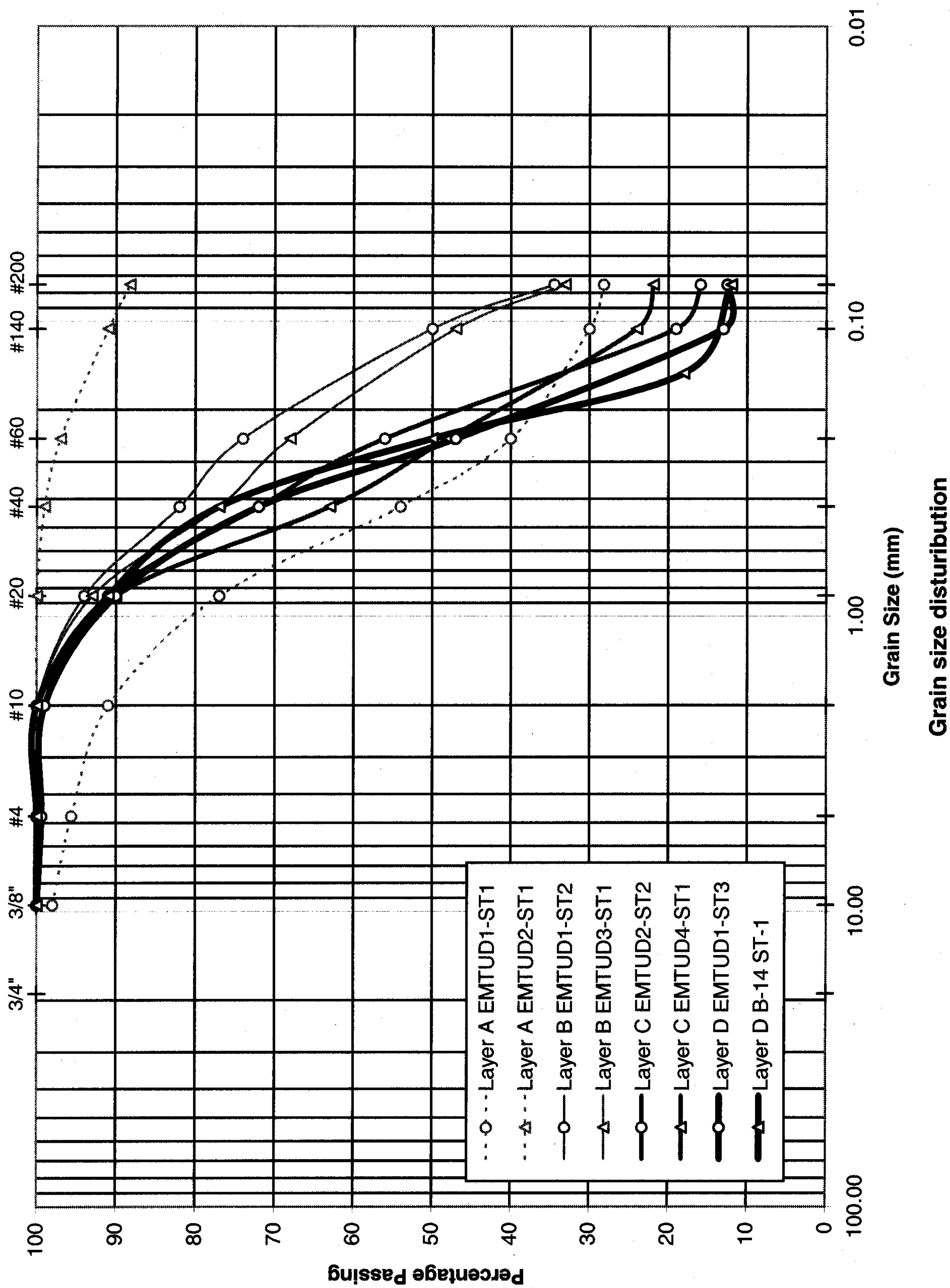
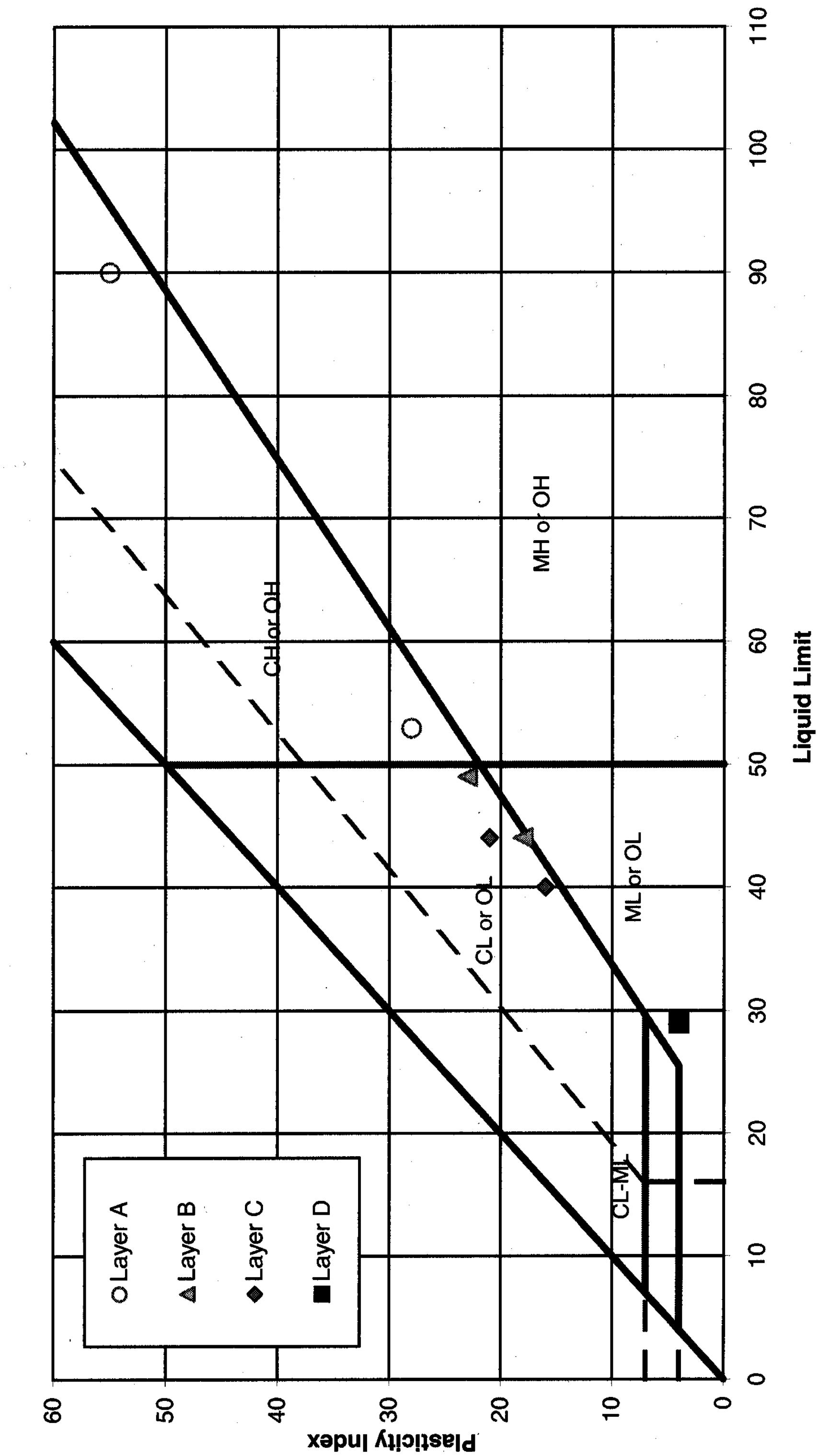

Percentage Passing
Grain Size (mm)
Grain size disturibution
3/4"
3/8"
#4
#10
#20
#40
#60
#140
#200
100.00
10.00
1.00
0.10
0.01
Layer A EMTUD1-ST1
Layer A EMTUD2-ST1
Layer B EMTUD1-ST2
Layer B EMTUD3-ST1
Layer C EMTUD2-ST2
Layer C EMTUD4-ST1
Layer D EMTUD1-ST3
Layer D B-14 ST-1



Plasticity chart (Ref. ASTM D2487)

LOG of BORING No. B-13

1 of 2

DATE 9/10-11/85 SURFACE ELEVATION 295.7 LOCATION N 75,990 E 58,950

DEPTH, ft.	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
0	6						
	34						
5	34						
	38	Very dense orange-brown, red-brown, and purple clayey medium to fine SAND with intermittent fine sandy clay lenses					
10	36						
	45						
15	42						
20	31	-stratified					
25	40	-becoming lavender					
30	34		262.7				
35	31	Hard red-brown and orange-brown with white micaceous fine sandy clayey SILT	257.7				
40	24	Medium dense orange-brown and white micaceous silty clayey medium to fine SAND					
45							

Continued on Sheet 2

Completion Depth 51.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

A-30

LOG of BORING No. B-13

2 of 2

DATE 9/10-11/85 SURFACE ELEVATION 295.7 LOCATION N 75,990 E 58,950

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
45		23						
			Medium dense orange-brown and white micaceous clayey medium to fine SAND					
50		25		244.2				
55								

Completion Depth 51.5 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

LOG of BORING No. B-14

1 of 4

DATE 9/26-27/85 SURFACE ELEVATION 289.9 LOCATION N 76,000 E 59,408

DEPTH, ft.	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
0	9	Dense gray becoming brown fine sandy SILT	287.4				
	27						
5	66						
	46						
10	21						
	26						
15	30						
20	20	Medium dense to very dense orange-brown, red-brown, purple, and light gray mottled clayey medium to fine SAND with intermittent fine sandy clay lenses					
25	22						
30	30						
35	24						
40	22						
45							

Continued on Sheet 2

Completion Depth 140.0 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

LOG of BORING No. B-14

2 of 4

DATE 9/26-27/85 SURFACE ELEVATION 289.9 LOCATION N 76,000 E 59,408

DEPTH, ft.	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
45	25						
50	24	Medium dense red-brown, yellow-brown, lavender, and gray clayey medium to fine SAND					
55	17						
	15	-micaceous					
	P			21.2	NP	NP	M,T
60	36						
65	21	-interbedded with medium to fine sandy clay lenses					
70	13						
	P						
	21						
75	31		213.9				
		Medium dense yellow-brown silty medium to fine SAND	210.9				
80	11						
	P	Medium dense yellow-brown clayey medium to fine SAND interbedded with medium to fine sandy clay lenses					
	22						
85	27						
90							

Continued on Sheet 3

Completion Depth 140.0 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

LOG of BORING No. B-14

DATE 9/26-27/85 SURFACE ELEVATION 289.9 LOCATION N 76,000 E 59,408

DEPTH, ft.	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
90	67	Same as above	196.9				
95	73	Dense orange-brown and yellow-brown silty medium to fine SAND					
100	62						
105	38	-clayey					
110	64		176.9				
115	33	Very stiff to hard red-brown gray and yellow-brown becoming light green fine sandy clayey SILT and clayey fine SAND, petroleum odor at 115.0 feet					
120	17						
125	23	-slightly cemented silts and shells					
130	35	-slightly cemented silts					
135							

Continued on Sheet 4

Completion Depth 140.0 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

4 of 4

LOG of BORING No. B-14

DATE 9/26-27/85 SURFACE ELEVATION 289.9 LOCATION N 76,000 E 59,408

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	DESCRIPTION	ELEVATION	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	OTHER TESTS
135		15 P 31	Very stiff light green micaceous fine sandy clayey SILT and clayey fine SAND -trace shells	149.9	41.4 37.9	36	27	
140								

Completion Depth 140.0 Feet Water Depth NA Feet Date

Project Name SRP - Area 600G Project Number 85C2445

Woodward-Clyde Consultants

SRS
SAVANNAH RIVER SITE

FIELD BORING LOG

PROJECT EAV / MegaTrench				JOB NO.	SHEET NO. 1 OF 2	HOLE NO. EMTUD-1
SITE EAV		COORDINATES N 75919 E 59355			WEATHER CONDITIONS Sunny ~85°F	
BEGUN 8 May 00	COMPLETED 8 May 00	DRILLING CO./DRILLER Alliance / M. Coleman	DRILL MAKE AND MODEL Mobil B-59	HOLE SIZE 6"	SAMPLE HAMMER WEIGHT/FALL NA	TOTAL DEPTH 50.0 ft
GROUND EL. 281.31	GROUND WATER DEPTH/DATE NA	TECHNICAL OVERSIGHT BY: Kirk Baker / SAIC		REVIEWED BY:		

SAMP. TYPE AND NO.	DEPTH (ft)	BLOW COUNT/ PRESSURE (psi)	REC./PEN.	GRAPHICS	DESCRIPTION AND CLASSIFICATION	NOTES
ST-1	5 – 7		70% / 20"		Poorly Graded Sand w/ clay (SP-SC); sand: med ~65%, clay ~35%; Mod Red 5R 5/4 varigated yellow and white; subrounded; moist	1200 psi; 20" penetration
	10				Sand or Poorly Graded Sand w/ clay (SP-SC); Sand: med-coarse ~75% clay ~25%; Mod. Yellowish Brown 10YR 5/4; subrounded; moist	
ST-2	13 – 15		100% / 24"		Poorly Graded Sand w/ clay (SP-SC); sand: med ~60%, clay ~40%; Pale Yellowish Orange 10YR 8/6 varigated light gray; subrounded; moist	1050 psi; 24" penetration
	20				SAME AS ABOVE	
	25				SAME AS ABOVE	
	30				Poorly Graded Sand w/ clay (SP-SC); sand: fine-med ~65%, clay ~35%; Lt Brown 5YR 6/4; subrounded; moist	
	35				SAME AS ABOVE	
	40				Poorly Graded Sand w/ clay (SP-SC); sand: med-fine ~70%; clay ~30%; Pale Yellowish Orange 10YR 8/6; subrounded; moist	

SS = SPLIT SPOON; ST = SHELBY TUBE; PS = PISTON; PB = PITCHER; CR = CORE

SITE GEOTECHNICAL SERVICES

HOLE NO. EMTUD-1

SRS
SAVANNAH RIVER SITE

FIELD BORING LOG

PROJECT: EAV / Megatrench | JOB NO.: | SHEET NO.: 2 OF 2 | HOLE NO.: EMTUD-1

SAMP. TYPE AND NO.	DEPTH (ft)	BLOW COUNT/ PRESSURE (psi)	REC./PEN.	GRAPHICS	DESCRIPTION AND CLASSIFICATION	NOTES
	45				SAND Poorly Graded Sand w/ clay (SP-SC); sand: med-fine ~65%, clay ~35%; Lt Brown 5YR 5/6; subrounded; moist	
ST-3	48 – 50		100% / 24"		Poorly Graded Sand w/ silt (SP-SM); sand: med-fine ~80%, silt ~20%; Lt Brown 5YR 5/6 variegated mod. red; subrounded; moist	900 psi; 24" penetration
					TD = 50 ft bls	

SS = SPLIT SPOON; ST = SHELBY TUBE; PS = PISTON; PB = PITCHER; CR = CORE

SITE GEOTECHNICAL SERVICES

HOLE NO. EMTUD-1

SRS

FIELD BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EAV / Mega Trench		1 OF 1	EMTUD-2

SITE	COORDINATES	WEATHER CONDITIONS
EAV	N 76013 E 59484	Sunny ~80 °F

BEGUN	COMPLETED	DRILLING CO./DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	SAMPLE HAMMER WEIGHT/FALL	TOTAL DEPTH
8 May 00	9 May 00	Alliance / M. Coleman	Mobil B-59	8"	NA	36.0 ft

GROUND EL.	GROUND WATER DEPTH/DATE	TECHNICAL OVERSIGHT BY:	REVIEWED BY:
280.28	NA	Brad Baker	

SAMP. TYPE AND NO.	DEPTH (ft)	BLOW COUNT/ PRESSURE (psi)	REC./PEN.	GRAPHICS	DESCRIPTION AND CLASSIFICATION	NOTES
	5				Lean Clay w/ Sand; sand: med-fine ~40% clay ~60%; Mod Red 5R 4/6 varigated yellow and pale purple; poorly graded; subrounded; moist (CL)	
ST-1	7 – 9		100% / 2.0ft			700 psi; 2 ft penetration
	10				Lean Clay w/ sand: sand: med-fine ~30% clay ~70%, Mod Red 5R 4/6 varigated pale purple 5P 6/2; poorly graded; subrounded; moist (CL)	
	15				Silt with SAND. sand: med-fine ~40% silt ~60%. Grayish Purple 5P 4/2; poorly graded; subrounded; moist (ML)	
	20				Silt w/ sand; sand: med-fine ~40% silt ~60%. Dk Yellowish Orange 10YR 6/6; poorly graded, subrounded; moist (ML)	
	25				SAME AS ABOVE w/ sand size fine-coarse, well graded	
	30				SAME AS 25ft grab sample above	
ST-2	34 – 36		100% / 24"		Poorly Graded Sand w/ silt: sand: med-fine ~85%; silt ~15%; Lt Red 5R 6/6; subrounded; poorly graded; moist (SP-SM)	100 psi; 2 ft penetration; TD = 36 ft bls

SS = SPLIT SPOON; ST = SHELBY TUBE; PS = PISTON; PB = PITCHER; CR = CORE

SITE GEOTECHNICAL SERVICES

HOLE NO. EMTUD-2

SRS
SAVANNAH RIVER SITE

FIELD BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EAV / Megatrench		1 of 1	EMTUD-3

SITE	COORDINATES	WEATHER CONDITIONS
EAV	N 75919 E 59609	Sunny ~85°F

BEGUN	COMPLETED	DRILLING CO./DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	SAMPLE HAMMER WEIGHT/FALL	TOTAL DEPTH
9 May 00	9 May 00	Alliance / M. Coleman	Mobil B-59	8" φ	N/A	16.0 ft

GROUND EL.	GROUND WATER DEPTH/DATE	TECHNICAL OVERSIGHT BY:	REVIEWED BY:
277.21	NA	Brad Baker / SAIC	

SAMP. TYPE AND NO.	DEPTH (ft)	BLOW COUNT/ PRESSURE (psi)	REC./PEN.	GRAPHICS	DESCRIPTION AND CLASSIFICATION	NOTES
	5				Poorly Graded SAND w/ clay (SP-SC); sand: med-coarse ~70%, clay ~30%; Mod Red 5R 4/6; subrounded; poorly graded; moist	
	10				Poorly Graded SAND w/ clay (SP-SC); sand: med-coarse ~60% clay ~40%; Mod Reddish Brown 10R 4/6 w/ yellow mottling; subrounded; poorly graded; moist	
ST-1	14–16		100% / 24"		Poorly Graded Sand w/ silt (SP-SM); sand: med-fine ~65%, silt ~35%; Pale Yellowish Orange 10YR 8/6; variegated red and white; micaceous; subrounded; moist	900 psi
					TD = 16 ft bls	

SS = SPLIT SPOON; ST = SHELBY TUBE; PS = PISTON; PB = PITCHER; CR = CORE

SITE GEOTECHNICAL SERVICES

HOLE NO. EMTUD-3

SRS
SAVANNAH RIVER SITE

FIELD BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EAV / MegaTrench		1 of	EMTUD-4

SITE	COORDINATES	WEATHER CONDITIONS
EAV	N 75826 E 59484	Sunny ~90°F

BEGUN	COMPLETED	DRILLING CO./DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	SAMPLE HAMMER WEIGHT/FALL	TOTAL DEPTH
9 May 00	9 May 00	Alliance / M. Coleman	Mobil B-59	8" ϕ	NA	27 ft

GROUND EL.	GROUND WATER DEPTH/DATE	TECHNICAL OVERSIGHT BY:	REVIEWED BY:
278.76	NA	Brad Baker / SAIC	

SAMP. TYPE AND NO.	DEPTH (ft)	BLOW COUNT/ PRESSURE (psi)	REC./PEN.	GRAPHICS	DESCRIPTION AND CLASSIFICATION	NOTES
	5				Poorly Graded SAND w/ silt (SP-SM) sand: med-coarse ~75%; silt ~25%; Mod Reddish Orange 10R 6/6 mottled white, micaceous; subrounded; moist	
	10				Poorly Graded SAND w/ silt (SP-SM); sand: fine-med ~65% silt ~35%; Pale Reddish Brown 10R 5/4; slightly micaceous; subrounded; moist	
	15				~~Poorly graded~~ Silt w/ sand (ML): sand: fine ~20% silt ~80%; Pale Reddish Brown 10R 5/4 variegated yellowish orange; ~~well graded~~ poorly graded; moist	~20 ft v. hard drilling
	20				Poorly Graded Sand w/ silt (SP-SM); sand: med-coarse ~70% silt ~30%; Dk Yellowish Orange 10YR 6/6; poorly graded; subrounded; moist	
ST-1	25		100% / 24"		Poorly Graded Sand w/ silt (SP-SM) sand: med-coarse ~80% silt ~20%; Pale Yellowish Orange 10YR 8/6 w/ whisps of white clay; slightly micaceous; subrounded; moist	900 psi
	27				TD = 27 ft bls	

SS = SPLIT SPOON; ST = SHELBY TUBE; PS = PISTON; PB = PITCHER; CR = CORE

SITE GEOTECHNICAL SERVICES

HOLE NO. EMTUD-4

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Appendix C

Ground Water Elevations

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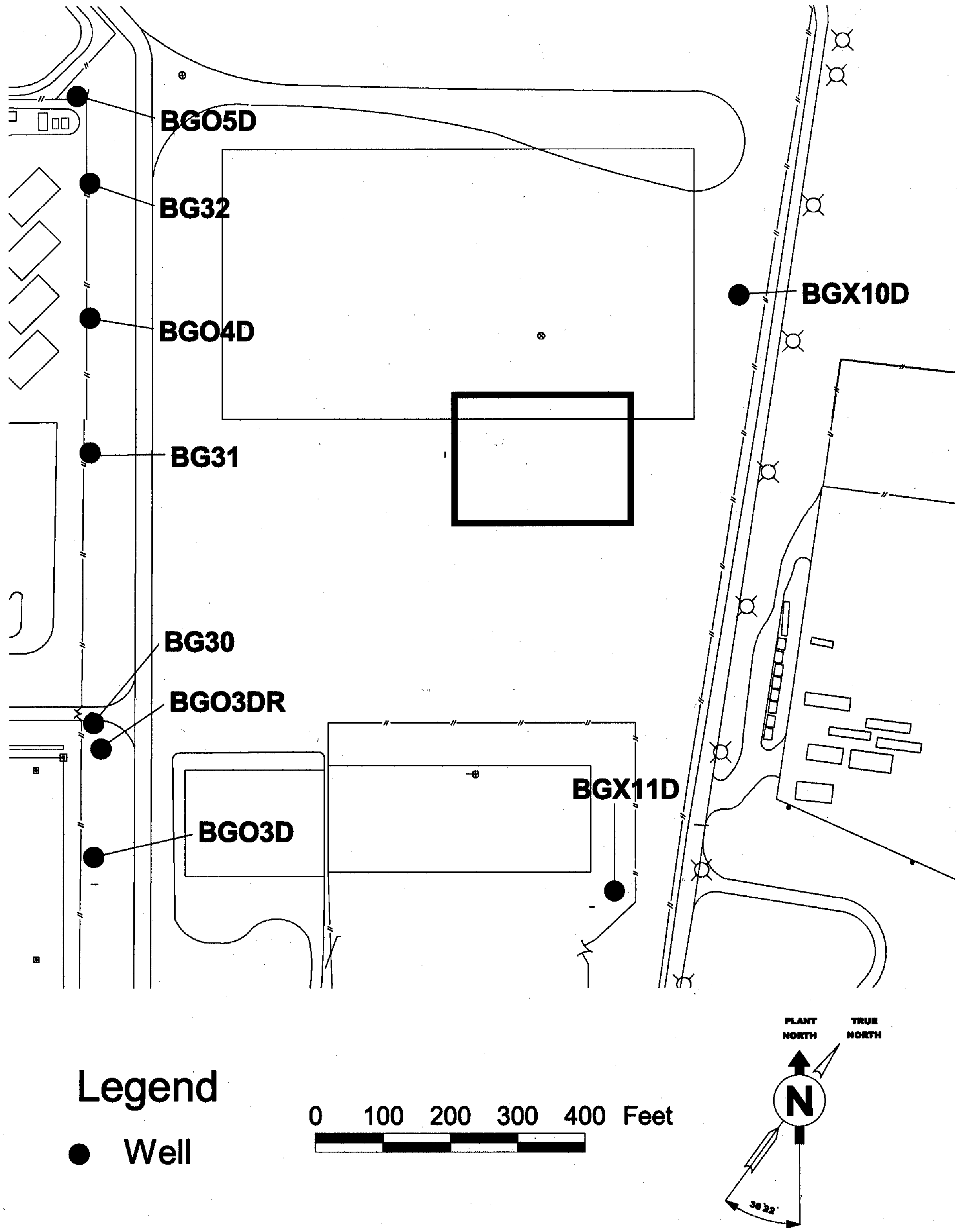
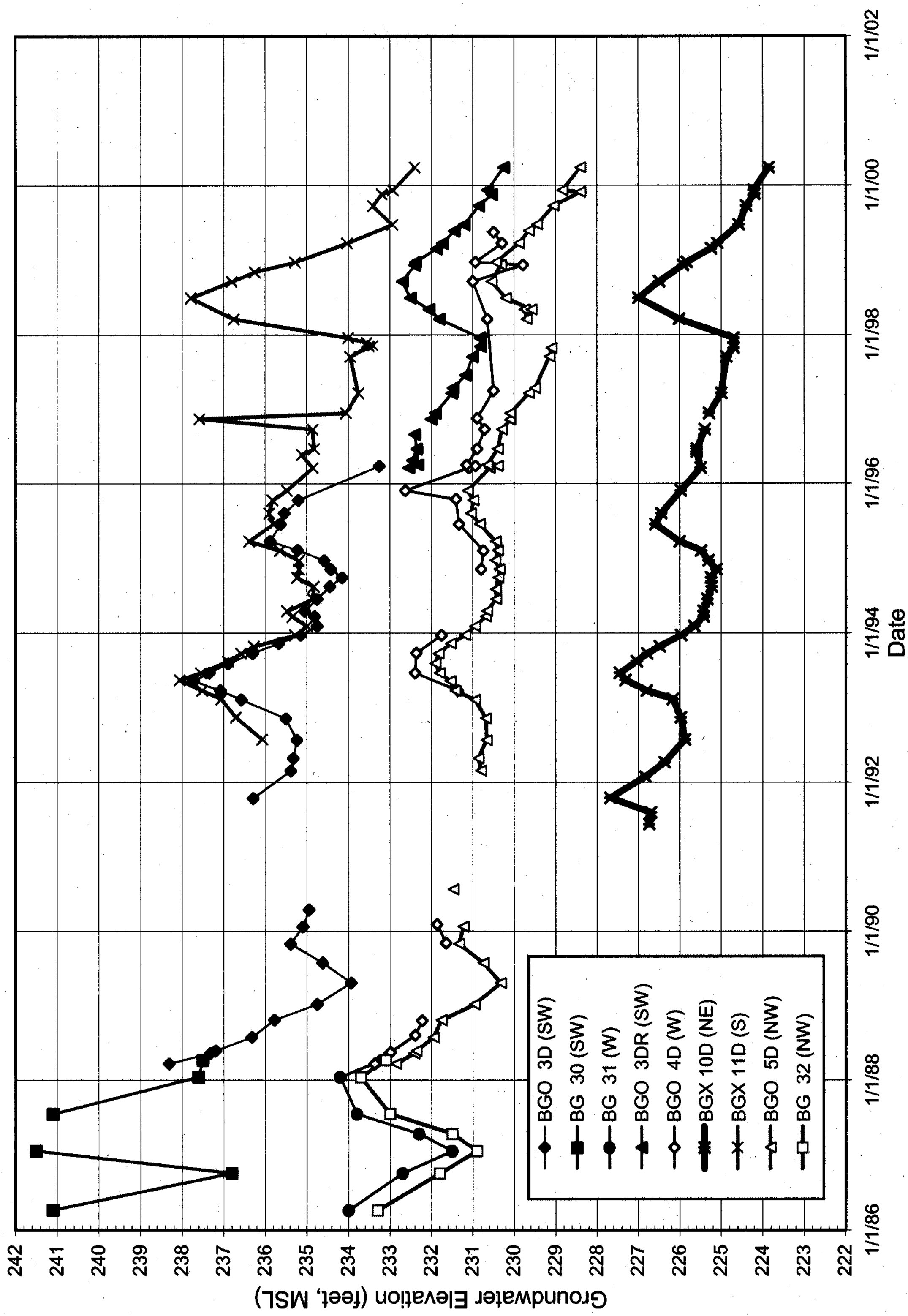


Groundwater monitoring well locations



Groundwater elevations at monitoring wells near the Mega-trench site

Appendix D

Laboratory Test Results

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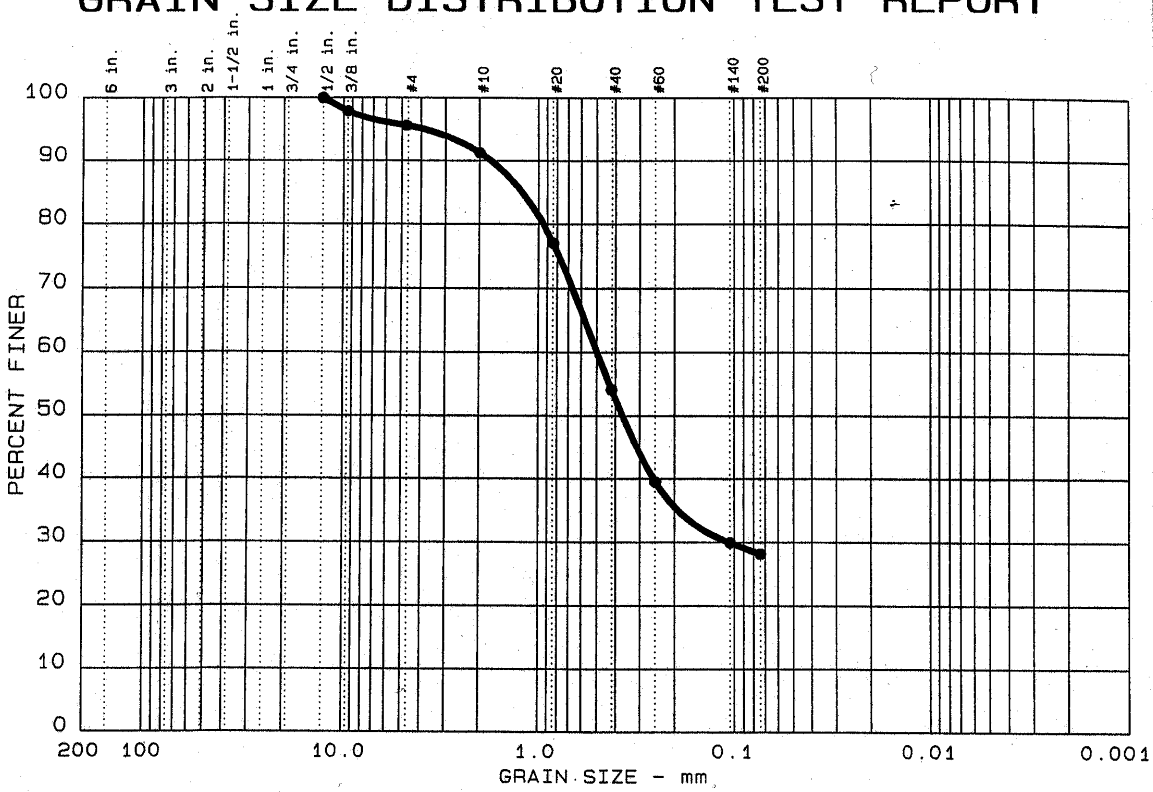
GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	4.4	67.4	28.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	53	28	1.20	0.50	0.37	0.105				

MATERIAL DESCRIPTION	USCS	AASHTO
● Tan Brown Clayey Sand	SC	A-2-7 (2.3)

Project No.: 50161-7-0108 Task 55
Project: MEGA Trench Slope Study
● Location: EMTUD1 St-1 @ 5-7 Ft.

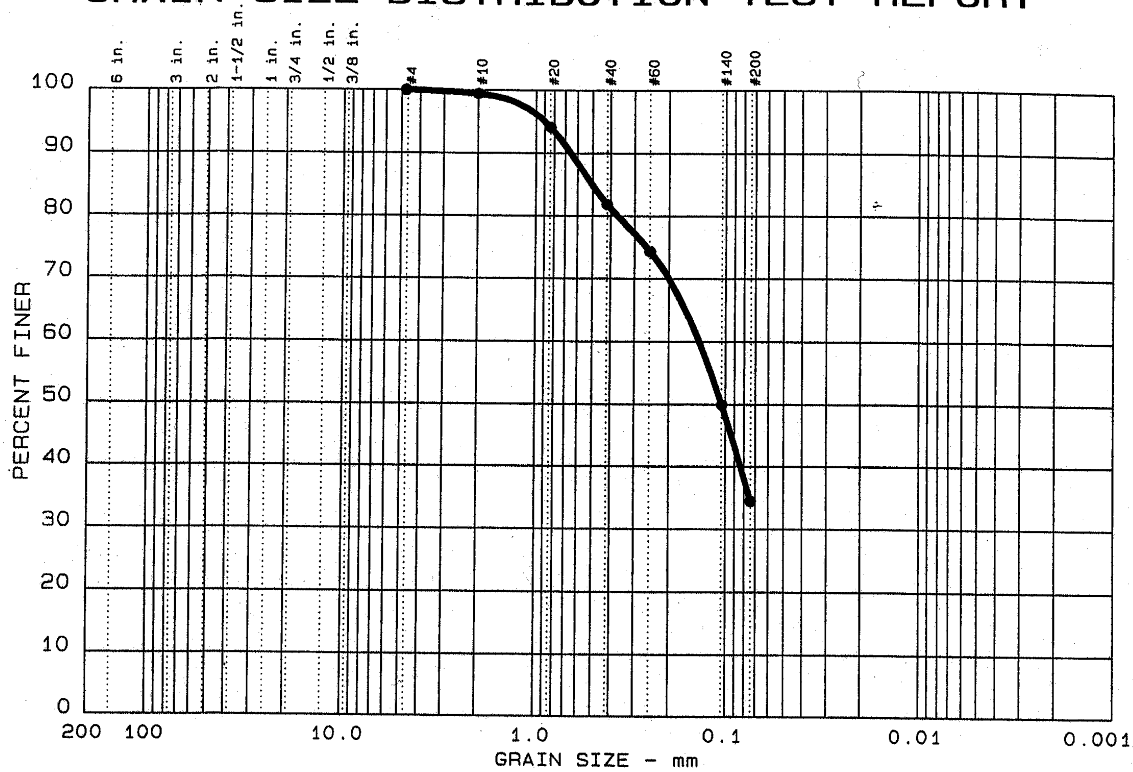
Date: June 1, 2000

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
Tested by: SC
Reviewed by: Hb
ASTM D422, D2216 & D4318
Moisture Content = 11.4%

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	0.0	0.0	65.5	34.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	44	18	0.50	0.14	0.10					

MATERIAL DESCRIPTION	USCS	AASHTO
● Tan Brown Clayey Sand	SC	A-2-7(1.6

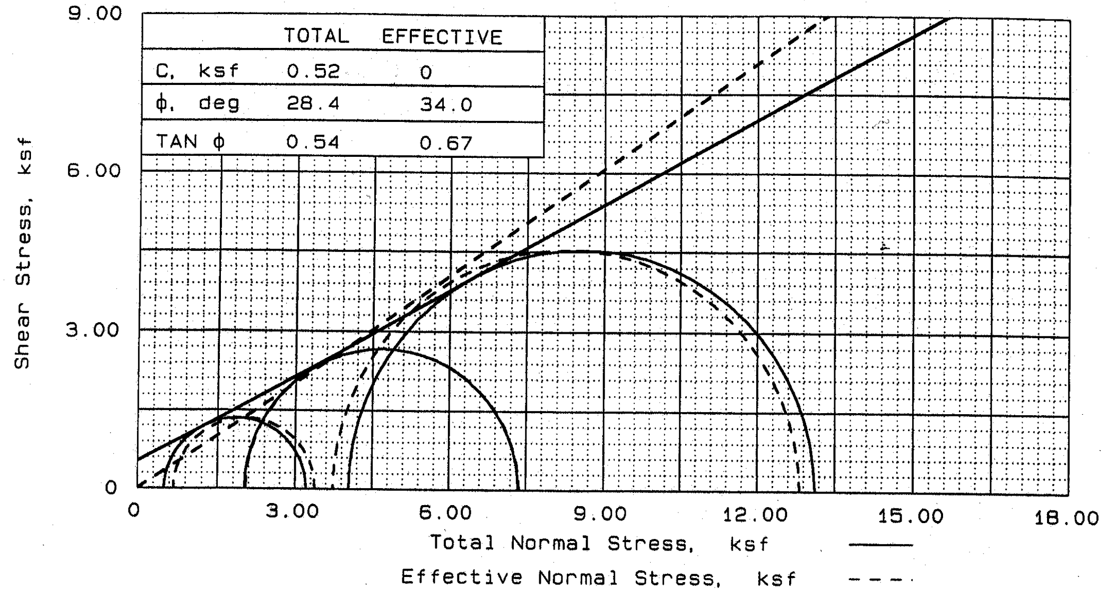
Project No.: 50161-7-0108 Task 55
Project: MEGA Trench Slope Study
● Location: EMTUD1 ST-2@ 13-15 Ft.

Date: June 1, 2000

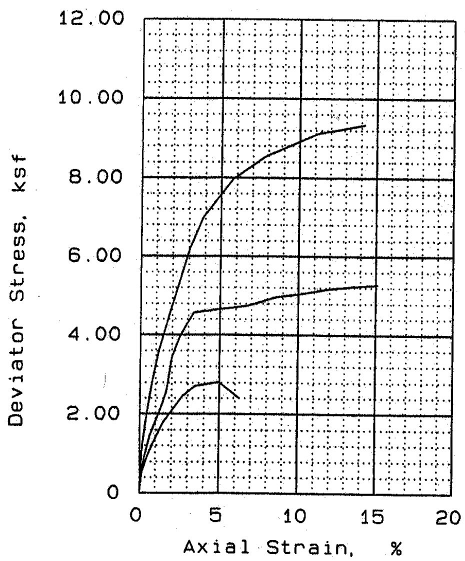
GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
Tested by: SC
Reviewed by: Hb
ASTM D422, D2216 & D4318
Moisture Content 15.8%

Figure No.



	TOTAL	EFFECTIVE
C, ksf	0.52	0
ϕ, deg	28.4	34.0
TAN ϕ	0.54	0.67



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	18.3	15.0	13.8
	DRY DENSITY, pcf	97.7	101.7	104.2
	SATURATION, %	69.8	63.5	62.1
	VOID RATIO	0.694	0.627	0.587
	DIAMETER, in	2.88	2.85	2.86
	HEIGHT, in	6.09	5.99	5.99
AT TEST	WATER CONTENT, %	23.7	20.9	19.7
	DRY DENSITY, pcf	101.6	106.5	108.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.628	0.553	0.521
	DIAMETER, in	2.83	2.79	2.82
	HEIGHT, in	6.08	5.96	5.92
BACK PRESSURE, ksf		2.88	2.88	2.88
CELL PRESSURE, ksf		3.38	4.90	6.91
FAILURE STRESS, ksf		2.70	5.34	9.08
PORE PRESSURE, ksf		2.71	2.87	3.18
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		3.37	7.37	12.81
$\bar{\sigma}_3$ FAILURE, ksf		0.68	2.03	3.73

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Ud
DESCRIPTION: Tan Brown Clayey Sand
LL= 44 PL= 18 PI= 26.0
SPECIFIC GRAVITY= 2.65
REMARKS: Tested by: JTM

Reviewed by: HJ

FIG. NO.

CLIENT: SRS

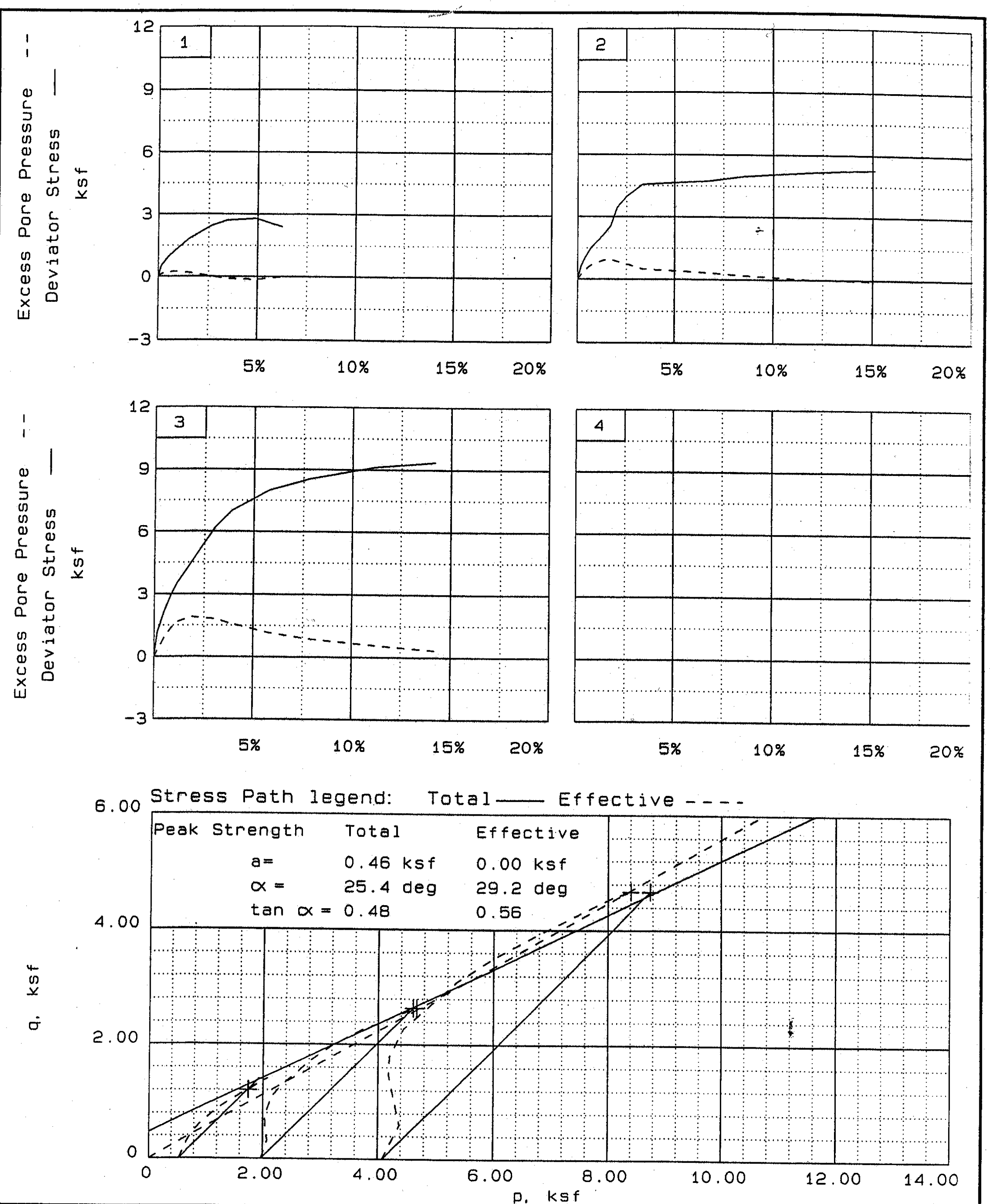
PROJECT: Mega Trench Slope Study

SAMPLE LOCATION: EMTUD-1 ST-2 @ 13-15 Ft.

PROJ. NO.: 5016170108 DATE: June 1, 2000

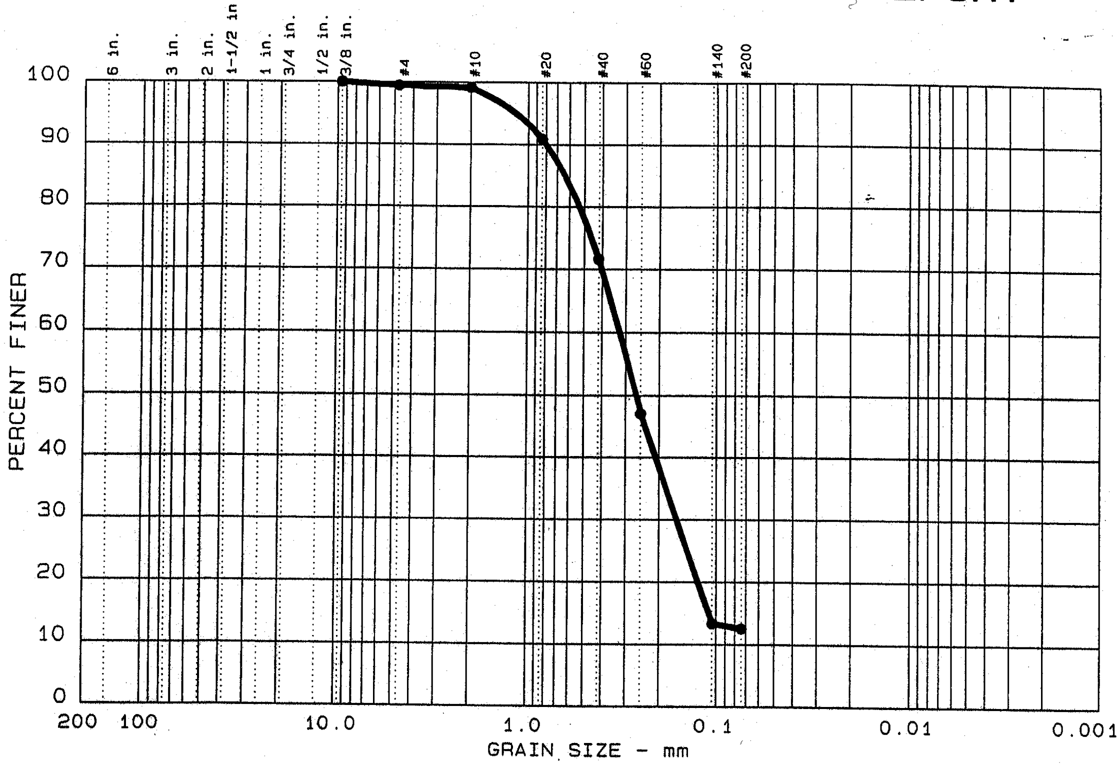
TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.



Client: SRS
Project: Mega Trench Slope Study
Location: EMTUD-1 ST-2 @ 13-15 Ft.
File: T55ST2TP Project No.: 5016170108 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	8	0.0	0.6	86.9	12.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	29	4	0.64	0.32	0.26	0.161	0.1095			

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown Silty Sand	SM	A-2-4 (0.0)

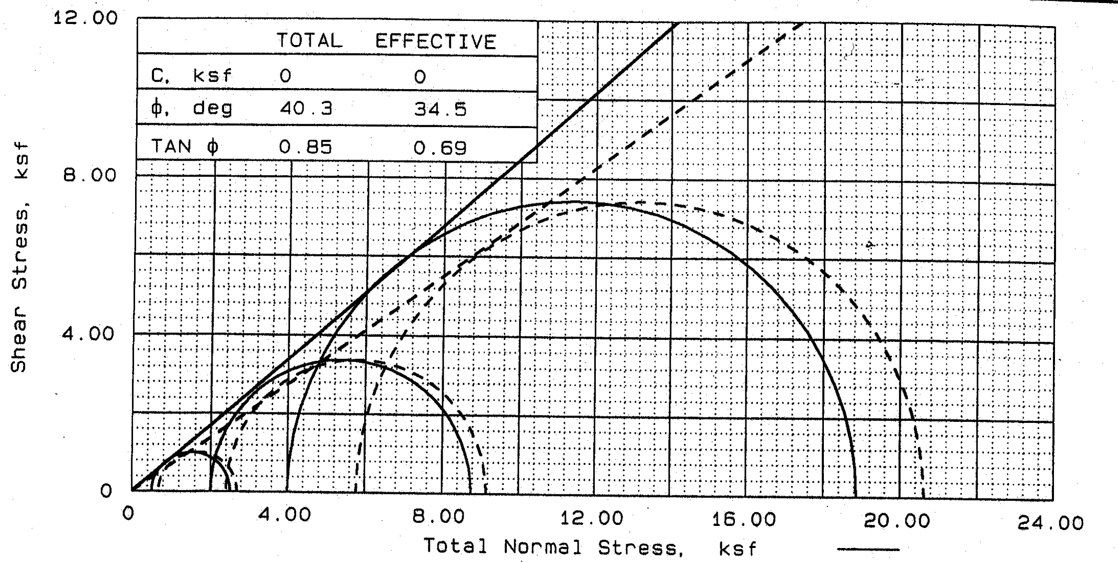
Project No.: 50161-7-0108 Task 55
Project: Mega Trench Slope Study
● Location: EMTUD1 ST-3 @ 48-50 Ft.

Date: June 5, 2000

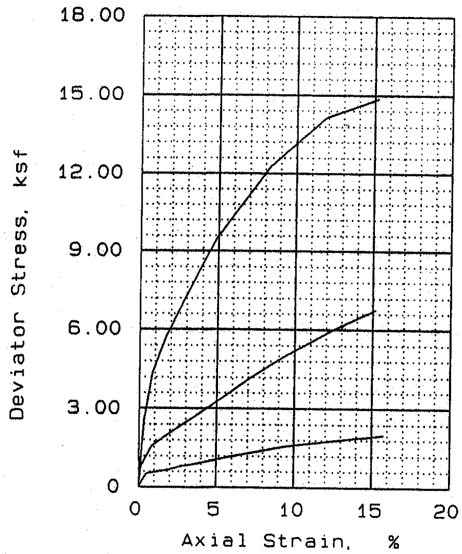
GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
Tested by: SC
Reviewed by: HD
ASTM D422, D2216 & D4318
Moisture Content 14.1%

Figure No.



	TOTAL	EFFECTIVE
C, ksf	0	0
φ, deg	40.3	34.5
TAN φ	0.85	0.69



	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	12.5	13.3	16.0
	DRY DENSITY, pcf	98.4	98.9	101.1
	SATURATION, %	47.1	50.9	64.8
	VOID RATIO	0.714	0.704	0.667
	DIAMETER, in	2.85	2.83	2.88
	HEIGHT, in	5.99	5.97	5.97
AT TEST	WATER CONTENT, %	26.1	25.6	23.8
	DRY DENSITY, pcf	98.9	99.7	102.6
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.704	0.691	0.643
	DIAMETER, in	2.85	2.83	2.87
	HEIGHT, in	5.98	5.94	5.92
	BACK PRESSURE, ksf	5.04	4.95	5.14
	CELL PRESSURE, ksf	5.54	6.95	9.14
	FAILURE STRESS, ksf	2.00	6.77	14.86
	PORE PRESSURE, ksf	4.87	4.55	3.37
	STRAIN RATE, %/min.	0.100	0.100	0.100
	ULTIMATE STRESS, ksf			
	PORE PRESSURE, ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	2.68	9.17	20.63
	$\bar{\sigma}_3$ FAILURE, ksf	0.68	2.4	5.77

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Ud
DESCRIPTION: Brown Silty Sand

LL= 29 PL= 25 PI= 4.0
SPECIFIC GRAVITY= 2.70
REMARKS: Tested by: JTm

Reviewed by: HB

FIG. NO.

CLIENT:

PROJECT: Mega Trench Slope Study

SAMPLE LOCATION: EMTUD-1
St-3 @ 48-50 Ft.

PROJ. NO.: 5016170108 DATE: June 12, 2000

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.

APPENDIX C

B-25 EXHUMATION

MAY 2-3, 2001

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APPENDIX C

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B-25 EXHUMATION, MAY 2-3, 2001

On March 15, 1993, four B-25 containers were buried in E Area, just east of the Old Burial Grounds. The B-25s were buried as part of a remote sensing experiment, designed to locate buried objects using ground-penetrating radar. Simulated waste material (wood) had been placed within the B-25s, as part of their previous use in the dynamic compaction experiment described in McMullin and Dendler (1994). The B-25s were in relatively good condition at burial, with some wall-flexure visible in the photographs taken prior to burial (Figures C-1 through C-4). The burial location is within a clean area.

The uppermost of the four B-25s was exhumed on May 3, 2001. It was transported to the FAB Laboratory in 773-A, where detailed corrosion evaluation was to be performed by Kerry Dunn, SRTC. The evaluation included documenting the general box condition, total area degraded or perforated by pitting, rate of corrosion, condition of protective coatings, physical and chemical form of box corrosion products, and other metallurgical examinations.

The exhumation began on May 2, 2001. Soils were removed to the top of the B-25. The top of the box was at a depth of 8 ft bls. Soil adjacent to the box was obtained at a depth of 9.5 ft for corrosion-related analyses, such as pH, resistivity, chloride, and sulfate. The sample was shipped to Law-Gibb Engineering (see Table 2 in text). The B-25 was not uncovered and exhumed until the following day to allow sufficient time for exhumation and transportation in one day.

The B-25 to be exhumed had a label with the number 66 on the top side-corner. The word “WOOD” was written under the label. The B-25 appeared to be in good overall condition from outside the excavation. Large areas of rust were not obvious. On closer inspection from within the excavation, the B-25 sides appeared to be relatively uniformly covered with blisters under the yellow-painted exterior. Some blisters contained water. Some blisters overlay obvious pitting corrosion. The yellow paint was underlain by a very dark gray to black primer coating. On at least one area of the container lip, the paint-layer was loosened to the point that it would separate from the primer-layer on contact.

The top of the uppermost B-25 (the one exhumed) was about 6 in. to 2 ft inside the B-25 and overlain by soil. The container was also full to the top with water. The B-25 interior beneath the top contained simulated waste, soil, and water. Samples of this water were obtained for analysis, and will be described in the corrosion report. The top of the underlying B-25 (which was not exhumed) was solidly in place. Some mud, but little soil was on top of the underlying B-25. Upon lifting the uppermost B-25 from the excavation, one cable was inadvertently placed through a handle on the top of the underlying B-25. This caused the top of the underlying B-25 to be lifted up. After repositioning the cable, the top of the underlying B-25 was raised by hand for examination of the interior. The underlying B-25 contained no visible soil and was about half-filled with water. The rubber gasket lining the underlying B-25 lid and forms the contact between the container sides and the lid, appeared to be in overall good condition. The interior sides were dark, apparently with the primer coating. The wood material in both B-25s was very dark and saturated, and there was a distinct “landfill” odor, which might suggest anaerobic conditions within the containers.

Upon raising the B-25 to land surface, the container was tipped over to remove the soil on top, making the container safer to handle and transport. Photographs (C-5 through C-34) of the exhumation are included in sequence of occurrence. A copy of the chain-of-custody for the soil sample is included (Figure C-35), as are daily activity reports for the exhumation (Figures C-36 and C-37).

Figure C-1. View to northeast.

NOTE: Figures C-1 throuth C-4 show the burial of B-25 containers previously used in dynamic compaction study, March 15, 1993. [See McMullin and Dendler (1994).] The containers and other objects were buried as part of a ground-penetrating radar experiment.

Uppermost B-25 (shown in Figures C-1 through C-3) exhumed May 3, 2001 for corrosion study.

Figure C-2. View to east.

Figure C-3. View of northwestern B-25 sides, looking east.

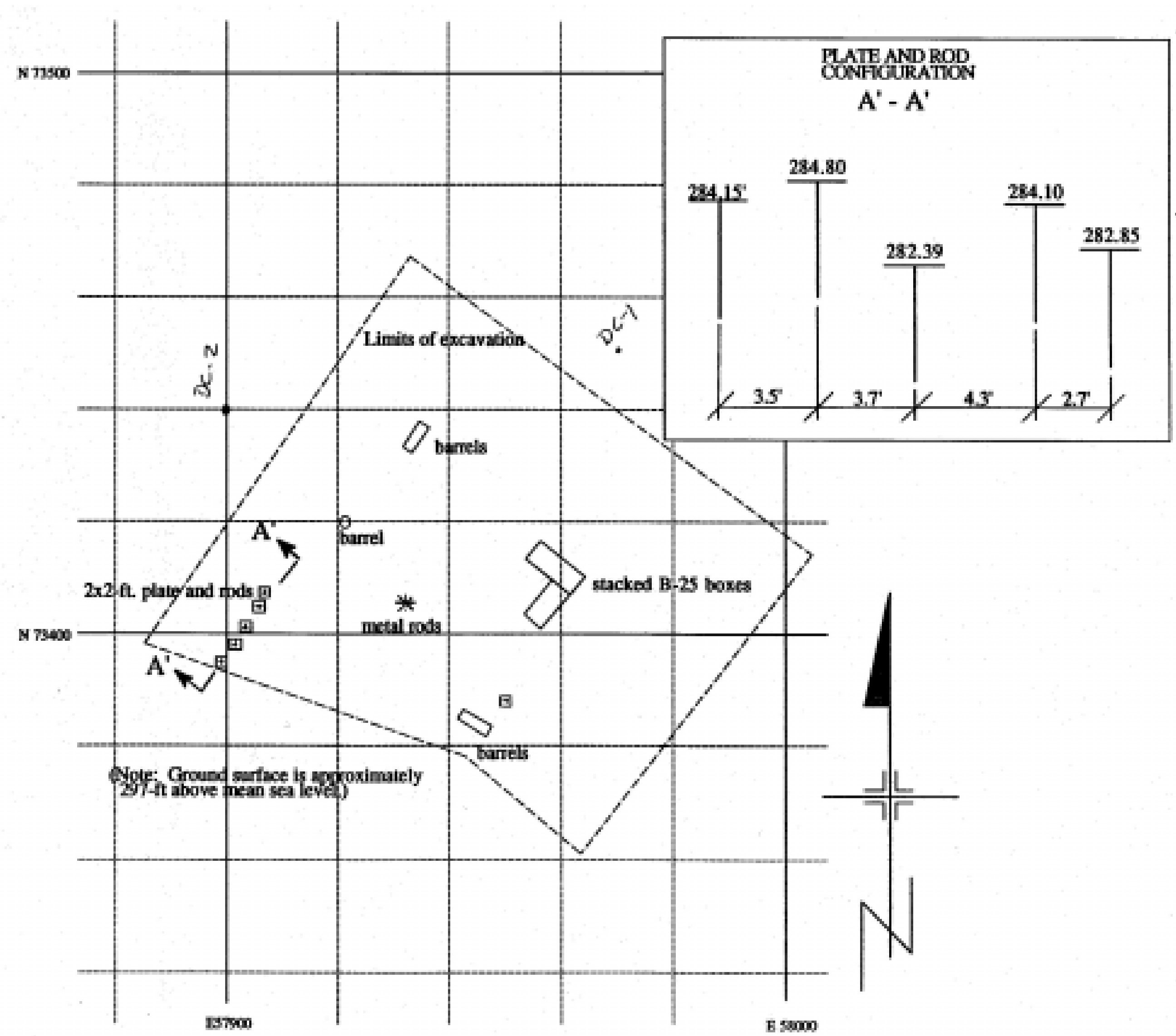

Figure C-4. Layout of B-25 containers and other objects buried March 15, 1993 as part of ground-penetrating radar experiment.

Figure C-5. Prior to excavation, May 2, 2001. B-25 location marked by orange paint on asphalt and grass. View to northeast.

Figure C-6. Surface soils adjacent to B-25 location at start of excavation, May 2, 2001. View to west.

Figure C-7. South B-25 corner by probe. Note B-25 is full of water and soil, May 2, 2001. View to northwest.

Figure C-8. South B-25 corner by probe. Note B-25 is full of water, May 2, 2001. View to west.

Figure C-9. B-25 southeast side, May 3, 2001. Container designation "66" and original contents hand-labeled "wood" visible on upper-right (upper eastern) corner. View to west.

Figure C-10. B-25 southeast side, May 3, 2001. View to west.

Figure C-11. B-25 southeast side, May 3, 2001. View to north.

Figure C-12. B-25 southeast side, May 3, 2001. View to northeast.

Figure C-13. B-25 southeast side, May 3, 2001. View to northwest.

Figure C-14. B-25 northwest side, May 3, 2001. View to east.

Figure C-15. B-25 northwest side, May 3, 2001. View to northeast.

Figure C-16. B-25 north corner, May 3, 2001. View to south.

Figure C-17. B-25 north corner, May 3, 2001. View to southwest.

Figure C-18. B-25 south corner, southeast side close-up, May 3, 2001. Note ribbon-like delaminated paint. View to northwest.

Figure C-19. B-25 south corner, southwest side close-up, May 3, 2001. Note ribbon-like delaminated paint. View to east.

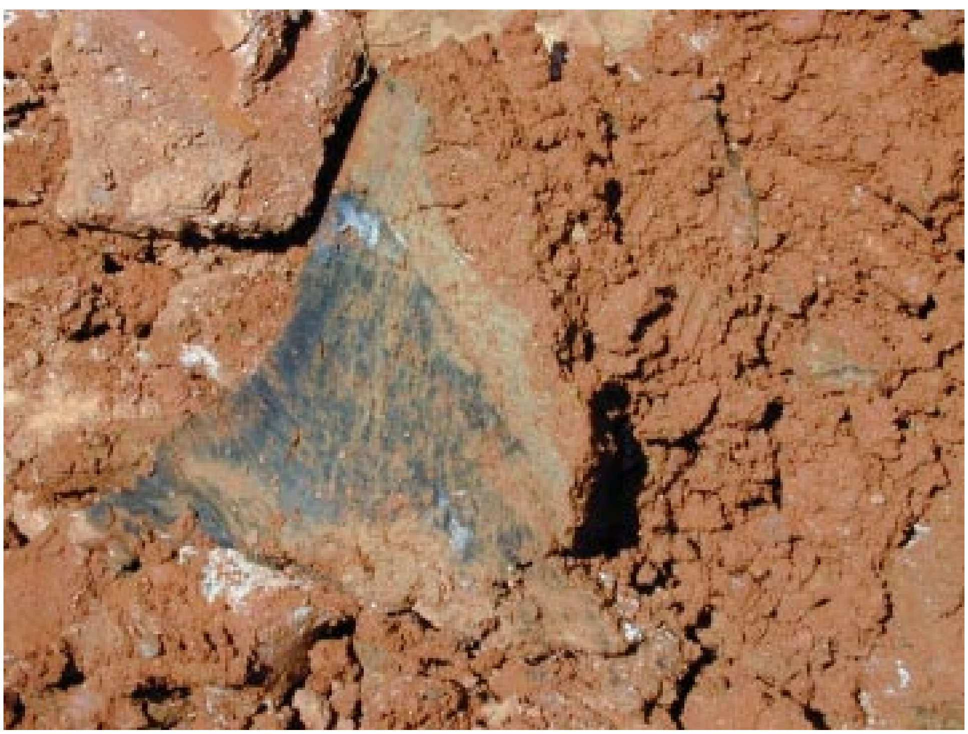

Figure C-20. Piece of soil about 1 ft. wide which fell from B-25 side, May 3, 2001. Note adhesion of paint and dark primer layer.

Figure C-21. B-25 west corner, northwest side, close-up, May 3, 2001. Original contents hand-label "wood" legible.

Figure C-22. B-25 west corner, northwest side, close-up, May 3, 2001. Dark corrosion product wiped off to expose container "66" designation.

FigureC- 23. B-25 northwest side close-up, May 3, 2001. Note some blisters lacking paint covering, while other still covered by upwelled paint.

Figure C-24. B-25 southeast side close-up, May 3, 2001. Note some blisters lacking paint covering, while other still covered by upwelled paint.

Figure C-25. B-25 south corner close-up, May 3, 2001. Note B-25 is full of water and soil.

Figure C-26. B-25 upper edge. Top has been pushed down into B-25 and covered with soil. Note delaminated paint along edge.

Figure C-27. B-25 being cleared for removal from excavation. Note water and soil within B-25.

Figure C-28. Wood simulated waste within B-25 underlying the excavated B-25, northwest side.

Note wood's dark color and water within the underlying B-25 (about half-full of water). Interior of underlying B-25 also had obvious "landfill" odor.

Figure C-29. Wood simulated waste within B-25 underlying the excavated B-25, northwest side. Note in-place saturated soil that has accumulated on lid of underlying B-25.

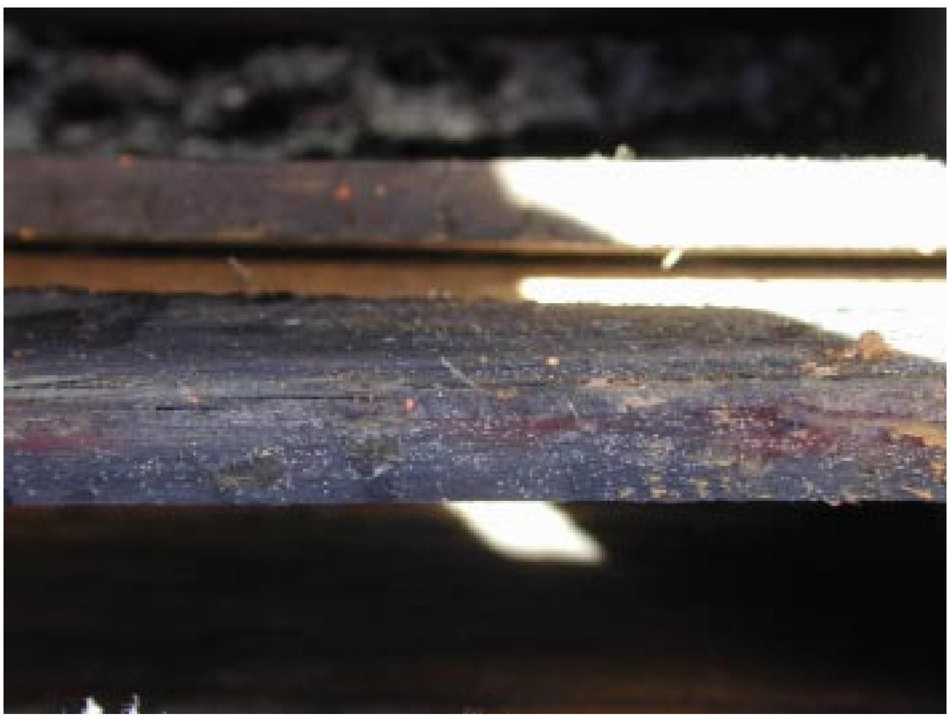

Figure C-30. Close-up of wood simulated waste within B-25 underlying the excavated B-25, northwest side. Water within underlying B-25 is visible along top of photograph.

Figure C-31. Initial lifting of B-25. Cables inadvertently run through handles on top of underlying B-25 pulled its lid up. B-25 was lowered, and cables re-routed to leave underlying B-25 top in place.

Figure C-32. B-25 being lifted from excavation.

Figure C-33. B-25 turned on side at grade to remove soil and water to facilitate transport to laboratory. Note soil thickness approximately 2 ft. toward center of lid.

Figure C-34. B-25 turned on side at grade to remove soil and water to facilitate transport to laboratory. Note wood simulated waste material.

CHAIN OF CUSTODY

Savannah River Site
Savannah River Technology Center
Building 773-42A
Aiken, SC 29808

Date: 05/02/01 Time: 14:10 Soil Sample #: —
Soil Sample Id: B25DS1S
Location: E-Area;
Interval: depth 9.5ft
Field QC Code: Sampling Event Code: —
Matrix: Soil Sampling Tool: Grab Sample

Ship To: Law/Gibb Engineering
Contract:

Laboratory Work Request Form

Lab ID:*

Item	Preservative	pH	Qty	Container	Option	Analysis Requested
1	NA	—	1	Polyethylene bag w/in bucket		Natural Moisture Content D2216
						pH determination D4972
						conductivity/resistivity G57
						specific gravity D854
						Sulfate ion in water D516-90
						Chloride ion in water D512-89

Comments*

Cooler Information

Cooler number	Items in cooler	Cooler temp.
Cooler number	Items in cooler	Cooler temp.

Sample Bottle Labels

Custody Transfer Record

Relinquished By***	Date	Time	Received By	Date	Time
(Sampler)					

*optional **pH: C-correct I-incorrect ** First relinqisher is the sampler

Figure C-35. Chain of Custody form for samples.

OSR 30-2 (Rev 12-89)

DAILY ACTIVITIES REPORT

PROJECT: ~~TPSR~~NS529 B-25 Exhumation	~~DRILLING~~ SUBCONTRACTOR: Construction Bechtel SRS Const. Svcs.
	~~DRILLER~~
~~WELL NUMBER~~: B-25 / TECHNICAL OVERSIGHT: W. E. Jones	OVERSIGHT FIRM: SRTC
LOCATION: E Area	DATE: 05/02/00 / PAGE: 1 of 1

START	STOP	DESCRIPTION OF ACTIVITIES; REMARKS
0700		pH Meter calibration check - OK
0830		Onsite Solomon Hood does not have shift supervisor's
		signature on WCP. Met w/ Jim Kemp who says
		Mike Ladd "owns" property who says Mike Serrato
		owns property
1005		On phone w/ B. Aylward & M. Serrato who
		authorize me to sign WCP.
		Checked w/ Radcon Gene Folk & Elaine Mills - EM will do courtesy
		check on B-25.
1045 ~~1245~~ WEJ		Excavating to ~6 ft depth above & on Eastside B-25s.
1245		Measured pH of soil in excavated soil pile pH = 5.3 brn sandy clay
1250		Construction crew excavating.
1305		Measured pH of soil (@ that above) w/ pHydrion litmus paper pH ~5
1350		Found box north end - appears to be full of water.
1410		Obtained soil sample from N-end of B-25 pH/Temp °F →
		5.3/64.7; 5.4/64.4; 5.4/64.4 of 5.7/64.4; 5.4/64.6; 5.3/64.5
		sample designation B25DS1S depth 9.5 ft.
1350		Took sample B25DS1S (9.5 ft depth) to Bruce Triplett
		WEJ

TECHNICAL OVERSIGHT SIGNATURE W E Jones DATE 5/2/01

Figure C-36. Daily Activities Report for May 2, 2001.

OSR 30-2 (Rev 12-89)

DAILY ACTIVITIES REPORT

PROJECT: TTPSR115529 B-25 Exhumation	~~DRILLING~~ SUBCONTRACTOR: Construction Bechtel SRS Const. Svcs.
	~~DRILLER~~:
~~WELL NUMBER~~: B-25 — TECHNICAL OVERSIGHT: W. Jones	OVERSIGHT FIRM: SRTC
LOCATION: E Area	DATE: 05/03/01 — PAGE: 1 of 1

START	STOP	DESCRIPTION OF ACTIVITIES; REMARKS
0710		Arrived worksite. Backhoe operator clearing overburden.
0725		Phoned Bruce Triplett re: grab soil sample from yesterday
0750		Checked pH of soil (reddish brown sandy clay) excavated from ~6 ft depth
		pH ~5 to 6 by pH paper (litmus paper).
0755		North side of box exposed & photographed – appears to be in good shape –
		no obvious rust visible from outside excavation. Backhoe scraped off some
		paint along B-25 north side top & top corners of north side of B25.
0810		Kerry Dunn onsite w/ technicians.
1300		pH of soil sample from ~12 ft. depth w/ pH paper 5 to 6.
1500		Pulled out B-25* – top of underlying box began coming up due
		to cable passing through handle on top. Cable rerouted – turned
		B-25 on side at ground surface to remove soil. Transported
		to A-Area after RadCon swiped & OK'd.
		*Little to no rust observed on B-25 removed (B-25 had #66 on
		upper right western side w/ "Wood" handwritten). Outer coat of
		yellow paint seemed to be "bubbled up" in places, with underlying
		primer coat (dark green) coming through yellow coat in ~~circular~~ round(ed)
		"buckshot" pattern. Top of upper box (exhumed box) was inside the
		B-25, w/ soil & water above, soil, water & wood simulated
		waste below the top. Inside underlying box was no soil, but
		was about half-full of water & also contained wood simulated
		waste. Wood in both boxes was black to blue-black. Obvious
		"landfill" odor from both boxes. The top of the Box west of the
		exhumed box was inside its box – did not see the top of the box
		located to the south of the exhumed box. The top of the underlying
		box did not have much soil – more like a ~~flood~~ wet layer of silt/clay moist to wet.
		Weather was sunny, breezy, warm to hot today.

TECHNICAL OVERSIGHT SIGNATURE [signature] DATE 05/03/01

Figure C-37. Daily Activities Report for May 3, 2001.

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APPENDIX D

PROCUREMENT SPECIFICATIONS

BURIAL BOX SPECIFICATION
PROJECT PROBLEM No. 2-8200
Revision No. 10
November 12, 1986

C-SPP-G-00101
LOW LEVEL WASTE B-12 AND B-25 BOX SPECIFICATION
Revision 5
May 29, 2001

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LOW LEVEL WASTE B-12 AND B-25 BOX SPECIFICATION 271

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BURIAL BOX SPECIFICATION - 1986

OSR 3-4A

INTER-OFFICE MEMORANDUM

SAVANNAH RIVER PLANT

November 12, 1986

TO: B. L. GODWIN, 742-A
P & GS DEPARTMENT

FROM: T. J. H. POSEY, 706-F
PROJECT DEPARTMENT

LOW LEVEL WASTE BURIAL BOXES

Burial box purchase orders placed during the next six months should refer to the attached burial box Specification (Revision No. 10) and SRP Drawing S4-G-183 (Revision No. 13). Revision 10 increases the vendor supply to 200 boxes per week. Revision 13 adds closure design, Detail 'V'. If there are any questions please call me at 74491.

TJHP:ksn

CC: L. C. Thomas, 724-7G
T. A. Drew, 703-F
T. L. Hendrix, 773-A
C. V. Lester, 221-10F
R. M. Damm, 773-A
R. O. Pekkala, 707-C
G. H. Street, 706-F
J. W. Jennings, 706-F
J. W. Crichton, Jr., 703-A
J. E. Haywood, 703-F
R. F. Mayock, 703-A

BURIAL BOX SPECIFICATION
PROJECT PROBLEM NO. 2-8200
DATE: November 12, 1986
REVISION NO. 10
Page 1 of 4

IDENTIFICATION

Low-Level Waste Burial Boxes

GENERAL

The following specification describes the requirements for a carbon steel burial box for low-level solid waste. Refer to Du Pont drawing S4-G-183 (Rev. 13). This box is not designed for use in a compactor.

CONSTRUCTION

Material: Carbon Steel, ASTM A-569.

Thickness: 14 gauge.

Size: Outside dimensions of burial box (without lid) to be 6'-0" long x 3'-10" wide x 3'-11" high. All tolerances to be ± 1/4".

Capacity: 5,000 lbs. (solid-like material)

Strength: Burial box (when half filled) must be able to support a uniform load of four times the capacity on its top. Vendor to provide stiffeners or crimping as specified on drawing. All reinforcing must be to the interior of the box.

Lid: The lid shall be fabricated to allow removal by a forklift. Handles shall be provided on each end of the lid to allow manual guiding and lifting of lid by personnel. The lid lifting lugs and handles must be positioned as to not interfere with box stacking. Provisions must be made to ensure fast positive sealing of lid to the burial box in order to retain contents, seal against weather, and reduce radiation exposure while sealing. Vendor must use closure design shown on S4-G-183 or design approved by Du Pont.

Gasket: A 1/2" thick x 1" wide gasket, closed-cell neoprene (ASTM D-1056-73, Grade CE-41), shall be provided on the lid. Gasket should have removable tape to prevent gasket from sticking to box rim until lid is removed prior to filling.

Welding: All welding shall be in accordance with requirements of ASME Section IX.

Lifting Provisions: Means to facilitate safe handling of burial box by forklift must be provided on bottom of box.

BURIAL BOX SPECIFICATION
PROJECT PROBLEM NO. 2-8200
DATE: November 12, 1986
REVISION NO. 10
Page 2 of 4

CONSTRUCTION Continued

Finish: Interior and exterior of burial box and lid must be free of all burrs and sharp edges. A zinc chromate primer is to be applied to the interior of the box. Exterior of box shall have a zinc chromate primer with a top coat of alkyd enamel. Finish color to be high visibility yellow. Du Pont shall approve protective coating procedure prior to fabrication.

MISCELLANEOUS

Storage: Burial boxes to be stackable (up to four high) when filled.

Quotation: The quotation shall include six (6) copies of detail drawings for Du Pont approval. Drawings must show materials, dimensions and typical weld details.

Delivery: Vendor must be capable of supplying 200 boxes per week on demand.
Marking: The following information must be stenciled on each box:

1. Empty weight (for example, 350 lb.)
2. Volume (for example, 90 ft^3)
3. Pay load - (for example, 5000 lb.)
4. Total Pay load - (for example, 5350 lb.)
5. DO NOT place cadmium, lead, or mercury in this box.

INSPECTION

Inspection of random samples of burial boxes to be performed at the vendor's site in accordance with the attached inspection specification.

INSPECTION SPECIFICATION

Inspection - Burial Boxes

1.0 Opportunity to inspect this equipment by a Du Pont Quality Assurance Field Representative (QAFR) is required prior to shipment in accordance with the following instructions. Notify Quality Assurance Engineering Scheduling at least 48 hours before each inspection is required by calling (302) 366-3601.

2.0 When major components or service are obtained from sub-vendors, the QAFR may inspect these items at the point of manufacture (witness point). It is the vendor's responsibility to include Du Pont inspection and notification requirements in sub-orders.

3.0 Special Considerations

3.1 Welders and procedures to be qualified per ASME.

3.2 A standing water test may be witnessed (witness point, minimum 5%).

3.3 A uniform load test (20,000 lbs.) may be witnessed (witness point, minimum 5%). Box to be half full of sand or water.

3.4 The sealing technique shall be demonstrated for fast, positive sealing. A one-time demonstration will suffice but must be re-demonstrated when any revision in design is made by the vendor.

3.5 Removal of lid without damage to lid or gasket material.

4.0 Inspection Schedule (Vendor to request inspection at the following points)

4.1 Preliminary - Vendor should completely fabricate only one box for inspection. Should box not meet specifications, changes can be made prior to fabricating a large quantity of units. Du Pont may choose to waive preliminary inspection if fabricator has supplied boxes on previous orders.

4.2 Final - After fabrication and prior to painting of boxes.

5.0 Inspection Instructions (The following inspections will be performed on 5% minimum of total order and may be witnessed by the QAFR)

5.1 Verify by review of documentation that welders and procedures used were qualified per ASME Section IX.

5.2 Visually inspect welding for quality and for weld detail compliance to approved drawings.

INSPECTION SPECIFICATION
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REVISION NO. 10
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5.3 Verify that all edges and burrs are removed from interior and exterior of box and lid.

5.4 Conduct 4-hour standing water test. Box to be filled a minimum of 6" deep with water. No leaks are permitted. If leaks are found, perform test on 10% of total order. If further leaks are found, test 100% of total order. Any leaking boxes will be repaired by the vendor and retested (w/o charge).

5.5 Conduct uniform load test. Box shall be half full of sand or water.

5.6 Review surface preparation and painting requirements.

5.7 Check boxes for general dimensions and trial fit of lid. Verify materials and inspect box interior for no distortions greater than 1/2" deformation.

5.8 Review sealing technique and effectiveness. A one-time dimensional check of the sealing design is required to insure gasket compression of 20-30%.

5.9 Check boxes to assure that lid can be removed without gasket material adhering to box rim. Lid and gasket material must not show damage during this procedure. Perform test on 5% of total order.

5.10 Document test results.

TJHP:ksn

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LOW LEVEL WASTE B-12 AND B-25 BOX SPECIFICATION

OSR 45-10# (Rev 12-28-95)

Procurement Specification Cover Sheet

1. Title
Low Level Waste B-12 & B-25 Box Specification

2. Specification No.	3. Revision	4.	5. Page
C-SPP-G-00101	5	☐ Commercial ☒ Engineered	1 of 20
6. Functional Classification N/A	7. Requester Department CSWE	8. Requester Division Solid Waste	

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Department: Solid Waste Quality Assurance	

ENGINEERING DOC. CONTROL - SRS
00611704

OSR 45-9# (Rev 12-28-95)

Standard Procurement Specification Revision History Sheet

1. Specification No.	2. Revision No.	3. Page
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4. Date	5. Revision No.	6. Paragraph No.	7. Description of Changes
1/13/2000	0		Initial Issue
5/3/2000	1	2.2, Attachments	Replaced cover sheet; Added Pg. 1A; revised Section 2.2;
		5.8, 5.9, & 5.10	Replaced Att. 5.8 & 5.10; revised Att. 5.9.
6/15/2000	2	3.7.2, 4.2.9,	Replaced cover sheet; Deleted COC requirement in 3.7.2;
		Att. 5.1 & 5.9	Revised 4.2.9, Att. 5.1 & 5.9
7/10/2000	3	Section 3.2.6	Replaced cover; revised sht. 2; revised Section 3.2.6
7/26/2000	4	MISC.	RE-WRITTEN. Revised sections 2.1, 2.3, 3.2.6, 3.5.1, 3.7, 3.8, 4.2.9, 4.5
			Added table of contents, New Revision sheet and cover sheet.
			Corrected Attachments 5.2, & 5.4, 5.10, Deleted 1.2, 4.2.6, 4.3.1
5/14/2001	5	MISC.	General Rewrite. All sections modified. Deleted Att. 5.2
			thru 5.7. Other attachments renumbered. Added one new
			attachment (4).

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1.0 SCOPE

1.1 General Description of the Item

This specification covers design, fabrication, assembly, inspection, test and delivery of Low Level Waste leak proof (B-Series) metal boxes. These boxes are to meet Department of Transportation (DOT) requirements specified in section 2.2.1. Two sizes of boxes are required as described below:

1.1.1 Box B-12 (45 Cu. Ft. nominal)

1.1.2 Box B-25 (90 Cu. Ft. nominal)

1.2 Background:

Boxes are used for packing, transporting and storage of Low Level Solid Radioactive Waste, low specific activity (LSA) material, or surface contaminated objects (SCO) containing not more than 1% liquid by volume.

2.0 REFERENCES

2.1 Definitions

WSRC – Westinghouse Savannah River Company and its representatives

SSR – Source Surveillance Representative

2.2 Codes / Standards / Orders / Regulations

2.2.1 Codes/Regulations

Title 49 CFR 173.410

2.2.2 Standards

Use of any other edition, revision, or issue requires approval by WSRC.

- ASTM A569-93, Steel, Carbon (0.15%) Hot-rolled, Sheet and Strip, Commercial Quality
- ASTM D1056-98, Specification for Flexible Cellular Materials
- AWS D1.1-98, Structural Welding Code-Steel
- AWS D1.3-98, Structural Welding Code-Sheet Metal
- 1998 ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications

3.0 ITEM REQUIREMENTS

3.1 Performance Requirements

Each box shall be capable of holding (without release) its contents of radioactive waste during transportation and storage.

3.2 Design Requirements

Boxes are to be designed and built in accordance with 49 CFR 173.410 requirements and this specification. Based on the following information, Supplier to provide **Box Fabrication Drawings** to WSRC for approval in accordance with Attachment 3.

3.2.1 Box Dimensions

Attachment 1 provides suggested design criteria for both boxes.

Note: Box configuration given in Attachment 1 (relative to length, width and height) is essential for WSRC use. Fabrication drawings will be reviewed by WSRC to ensure this relative configuration is maintained.

3.2.2 Box Capacity

1. Each **B-12** box shall be capable of holding five-thousand pounds (**5,000** lbs) of solid radioactive waste (with not more than one percent (1%) liquid by volume).
2. Each **B-25** box shall be capable of holding six-thousand pounds (**6,000** lbs) of solid radioactive waste (with not more than one percent (1%) liquid by volume).

3.2.3 Box Strength

Each box shall be capable of being stacked five (5) high. The bottom box shall support:

1. For a **B-12** box twenty thousand pounds (**20,000** lbs.) payload plus box and lid weights with minimal distortion of the side wall (ref. Section 4.2.6 Uniform Load Test requirements).
2. For a **B-25** box twenty-four thousand pounds (**24,000** lbs.) payload plus box and lid weights with minimal distortion of the side wall (ref. Section 4.2.6 Uniform Load Test requirements).

3.2.4 Closure Mechanism

1. Supplier shall submit a **Closure Mechanism Design** to WSRC for approval in accordance with Attachment 3.
2. Provisions shall be made to ensure fast, positive closure of the lid to the box:
    a. Closure mechanism shall achieve twenty percent (20%) minimum compression of the gasket between the lid and box after closure.
    b. Supplier shall identify to WSRC the methods and objective data substantiating that this requirement has been met.
3. Closure mechanism shall not interfere with the box stacking capabilities.
4. Supplier shall deliver **Closure Instructions** to WSRC with each shipment in accordance with Attachment 5.

3.2.5 Lifting

1. Each box shall be configured to allow for manipulation of the box with a fork truck.
2. Boxes, whether empty or loaded, shall **NOT** be lifted by the lid.
3. The lid shall be configured to allow lifting of the lid off the box by either hand or fork truck (using lid lifting lugs or lid handles shown on Attachment 1).
4. Neither configuration shall interfere with the stacking capabilities of the box.

    Note: Removable eyes and/or lifting lugs shall **NOT** be considered as a viable alternative to manipulate these boxes. The outer box support legs shall be located at least 2" in from the 3'-10" side of the box for convenience in installing rope/sling for lifting (See Attachment 1).

3.2.6 Finish

1. Box surfaces shall be primed with a primer that is a rust inhibitor (minimum dry film thickness of 2.0 mil).
2. The box exterior shall be painted with a compatible alkyd enamel finish (minimum dry film thickness of 1.25 mil).
3. Outer color shall be yellow or gray as required by WSRC.
4. The resultant cured coating shall be RCRA non-hazardous.

5. Supplier shall submit the **Material Safety Data Sheet (MSDS)** for each type of coating to WSRC for review in accordance with Attachment 3.
6. Supplier shall submit **Cleaning and Coating Procedures** and a **Coating Repair Procedure** to WSRC for approval and use in accordance with Attachment 3.
7. Supplier shall verify dry film thickness and deliver a **Dry Film Thickness Report** to WSRC in accordance with Attachment 5.

3.3 Service Conditions

These boxes may be subjected to transportation vibrations, pressures due to temperature rise and fall, and various weather conditions (typical for the Southeastern U.S.) due to being transported/stored outdoors.

3.4 Fabrication and Assembly Requirements

Supplier shall submit **Fabrication and Inspection Procedure(s)** to WSRC for approval in accordance with Attachment 3.

3.4.1 Materials of Construction

1. All equipment, material, and articles incorporated in the work covered by this specification shall be:
   - new and unused
   - free from defects that would adversely affect the performance or maintainability of individual components across the overall assembly of this box
2. Materials not specified herein shall be of the same quality as materials used for the intended purpose in commercial practice.
3. Sheet metal shall be a minimum of 12-gauge carbon steel, ASTM A569-93.
4. Unless approved by WSRC, no material of foreign origin shall be used in the manufacture of these boxes.

3.4.2 Steel Fabrication

1. Steel shall be free from kinks, sharp bends, and other conditions that would be deleterious to the finished product.
2. Fabrication processes shall not reduce the strength of the steel to a value less than required by design.
3. All bends shall be made by controlled means to ensure uniformity of size and shape.

3.4.3 Welding

1. Welding, weld procedures and weld inspection procedures shall be in accordance with AWS D1.1, AWS D1.3 or ASME Section IX as appropriate. For weld procedures and weld inspection procedures, the Supplier shall identify the specific code(s) applicable to the work.

2. Welding shall be as follows:

   - surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter
   - welds shall be of sufficient size and shape to develop the full strength of the parts connected by the weld
   - welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loading
   - no weld shall be less than 3/32"

3. Supplier shall submit **Weld Procedures and Weld Inspection Procedures** to WSRC for approval in accordance with Attachment 3.

3.4.4 Gasket

1. Material shall meet ASTM D1056-98.

2. **Documentation of Shelf Life** for Neoprene Gasket shall be provided to WSRC with each shipment in accordance with Attachment 5, and identify the following:

   a. Date of manufacture (cure date)

   b. Shelf-life of gasket prior to installation

   c. Useful life of gasket after installation/compression

   d. WSRC Purchase Order Number

3.4.5 Spare Parts

Supplier shall submit a **Spare Parts List** with related data for ordering in accordance with Attachment 3.

3.5 Quality Requirements

3.5.1 For work to this specification, Supplier shall possess a Quality Assurance Program that contains, at a minimum, QA controls for items/activities associated with box fabrication, inspection, testing, and personnel qualifications, instructions, and records.

3.5.2 Supplier shall submit their **Quality Assurance Manual** to WSRC for approval in accordance with Attachment 3.

3.5.3 Supplier shall identify specific inspections, with acceptance criteria, in Fabrication and Inspection Procedures (ref. Section 3.4). Supplier shall document fabrication and dimensional inspections in **Inspection Reports** and deliver them to WSRC with each shipment in accordance with Attachment 5.

1. Inspection Reports shall list the identification number of the box inspected and be traceable to the fabrication drawings.
2. Supplier shall maintain a copy of the signed Inspection Reports with their Quality Assurance Records.

3.5.4 Technical and QA requirements of this specification shall be invoked on sub-tier suppliers when the Supplier contracts others to provide for services, items, or parts thereof.

3.5.5 Supplier Records

The following records generated in association with this specification, shall be maintained by the supplier in an Underwriter's Laboratory approved fire resistant safe or fire resistant file cabinet for a minimum of one (1) year after shipment, and shall be made available to WSRC representatives.

- This specification with any revisions
- The contract with any revisions
- Approved Non-conformance Reports
- Product deviation documentation with approved SDDR
- Corrective Action Reports with associated WSRC Requests for Supplier Corrective Action forms, as applicable
- Procedures used to fabricate, inspect, and test
- Supplier's Quality Assurance Manual associated with the order
- Training Certification Records for welders and other personnel performing critical functions affecting product quality
- Any documentation generated that certifies product quality

Note: These records shall be made available to the SSR during every visit and when other WSRC authorized representatives request them.

3.6 Personnel Qualifications/Certification

3.6.1 Personnel shall be qualified or certified in accordance with the Supplier's approved Quality Assurance Program.

3.6.2 Comprehensive Training Records/Certifications shall be maintained by the Supplier to demonstrate employee qualifications.

3.6.3 Welders shall be qualified in accordance with AWS D1.3 or ASME Section IX as appropriate. The applicable code shall be documented in qualification records.

3.6.4 Weld Inspectors shall be qualified in accordance with AWS D1.1-98, Structural Welding Code-Steel.

3.7 Deliverables (including Submittals)

All Supplier paper records shall be on white (or white recycled) paper. The use of 100%-recycled paper is prohibited.

3.7.1 Submittals

1. The Engineering Document Requirements (EDR) form, Attachment 3, provides a consolidated list of documents to be submitted to WSRC for review, approval, and/or use. Instructions for submitting documents (quantity, schedule, etc.) are provided on the form. For first-time purchases using this specification, all documents listed on the EDR shall be submitted to WSRC. For repeat orders, the Supplier may substitute an **Engineering Documents Summary List** for documents that have not been changed/revised from a previous submittal. The following shall apply:

   - A revision or change to any part of a document will require the resubmittal of the entire document.
   - The Summary List (and its use) is not applicable to Quality Verification documents, any Engineering document that is unique to an item or lot of items, or documents excluded from this provision by the Purchase Order.
   - A sample Summary List is provided in Attachment 4. The information required in the attachment shall be provided regardless of format used by the Supplier.
   - The EDR form requirements for proceeding with work, submittal schedule, and statusing by WSRC will apply to the Summary List commensurate with the documents listed therein.

   WSRC will review and status the Summary List in accordance with Section 3.7.1.3.

2. Submit EDR Documents, with a Cover Sheet specifically identifying Supplier's name, Specification Number, list of enclosed documents and Purchase Order Number and/or Engineering Documents Summary List, to the address shown below with a copy of Cover Sheet and/or Summary List to the WSRC buyer:

   Westinghouse Savannah River Company
   Document Control Center
   704-1N
   Aiken, SC 29808

3. EDR document(s)/Summary List submitted by the supplier in accordance with this specification will be reviewed and processed by WSRC within 30 calendar days from the date of receipt. The supplier will be informed of each document status as follows:

Status 1	Work may proceed
Status 2	Submit final document, work may proceed
Status 3	Revise and resubmit, work may proceed subject to resolution of comments
Status 4	Revise and resubmit, work may not proceed
Status 5	Permission to proceed not required

   The supplier shall incorporate changes as required by WSRC comments and resubmit corrected engineering documents/Summary List for review within 15 calendar days. Supplier shall not change Status 1 documents without notifying WSRC and resubmitting the documents.

   Assignment of Status 1 to the documents by WSRC does not relieve the supplier of any part of these obligations to meet all of the requirements of the specification or the responsibility for the correctness of such documents and the adequacy and suitability of materials and equipment represented thereon for their intended function.

3.7.2 Deliverables

1. Low Level Waste B-12 and/or B-25 boxes. Quantity delivered as specified by Purchase Order..

2. Using Attachment 5, Quality Verification Document Requirements (QVDR) Form as a cover sheet, Supplier shall provide a document package with each shipment. The document package shall consist of all items listed on the QVDR. The items shall be traceable to the WSRC Purchase Order Number.

3.7.3 Changes/Revisions

Changes or revisions to requirements of this specification, or to requirements of WSRC approved Supplier submittals will be authorized by WSRC only.

3.8 Packaging, Shipping, Handling, and Storage Requirements

Packaging, shipping, handling, and storage requirements to be Level D as described below:

3.8.1. Prior to packaging, dirt, oil residue, water, metal chips, or other forms of contaminates shall be removed.

3.8.2. During shipping lid shall be fastened to box using nylon cable ties.

3.8.3. Items shall be properly packaged. All loose items shall be boxed, blocked, anchored, braced, and/or cushioned to prevent physical damage. Items shall be stored on cribbing, dunnage, or pallets for air circulation and to avoid trapping water.

3.8.4. Prior to shipping to WSRC, boxes shall be stored as follows:

1. may be stored outdoors
2. stored on paved or gravel surface
3. removed from high traffic areas to minimize damage from moving equipment
4. covered, at suppliers discretion, to provide protection from the elements

3.9 Marking and Identification Requirements

3.9.1 Supplier shall uniquely identify each box by embossing the following information on a secure, durable, steel tag(s) welded, in an upper corner of the long side of the box or by stenciling with paint. (**Note: Attaching of any tag requires a full perimeter weld to facilitate decontamination – minimum weld size does not apply.**) The identification shall consist of:

- Purchase Order Number
- Sequential Number for the box (for example, KX123456-02, indicating the second box of order KX123456)

3.9.2 Embossed tag shall be prepared and painted same as the box.

3.9.3 In addition to the above:

1. The following line items with appropriate values shall be stenciled (Minimum 1" lettering) on both long sides of the box on the upper 2/3 (ref. Attachment 1):
   - Empty Weight in Lbs. (e.g., 350 lbs. – Average of 5 empty boxes minimum)
   - Volume in Ft^3 (e.g., 45 ft^3)
2. The following line items with a blank left for the values shall be stenciled (Minimum 1" lettering) on both long sides of the box on the upper 2/3 (ref. Attachment 1):
   - *Payload in Lbs.
   - *Total Gross Wt. in Lbs.

   *Actual values to be stenciled by WSRC after loading.

   Note: Example above is for B-12. Appropriate information will be required for B-25.

3.9.4 All stenciling shall be paint of contrasting color and be compatible with the exterior coating.

3.10 Exceptions

3.10.1 After subcontract award, Supplier shall submit **a "Supplier Deviation Disposition Request" (SDDR) Form** (Attachment 2) for each deviation to this specification and for each proposed deviation after receipt of the order from WSRC. An SDDR form is attached to this specification for copy and use. The supplier shall submit SDDR forms to WSRC Document Control at address below and forward a copy to the WSRC buyer. Approved SDDR forms must be furnished with shipment.

Westinghouse Savannah River Company
Document Control
Bldg. 704-1N
Aiken, SC 29808

3.10.2 For each deviation, the supplier shall:

1. Identify the specification and revision number.
2. Identify the criteria that cannot be met by item and section number.
3. Present an explanation for the deviation.
4. Present a proposal with technical justification for resolution of the deviation.
5. Present a price adjustment for deviation resolution, if applicable.

3.10.3 The Supplier shall not perform or make delivery of any item for which an SDDR is submitted until written authorization is received from WSRC.

4.0 ACCEPTANCE OF ITEM

4.1 Final Acceptance Method

4.1.1 Prior to shipment to WSRC, the SSR shall:

1. Verify inspections/tests including vendor inspections are complete and accepted.
2. Verify compliance with features listed on page 19, Prior to Shipment Inspection Criteria.
3. *Verify the documentation package that accompanies the* shipment is in accordance with Attachment 5, Quality Verification Document Requirements.

4.1.2 Final acceptance shall be based upon the satisfactory completion of receiving inspection (RI) at SRS. Receiving Inspection (RI) shall verify the criteria listed on page 20, Receiving Inspection Acceptance Criteria.

4.1.3 **The Supplier, free of charge, shall replace any item received at WSRC that does not meet this specification.**

4.2 Inspection / Testing Requirements

4.2.1 It shall be the supplier's responsibility through their own quality control system, to perform inspections necessary to ensure conformance with this specification and compliance with the requirements of 49 CFR 173.410 (ref. Section 3.5).

4.2.2 Non-conforming items shall be identified and segregated (when practical) by the supplier or sub-tier supplier. A SDDR shall be written for each "use-as-is" or "repair" disposition and submitted to WSRC for approval. A copy of the approved SDDR shall accompany the box when it is shipped to WSRC. It is the responsibility of the supplier to ensure that WSRC approves all SDDRs.

4.2.3 The supplier is responsible for providing 5 day advance notification to the WSRC buyer prior to the start of any test activities required by this specification.

Note: It is the responsibility of the supplier to coordinate a schedule of planned test activities with the SSR that will minimize SSR trips to the facility when witnessing of test is required.

4.2.4. WSRC Procurement determines when the Supplier Surveillance Representative (SSR) shall visit the supplier's facility and what items/activities shall be reviewed/witnessed. The SSR will perform surveillances using criteria from the WSRC Surveillance Plan based on verification/test requirements of Sections 4.2 & 4.3 and other applicable criteria of this specification.

4.2.5 Supplier shall perform a **Weld Leak Test** (prior to painting) on each box to ensure that all welds are leak tight.

1. A **Weld Leak Test Procedure** shall be submitted to WSRC for approval in accordance with Attachment 3.
2. The leak test shall be documented on a **Weld Leak Test Report** and delivered to WSRC with the shipment in accordance with Attachment 5.
3. As a minimum the report shall list the product tested (Box, B-12 or B-25) and identification number, the date of the test, and the test results (per box).
4. The SSR shall witness five percent (5%) or a minimum of 3, whichever is more, of boxes selected at random (by the SSR). If a box leaks, an additional ten percent (10%) of the boxes (lot) shall be witnessed. If a leak is detected in the additional 10%, one hundred percent (100 %) of the lot shall be witnessed.

4.2.6 The Supplier shall perform at least one **Uniform Load Test** per box design. This test shall be witnessed by the SSR.

1. A **Uniform Load Test Procedure** shall be submitted to WSRC for approval in accordance with Attachment 3.
2. Test results shall be documented in a **Uniform Load Test Report** and delivered to WSRC with each shipment in accordance with Attachment 5.
3. As a minimum the report shall list the product tested (Box B-12 or B-25), the date of the test, and the test results.

4. Test criteria shall include the following:
   - The test shall demonstrate that each box, half full of sand or water is capable of supporting a uniform load of twenty-thousand pounds for a B-12 and twenty-four thousand pounds for a B-25; **plus**
   - The box and lid weight of four boxes (20, 000 + 4 x 475 = 21, 900 ± 300lbs for a B-12; & 24000 + 4 x 500 = 26000 ± 300lbs for a B-25) on the top surface (lid) of the box for a minimum of four hours (4 hrs. ± 5 minutes); **with**
   - Less than three-eighth inch (3/8") deformation in the side walls.

4.2.7 The Supplier shall perform at least one **Lid/Box Seal Test** per box design. This test shall be witnessed by the SSR.

1. A **Lid/Box Seal Test Procedure** shall be submitted to WSRC for approval in accordance with Attachment 3.
2. Test results shall be documented in a **Lid/Box Seal Test Report** and delivered to WSRC with each shipment in accordance with Attachment 5.
3. As a minimum the report shall list the product tested (Box, B-12 or B-25), the date of the test, and the test results.
4. A gasket compression of at least twenty-percent (20%) shall be achieved.

4.2.8 The Supplier shall perform **Visual Weld Inspections** on each box in accordance with AWS D1.3-98. The visual weld inspection shall be documented on a **Weld Inspection Report** and delivered to WSRC with the shipment in accordance with Attachment 5. The report shall contain the following minimum information:

1. Product inspected (Box, B-12 or B-25) and ID#
2. Date of inspection
3. Attributes inspected
4. Results of inspection
5. ID/Signature of Weld Inspector

4.2.9 The SSR shall visually verify **(prior to painting)** welds are acceptable in accordance with AWS D1.3-98. The verification shall be as follows:

1. All welds on the first piece of each design and five percent (5%) or a minimum of 3, whichever is more, of boxes selected at random by the SSR.
2. If a weld defect is detected, an additional ten percent (10%) of the boxes (lot) shall be inspected.
3. If a weld defect is detected in the additional ten percent (10%), the SSR shall visually verify one hundred percent (100%) of the lot.

4.3 WSRC Surveillance and Audits

4.3.1 WSRC reserves the right of access to the supplier's facilities, including their sub-tier supplier's and subcontractor's facilities for the purpose of review, surveillance, and witnessing of inspection and testing activities.

4.3.2 WSRC Procurement will coordinate the schedule for supplier access visits with WSRC organizations/representatives and supplier organizations/suppliers.

4.3.3 The SSR shall witness testing and inspect boxes at the Manufacturer's facility for each new design and/or purchased lot as required by this specification. A Surveillance Plan will be developed to include the specified witnessing/verification per Section 4.2 and the following:

- Verify material requirements are met (e.g. – Min. 12 gauge carbon steel, per ASTM A569, gasket per ASTM D1056, etc.)
- Verify that box surfaces, handles and lid are free of sharp edges and burrs.
- Verify box fabrication dimension requirements are met.
- Verify fit up of lid to box.
- Verify primer and paint provide a uniform cover over the entire box surface.
- Review Dry Film Thickness Report and ensure coating thickness requirements of the specification were met.
- Verify that box lid can be removed without the gasket material adhering to the box rim. No damage shall occur to the lid, box, rim, or gasket material during this procedure.

The SSR shall conduct surveillances on five percent (5%) or a minimum of 3, whichever is more, of boxes selected at random (by the SSR). If defects that could affect the integrity or use of the box are found, an additional ten percent (10%) of the boxes (lot) shall be verified. If critical defects are detected in the additional 10%, one hundred percent (100%) of the lot shall be verified.

4.3.4 A report of the surveillance/inspection results shall be documented and provided to the supplier with copies to the Buyer and WSRC Cognizant Technical Function (CTF).

5.0 ATTACHMENTS

1. Low Level Waste Burial Box B-12 Box Sketch (1 Page)
2. Supplier Deviation Disposition Request (SDDR) – OSR No. 45-4 (2 Pages)
3. Engineering Document Requirements (EDR) – OSR No. 45-6 (2 Pages)
4. Engineering Documents Summary List – Repeat Order (1 Page)
5. Quality Verification Document Requirements (QVDR) – OSR No. 45-5 (2 Pages)

PRIOR TO SHIPMENT INSPECTION CRITERIA

1	Quantity	Low Level Waste Burial boxes per Purchase Order.
2	Outer Packaging Surface	No punctures or tears, or significant deformation that may affect closure of the lid.
3	Container Weight **(one per shipment of each design)**	Container weight = Empty weight stenciled on the container (±10%).
4	Cleanliness	Interior and Exterior surfaces shall be free of rust, dirt, oil, grease, solvents, metal shavings, foreign contaminates.
5	Markings	Embossed steel tag in upper corner of long sides: • Purchase Order Number • Sequential Number
		Stenciled on both long sides (Minimum 1" Lettering; See Attachment 1 for details): • *Empty Weight in Lbs • *Volume in Ft^3 • **Payload in Lbs. • **Total Gross Wt. in Lbs. Stenciling shall be paint of contrasting color with the exterior coating. *Line items and actual values to be stenciled on container by Supplier. **Line items to be stenciled by Supplier. Actual values to be stenciled by WSRC after loading **(not an SSR Inspection item).**
6	Documents – General	1. Verify Engineering Documents (as listed on EDR form) used in the manufacture of the boxes are WSRC approved (Status 1). 2. Verify by review of documentation that welders and procedures used were qualified per AWS D1.3 or ASME Section IX as applicable for the work performed and weld inspectors were qualified per AWS D1.1-98. 3. Verify that documentation is being maintained per the requirements of this specification.
7	Deliverable Documentation	1. *Documentation provided with shipment in accordance with Attachment 5, Quality Verification Document Requirements (QVDR) Form.* 2. Approved SDDR(s), if applicable.

RECEIVING INSPECTION ACCEPTANCE CRITERIA		
1	Quantity	Low Level Waste Burial boxes per Purchase Order (lid, gasket and clips included).
2	Outer Packaging Surface	1. No apparent shipping damage. 2. Exterior surfaces free of rust, dirt, oil, grease, solvents, metal shavings, foreign contaminates.
3	Document Package	1. Document package with shipment signed by SSR. 2. Verify boxes received are identified with Purchase Order number and sequential number (sequence of numbers to match number of units purchased per P.O.).

Note to Receiving:.

1. Shelf-life Item: Establish shelf-life expiration date for gasket by adding supplier's recommended shelf life (ref. 3.4.4.2) to the cure and/or manufacture date identified in the documentation submitted with this receipt.

Low Level Waste B-12 & B-25 Box Specification
Procurement Specification No. C-SPP-G-00101, Revision 5
Page 1 of 1

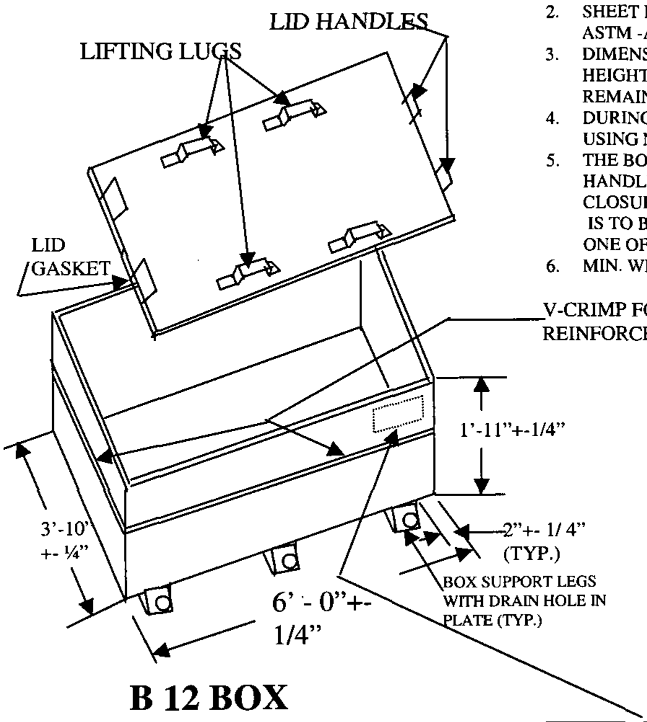
Attachment 1

LOW LEVEL WASTE BURIAL BOX

B-12 BOX SKETCH

GENERAL NOTES

1. THIS YELLOW/GRAY BOX IS TO BE USED FOR DISPOSAL OF SOLID LOW LEVEL RADIOACTIVE WASTE AS DEFINED IN WAC 3.17.
2. SHEET METAL SHALL BE MINIMUM OF 12 GAGE CARBON STEEL, ASTM -A569 U.O.S.
3. DIMENSIONS SHOWN ARE INSIDE DIMENSIONS OF B-12 BOX. HEIGHT FOR B-25 BOX IS 3'-11" , OTHER DIMENSIONS TO REMAIN SAME FOR B25.(L=6'-0", W=3'-10").
4. DURING SHIPPING, LID TO BE SECURELY FASTENED TO BOX USING NYLON CABLE TIES
5. THE BOX CLOSURE MECHANISM , LID LIFTING LUGS & HANDLES SHALL NOT INTERFERE WITH BOX STACKING OR LID CLOSURE/ PLACEMENT. FINAL CLOSURE MECHANISM DESIGN IS TO BE APPROVED BY WSRC. THIS MECHANISM WILL BE ONE OF THE CRITICAL ITEMS FOR REVIEW.
6. MIN. WELD SIZE SHALL BE 3/ 32".



STENCIL IN FOLLOWING INFORMATION IN 1" MINIMUM LETTERS BOTH LONG SIDES OF BOX.

EMPTY WT.	(Vendor Supply)	LBS*
VOLUME	(Vendor Supply)	CU.FT
PAY LOAD	(Blank)	LBS
TOTAL LOAD	(Blank)	LBS

*AVG. OF 5 EMPTY BOXES

B 12 BOX
B-25 BOX (SEE NOTE 3)

Emboss the following on a steel tag (ref section 3.9):
Purchase Order Number
Sequential Number for the Packaging

OSR 45-4# (Rev 3-29-2000)
Stores: 26-19104.00

Supplier Deviation Disposition Request

Attachment No. 2
Spec C-SPP-G-00101
Revision No. 5
Page 1 of 2

Note

1. Completion instructions attached.
2. Items 1-19 below to be completed by Supplier.
3. *Items WSRC entries only.
4. Attach additional information whenever necessary.
5. WSRC must be notified within 5 days after detection of deviation.
6. A copy of the completed SDDR form shall be included by the Supplier in the Quality Verification Data Package for each item to which this SDDR applies.

Supplier Completed

For Supplier Use		For WSRC Use		
Supplier SDDR No.	Date Submitted	WSRC SDDR No.	Project No.	Date Received

1. Supplier Name	Address	City/State	Zip	2. Supplier's Order No.
2.1 WSRC Spec No.	3. Supplier's Part No.	4. Suppliers Part Name	5. Deviation Detected (Date)	Method
6. All Previous SDDRS (No./Date)	7. WSRC PO No./Rev No.	8. WSRC Buyer	9. WSRC Part No.	
10. WSRC Part Name	11. WSRC SSR Notified (Date)	Method	12. WSRC Eng Notified (Date)	Method

13. Deviation Description (Attach extra sheets, photographs, sketches, etc., as necessary, and identify quantity and serial No.'s, as applicable.)

14. Suppliers Proposed Disposition ☐ Use-As-Is ☐ Repair ☐ Modify WSRC Requirement

15. Cost Impact | 16. Schedule Impact

17. Proposed Disposition and Technical (plus cost/schedule if applicable) Justification (Attach extra sheets, sketches, etc., as necessary.)

18. Associated Supplier Document Change(s)

19. Suppliers Authorized Representative (Name) | Date

Signature | Title

WSRC

*20. SRS Eng Action

☐ Accepted	☐ Dwg Change	☐ (WSRC	☐ Supplier)	Equip Description ____
☐ Rejected	☐ Spec/Req Change	☐ (WSRC	☐ Supplier)	End Use ____
☐ Eng	☐ Other Suppliers Affected	☐ Other ____		Responsible Division ____
☐ Follow-Up	☐ Baseline Change			Functional Class ____

*21. USQ Document No.

*22. WSRC Disposition Statement Including Justification (Attach extra sheets, sketches, etc., as necessary)

Incorporation Required ☐ Yes ☐ No	Document No.(s)	WSRC Action Required ☐ Yes ☐ No

*23. WSRC Acceptance/Printed Name/Signature

CTF/Disposition Originator	Date	CQF	Date
VER/CHK	Date	P&MMD	Date
MGR	Date	Other	Date

24. Supplier | Date

Back of
OSR 45-4A# (Rev 3-29-2000)

Attachment No. 2
Spec C-SPP-G-00101
Revision No. 5
Page 2 of 2

Instructions

(Use Black Ink or Typewriter)

This form is to be used after Purchase Order Award by a supplier or subtier supplier to

a) Notify WSRC when manufactured product or service does not meet established contract requirements and to document the supplier's proposed disposition, with their technical proposed disposition, with their technical (and where appropriate, Cost/ Schedule) justification.
b) Notify WSRC when the supplier wants to propose changes to the contract documents unanticipated at time of award.
c) Record WSRC disposition of the SDDR.

A deviation is any departure from the requirements of the procuring documents, which the supplier has incorporated or proposes to incorporate in the completed item or service provided. Deviation disposition can be classified as Use-As-Is or Repair.

Repair is defined as the process of restoring a nonconforming characteristic to a condition such that the capability of an item to function reliably and safety is unimpaired, even though that item still may not conform to the original requirement. Repair includes alternations to the properties to the material through heat-treating, welding, metal deposition, chemical processing, etc. The SDDR form is not required for cases where WSRC has previously provided authorization to proceed, using an accepted repair method for a specific type of repair. Records must be maintained for each specific repair.

An WSRC Engineering action and disposition statement does not relieve the supplier from responsibility for the accuracy, adequacy, or suitability of the item or service being provided as defined in the procurement documents, nor does it constitute waiver of the right to renegotiate the terms of the procurement documents.

Block No. **Entry Information**

1. Supplier's name and address — city, state, and zip code. List same information for subtier suppliers if applicable.
2. Supplier's order number if one has been assigned.
2.1 WSRC Spec. No. if one has been assigned.
3. Supplier's Part Number as applicable from the drawings, catalog, internal specification, etc.
4. Supplier's Part Name.
5. Date deviation detected and method used to detect deviation (NDE, dimensional, check, visual, etc.)
6. List all previous SDDRs and their dates that have been submitted for similar deviations requested on this purchase order.
7. WSRC Purchase Order Number and Revision Number.
8. WSRC Buyer Name.
9. WSRC Purchase Requisition (item, part, tag or code) Number(s).
10. WSRC Part Name, if one has been assigned.
11. Date and method (Fax, letter, etc.) used to notify the WSRC Supplier Surveillance Representative (SSR) whenever WSRC Quality Surveillance is applicable. If the Purchase Requisition identified no requirements for Supplier Surveillance, enter "Not Required."
12. Date and method (Fax, letter, etc.) used to notify WSRC Engineering.
13. Describe the deviating characteristics and define the extent of the out-of specification condition for each identified piece affected. Identify the location of the deviation characteristic by print coordinates or specific location, as applicable. Attach reproducible quality extra sheets, sketches, photographs, etc., as necessary. When proposing a change in either supplier or WSRC documents; describe the change; identify the documents completely including title or subject, date and revision; and where appropriate, attach a copy of areas in question.
14. State proposed disposition.
15. Enter cost impact that would result from proposed changes and which will be reflected in appropriate Procurement documents.
16. Enter delivery schedule impact that would result from proposed changes.
17. Describe the proposed disposition and provide technical (and where appropriate cost/schedule) justification for WSRC evaluation. Attach reproducible quality copies whenever required. If the deviation is correctable by repair, submit a detailed repair procedure or reference the procedure previously submitted and approved by WSRC for use in similar situations. Provide supplier control number and procedure title. For documents, provide suggested corrective wording, procedures, documents, etc. Provide a copy of each SDDR attachment to the WSRC SSR at the supplier's location.
18. Identify the nature of changes that may be needed on associated supplier documents (drawings, specifications, procedures, installation instructions, etc.).
19. Enter the name (typed or printed) and title of the supplier's representative authorizing the disposition request and have appropriate signature and date signed.

*20. Check all applicable boxes to define the action required by WSRC Engineering and include the appropriate equipment description, end use, responsible division and functional classification. Refer to baseline change procedures for baseline changes.

21. USQ Document No. "Repair", Modify WSRC Requirements" and "Use-as-is" disposition for nuclear and nuclear support facilities, enter the applicable USQ Document Number (e.g. Unreviewed Safety Question Screening, (USQS) and/or Unreviewed Safety Question Evaluation, (USQE), Categorical Exclusion document number) utilized to document the review performed by a USQ - Qualified Person in accordance with 11Q, for all non-nuclear facilities, enter "N/A" for "Repair", "Use-as-is", "Rework", and "Reject" Requirements" dispositions.

*22. Provide appropriate justification for the WSRC action(s) indicated in Block 20. When changes to drawings, specifications, requisitions, or other WSRC documents are involved, each document should be identified and the associated change briefly described. If other suppliers are affected, indicate who they are and the documents that initiated resolution of that involvement. "Other" follow-up action (e.g., the need for additional WSRC calculations, additional drawings or sketches, inspection by WSRC Engineering representative, etc.) should also be identified here. If WSRC action is required, so indicate.

*23. Originator — Signature of Responsible Engineer.
Verifier/Checker — Signature of the Verifier/Checker Reviewing the Engineering action and the date signed.
MGR — Signature of the WSRC Department Manager and the date signed.
CQF — Signature of the Cognizant Quality Function Representative and the date signed.
P&MMD — Signature of the WSRC Procurement and Materials Management Department representative acknowledging the SDDR and the date signed.

24. Signature of the supplier's inspector or other representative authorized to verify that the accepted disposition was correctly accomplished and the date signed. Not required for "use-as-is" disposition.

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Engineering Document Requirements

Attachment No. 3
Revision No. 5
Spec/Req'n No. C-SPP-G-00101
Page 1 of 2

1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of Copies	8. Remarks
			Yes	No		Init	Final		
1.3	3.2	Box Fabrication Drawings	X		Prior to fabrication	1	1	HC	
1.3	3.2.4.1	Closure Mechanism Design	X		Prior to fabrication	1	1	HC	
11.0	3.2.6.5	Material Safety Data Sheet - Paint		X	Prior to fabrication	1	1	HC	
15.0	3.2.6.6	Cleaning and Coating Procedures	X		Prior to fabrication	1	1	HC	
14.0	3.2.6.6	Coating Repair Procedure		X	Prior to fabrication	1	1	HC	
25.0	3.4	Fabrication and Inspection Procedures	X		Prior to fabrication	1	1	HC	
2.0	3.4.3.3	Weld Procedures	X		Prior to fabrication	1	1	HC	
12.0	3.4.3.3	Weld Inspection Procedures	X		Prior to fabrication	1	1	HC	
25.0	3.4.5	Spare Parts and Related Data for Ordering	X		Prior to fabrication	1	1	HC	
6.0	3.5.2	Quality Assurance Manual	X		Prior to fabrication	1	1	HC	
24.0	4.2.5.1	Weld Leak Test Procedure	X		Prior to fabrication	1	1	HC	
26.0	4.2.6.1	Uniform Load Test Procedure	X		Prior to fabrication	1	1	HC	
26.0	4.2.7.1	Lid/Box Seal Test Procedure	X		Prior to fabrication	1	1	HC	

OSR 45-6A# (Rev 8-27-91)

Attachment No. 3
Revision No. 5
Spec/Req'n No. C-SPP-G-00101
Page 2 of 2

Engineering Document Requirements Form Instructions

Purpose The Engineering Document Requirements (EDR) form is prepared by the originator, establishes a basis for actions required of a Supplier and provides the schedule for the submittal of engineering documents by the Supplier.

Legend

Entry No.	Information Required
1	Document category number — see below.
2	Applicable specification number and appropriate paragraph.
3	Description corresponding to document category number.
4	Permission to proceed with fabrication or other specific processes is marked yes, if required.
5	List a milestone after award i.e., prior to fabrication, prior to test, prior to shipment, or with shipment that the listed document is to be submitted by Supplier.
6	Number of copies required for submittal.
7	Reproducible, Mylar, Vellum, etc.
8	Enter remarks when appropriate.

Document Category Number and Descriptions

1.0 Drawings
- 1.1 Outline Dimensions, Services, Foundations and Mounting Details — Drawings providing external envelope, including lugs, centerline(s), location and size for electrical cable, conduit, fluid, and other service connections, isometrics and details related to foundations and mountings.
- 1.2 Assembly Drawings — Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.
- 1.3 Shop Detail Drawings — Drawings which provide sufficient detail to facilitate fabrication, manufacture, or installation. This includes pipe spool drawings, internal piping and wiring details, cross-section details and structural and architectural details.
- 1.4 Wiring Diagrams — Drawings which show schematic diagram equipment, internal wiring diagrams, and interconnection wiring diagram for electrical items.
- 1.5 Control Logic Diagrams — Drawings which show paths which input signals must follow to accomplish the required responses.
- 1.6 Piping and Instrumentation Diagrams — Drawings which show piping system scheme and control elements.

2.0 Parts Lists and Costs — Sectional view with identified parts and recommended spare parts for one year's operation and specified with unit cost.

3.0 Complete WSRC Data Sheets — Information provided by Supplier on data sheets furnished by WSRC.

4.0 Instructions
- 4.1 Erection/Installation — Detailed written procedures, instructions, and drawings required to erect or install material or equipment.
- 4.2 Operations — Detailed written instructions describing how an item or system should be operated.
- 4.3 Maintenance — Detailed written instructions required to disassemble, reassemble and maintain items or systems in an operating condition.
- 4.4 Site Storage and Handling — Detailed written instructions, requirements and time period for lubrication, rotation, heating, lifting or other handling requirements to prevent damage or deterioration during storage and handling at jobsite. This includes shipping instruction for return.

5.0 Schedules: Engineering and Fabrication/Erection — Bar charts or critical path method diagram which detail the chronological sequence of activities, i.e., Engineering submittals, fabrication and shipment.

6.0 Quality Assurance Manual/Procedures — The document(s) which describe(s) the planned and systematic measures that are used to assure that structures, systems, and components will meet the requirements of the procurement documents.

7.0 Seismic Data Reports — The analytical or test report which provides information and demonstrates suitability of material, component or system in relation to the conditions imposed by the stated seismic criteria.

8.0 Analysis and Design Reports — The analytical data (stress, electrical loading, fluid dynamics, design verification reports, etc.) which demonstrate that an item satisfies specified requirements.

9.0 Acoustic Data Reports — The noise, sound and other acoustic vibration data required by the procurement documents.

10.0 Samples
- 10.1 Typical Quality Verification Documents — A representative data package which will be submitted for the items furnished as required in the procurement documents.
- 10.2 Typical Material Used — a representative example of the material to be used.

11.0 Material Descriptions — The technical data describing a material which a Supplier proposes to use. This usually applies to architectural items, e.g., metal siding, decking, doors, paints, coatings.

12.0 Welding Procedures and Qualifications — The welding procedure, specification and supporting qualification records required for welding, hard facing, overlaying, brazing and soldering.

13.0 *Material Control Procedures — The procedures for controlling issuance, handling, storage and traceability of materials such as weld rod.*

14.0 Repair Procedures — The procedures for controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection.

15.0 Cleaning and Coating Procedures — The procedures for removal of dirt, grease or other surface contamination, and preparation and application of protective coatings.

16.0 Heat Treatment Procedures — The procedures for controlling temperature and time at temperature as a function of thickness, furnace atmosphere, cooling rate and methods, etc.

19.0 UT — Ultrasonic Examination Procedures — Procedures for detecting discontinuities and inclusions in materials by the use of high frequency acoustic energy.

20.0 RT — Radiographic Examination Procedures — Procedures for detecting discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film.

21.0 MT — Magnetic Particle Examination Procedures — Procedures for detecting surface or near surface discontinuities in magnetic materials by the distortion of an applied magnetic field.

22.0 PT — Liquid Penetrant Examination Procedures — Procedures for detecting discontinuities in materials by the application of a penetrating liquid in conjunction with suitable developing materials.

23.0 Eddy Current Examination Procedures — Procedures for detecting discontinuities in materials by distortion of an applied electromagnetic field.

24.0 Pressure Test — Hydro, Air, Leak, Bubble or Vacuum Test Procedures — Procedures for performing hydrostatic or pneumatic structural integrity and leakage tests.

25.0 Inspection Procedures — Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met.

26.0 Performance Test Procedures — Test performed to demonstrate that functional design and operational parameters are met.
- 26.1 Mechanical Tests — e.g., pump performance, data, valve stroking, load, temperature rise, calibration, environmental, etc.
- 26.2 Electrical Tests — e.g., impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.

27.0 Prototype Test Reports — Reports of a test which is performed on a standard or typical examination of equipment or item, and which is not required for each item produced in order to substantiate the acceptability of equal items. This may include tests which result in damage to the item(s) tested.

28.0 Personnel Qualification Procedures — Procedures for qualifying welders, inspectors and other special process personnel.

29.0 Supplier Shipping Preparation Procedures — Procedures used by a Supplier to prepare finished materials or equipment for shipment from its facility to the jobsite.

Attachment 4

Engineering Documents Summary List – Repeat Order

WSRC Purchase Order Number: ____________ Specification Number: ____________________

Manufacturer (Company Name/Address): ______________________________

____

Contact Name/Phone/Fax: ______________________________

____

The following documents have not been changed/revised since their previous submittal under the listed Purchase Order below:

SPEC Paragraph Reference	Document Title(As shown on EDR Form)/Number	Rev/Eff. Date*	P.O. Under Which 'Document' was Submitted and Approved by WSRC.

*Record "No Change" if document has no revision/effective date.

Authenticated By: ______________________________
Supplier Management Representative

Verified By: ______________________________
WSRC CTF

OSR 45-5# (Rev 12-28-99)

Attachment No. 5
Revision No. 5
Spec/Req'n No. C-SPP-G-00101
Page 1 of 2

Quality Verification Document Requirements

1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. SSR Release	5. WSRC Receipt Inspection *Check-In*	6. Remarks	7. DOC Supplier Page Count
30.0	3.2.4.4	Closure Instructions				
15.0	3.2.6.7	*Dry Film Thickness Report*				
30.0	3.4.4.2	Documentation of Shelf-Life			Gasket Material	
25.0	3.5.3	Fab/Dim. Inspection Reports				
24.0	4.2.5.2	Weld Leak Test Report			Each Box	
26.0	4.2.6.2	Uniform Load Test Report				
26.0	4.2.7.2	Lid/Box Seal Test Report				
25.0	4.2.8	Weld Inspection Report			Each Box	

8. Supplier's Order No.	9. Supplier's Part	10. Supplier's Part Name	11. Quantity
12. PO No.	13. WSRC Line/Equip Tag or Code No.	14. WSRC Part Name	

15. Supplier's Conformance Statement
We certify that the work and required documents meet the requirements of the procuring documents.

Authorized Supplier Signature Title Date

16. Source Surveillance Representative at Suppliers Facility
Work was released based on satisfactory completion of quality surveillance and review of documentation.

☐ *With Authorized Deviations Noted in Column 6*
☐ No Deviations

Signature of SSR Date

17. Receiving Inspection at SRS
This form and the quality verification documents referenced hereon have been received and their relationship to the hardware items verified.

Signature of WSRC Inspector Date

Back of
OSR 45-5# (Rev 12-28-99)

Attachment No. 5
Revision No. 5
Spec/Req'n No. C-SPP-G-00101
Page 2 of 2

Quality Verification Document Requirements Form Instructions

Purpose The Quality Verification document Requirements (QVDR) is initiated by SRS and completed by the Supplier when providing quality verification documents. The QVDR is a multipurpose form to

Transmit quality verification documents from the Supplier,
Provide evidence of SSR release of documentation and/or work, and
Provide evidence of an SRS inspection check of documentation received at SRS.

WSRC Entries

Entry No.	Information Required
1	Enter Document Category Number — see below.
2	Enter Specification Number and Paragraph Reference.
3	Enter Description corresponding to the Document Category Number.
4	SSR to initial upon item release.
6	Enter "Remarks: as appropriate.
16	SSR and dates release.

Field Entries

Entry No.	Information Required
5	SRS inspector at the jobsite to complete check-in.
17	*The SRS Inspector will review the quality verification* documentation package. If found satisfactory, he signs and dates the check-in statement.

Supplier Entries

Entry No.	Information Required
7	Enter number of pages of quality verification document being submitted.
8	Enter information required.
9	Enter information required.
10	Enter information required.
11	Enter the quantity of units covered by the documents submitted. For each item on Entry No. 12 being released, provide a separate copy of this completed form and the supporting quality verification documents.
12	Enter information required.
13	Enter information required.
14	*Enter information required.*
15	Supplier — Signature of an employee authorized to sign such documents.

Document Category Numbers and Descriptions

12.0 Welding Verification Reports — Reports of welding performed to include weld identification, and certification that qualified welding procedures and welders were used.

13.0 Material Verification Reports — Reports relative to material which confirm, substantiate or assure that an activity or condition has been implemented in conformance with code and material specifications imposed by the procurement documents.

14.0 Major Repair Verification Reports — Reports may include weld repair locations (maps), material test reports for filler metal, pre- and post-weld heat treatment records, NDE records, etc. The resolution of whether a repair is major or not is an SRS responsibility.

15.0 *Cleaning and Coating Verification Reports — Reports include a certification of visual examination for surface preparation, surface profile,* materials, etc.; and also humidity data, temperature data and coating thickness data as required by the procurement documents.

16.0 Heat Treat Reports — Reports normally include furnace charts and similar records which identify and certify the item(s) treated, the procedure used, furnace atmosphere, time at temperature, cooling rate, etc.

17.0 Material Property Reports

- 17.1 MTR (Material Test Reports) — These reports include all chemical, physical, mechanical, and electrical property test data required by the material specification and applicable codes. These are applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc.
- 17.2 Impact Test Data — Reports of Charpy or drop weight tests including specimen configuration, test temperature and fracture data.
- 17.3 Ferrite Data — Reports of the ferrite percentage for stainless steel materials used, including castings and welding filler metals as deposited.
- 17.4 Material Certificate of Conformance — Documents which certify conformance to the requirements of the applicable material specification.
- 17.5 Electrical Property Reports — Reports of electrical characteristics, e.g., dielectric, impedance, resistance, flame tests, corona, etc.

18.0 Code Compliance — Verifying documents (such as data Forms U-1, M-2, State, etc.), which are prepared by the manufacturer or installer and certified by the Authorized Code Inspector.

19.0 UT — Ultrasonic Examination and Verification Reports — Examination results of certain characteristics of discontinuities and inclusions in material by the use of high frequency acoustic energy.

20.0 RT — Radiographic Examination and Verification Reports — Examination results of certain characteristics of discontinuities and inclusions in materials by x-ray or gamma-ray exposure of photographic film, including film itself.

21.0 MT — Magnetic Particle Examination and Verification Reports — Examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.

22.0 PT — Liquid Penetrant Examination and Verification Reports — Examination results of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.

23.0 *Eddy Current Examination and Verification Reports — Examination results of discontinuities in material by distortion of an applied electromagnetic field.*

24.0 Pressure Test — Hydro, Air, Leak, Bubble or Vacuum Test and Verification Reports — Results of hydrostatic or pneumatic structural integrity and leakage tests.

25.0 Inspection and Verification Reports — Documented findings resulting from an inspection.

26.0 Performance Test and Verification Reports — Reports of Test Results

- 26.1 Mechanical Test, e.g., pump, performance data, valve stroking, load, temperature rise, calibration, environment, etc.
- 26.2 Electrical Tests, e.g., load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.

27.0 Prototype Test Report — Report of the test which is performed on a standard or typical example of equipment, material or item, and which is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests which may, or could be expected to, result in damage to the item(s) tested.

28.0 Certificate of Conformance—A document signed or otherwise authenticated by an authorized individual certifying the degree to which items or services meet specified requirements.